A taxonomic revision and systematics study of *Prunus* (*s.l.*) in continental Southeast Asia

By

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Declaration

This thesis has not been submitted as an exercise for a degree at this or any other university, and it is my work.

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Summary

This thesis aims to provide a complete account of the genus *Prunus* L. for Thailand, Myanmar, Laos, Cambodia, and Vietnam. In addition, the relevant specific problems of *Prunus* in Southeast Asia are outlined, and the generic relationships between Asian members are assessed using a molecular approach. A taxonomic history of the genus and history of botanical works relevant to the genus *Prunus* in continental Southeast Asia and neighboring regions are given. The economic and ethnobotanical significance of some members is also provided. General morphological characteristics are described in terms specific to the study group and explained, and when appropriate, some figures are provided to add explanation.

Molecular phylogenetic analysis was undertaken with nuclear and plastid DNA gene regions (*ETS*-RosF and *IGS6R; psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN).* The nuclear dataset analysis, *ETS*-RosF, and *IGS6*R confirmed some patterns of infrageneric classification. In addition, the plastid dataset analyses, *psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN*, did not provide well-resolved or supported trees from their analysis. A combined analysis of nuclear and plastid genes provided improved resolution and support, and the findings concerning the infrageneric classification of *Prunus* and the utility of the markers for DNA barcoding are discussed. *Mesopygeum* formed a monophyletic group in all analyses, but section *Laurocerasus* was not supported as it is currently defined and was generally paraphyletic. Many well-supported subgroupings were identified.

The main part of this thesis's taxonomic chapter aimed to provide a complete revision of the genus *Prunus* in continental Southeast Asia. The revision was undertaken at the Herbarium, Department of Botany, Trinity College Dublin (**TCD**) and at the Herbarium, Royal Botanic Gardens, Kew (**K**). The major herbaria in Europe, **BM**, **E**, **K**, **L**, **P**, and **TCD** together with regional herbaria in Asia; Thailand, **BKF**, **BK**, **CMUB**, **QBG**; Cambodia; Japan, **KYO** and **FU**; Laos, **FOF**; Myanmar, **RAF**; and Vietnam, **VNM** which have good collections of South East Asian were visited to study their collections, including types: ten field trips, totaling six months were made to Laos, Myanmar, Thailand, and Vietnam in 2019 and 2020. The species were also reviewed and described to clarify their nomenclatural status, geographic distributions, and diagnostic character states. Full descriptions of genera and species, keys, synonyms, distribution maps, photographs, information about distribution, ecology, vernacular names, and specimens examined are given.

In chapter 5, information about habitats, ecology, distributions, and endemism of *Prunus* are provided with particular emphasis on continental Southeast Asia taxa. The *Prunus* species in continental Southeast Asia are found in various habitats except Mangrove, Swamp, and Beach forests. They are usually common in dry land, shade, and open habitats. The first group comprises the northern species, the Indo-Burmese, and the Sino-Himalayan elements. The second group contains some widespread taxa, but most belong to the Indo-Chinese element and are mostly confined to the central and upper Indo-Chinese peninsula.

Prunus did not appear as monophyletic using the nuclear dataset analysis, *ETS*-RosF, and *IGS6*R. In addition, the plastid dataset analyses, *psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN*, could have provided better-resolved and supported trees individually.

236 synonyms are recognized from the 50 *Prunus* recognized in continental Southeast Asia, including 26 names that are lectotypified here and 29 new synonyms. Four species (8 %) are new records to Thailand: *P. kalkmanii*, *P. polystachya*, *P. pygeoides*, and *P. ridleyi*. This updates biogeographic knowledge of the region and reflects the need to explore the region's diversity further. There is also no doubt that many species still need to be described because many specimens do not match any known species among the existing collections.

This Ph.D. has therefore reviewed the genus *Prunus* in continental Southeast Asia, mainly based on morphological analysis of all available *Prunus* specimens, and provided a basis for the future completion of accounts of the Rosaceae for the Flora of Thailand Project. In addition, *Prunus*'s historical biogeography, evolution, and phylogeny of *Prunus* were considered. The detailed revision of *Prunus* from continental Southeast Asia provides the taxonomic framework for conserving and utilizing its regional genetic resources. Many species of *Prunus* in continental Southeast Asia have been exposed to critical over-exploration in their natural habitats for ornamental or medicinal purposes and thus require strict protection for sustainable development. Herein, a preliminary assessment of their conservation status has been made.

Keywords: characters, cherry blossom, classification, conservation, continental Southeast Asia, phylogenetics, *Prunus*, Rosaceae, taxonomy.

Abbreviations

The abbreviations used in this thesis are listed here except herbarium acronyms and units listed in the *International System of Units* (Bureau International des Poids et Mesures 2006). Latin abbreviations follow McNeill et al. 2012; Turland et al., 2018.

AFLP: amplified fragment length polymorphism

alt.: altitude

Art./ Arts.: Article or Articles of International Code of Nomenclature for Algae, Fungi, and Plants (Shenzhen Code) (Turland et al., 2018)

auct. non: a misapplication of a name

B.I.: Bayesian inference

BIC: Bayesian information criterion

bp: base pairs

BS: bootstrap

ca.: *circa*, about

cf.: compare to

CMS: The Chicago Manual of Style: http://www.chicagomanualofstyle.org/home.html

comb. nov.: *combinatio nova*, new combination or a new nomenclatural combination

cpDNA: chloroplast deoxyribonucleic acid

CTAB: hexadecyl-trimethyl-ammonium bromide

diam.: diameter

DNA: deoxyribonucleic acid

dNTPs: deoxynucleotide triphosphates

ed(s).: *editio*, edition

EDTA-Na2: Ethylene-diamine-tetra-acetate acid disodium salt dihydrate

e.g.: *exampli grati,* for example

et: and

et al.: *et alii*, and others

ex: from; valid public by

excl.: *exclusions*, excluded

f.: *filius,* son of

fig.: *figura*, figure

fl.: flowers

fr.: fruits

FOC: Flora of China

GTR: general time revisable (nucleotide-substitution model)

ICN: *International Code of Nomenclature for Algae, Fungi, and Plants* (Melbourne Code)

ined.: *ineditus;* not validity published

IPNI: The International Plant Names Index: http://ipni.org/index.html

ITS: internal transcribed spacer region of 18S–26S nuclear ribosomal deoxyribonucleic acid

lvs.: leaves

Ma: mega-annum (million years ago)

MCMC: Metropolis-coupled Markov chain

MCMCMCP: Metropolis-coupled Markov chain Monte Carlo

ML: maximum likelihood

MP: maximum parsimony

msl.: mean sea level is an average surface level of one or more among Earth's coastal bodies of water from which heights such as elevation may be measured.

nom. illegit.: *nomen illegitimum*, an illegitimate name

nom. nov.: *nomen novum*, a new name

nom. nud.: *nomen nudum*, name unaccompanied by a description or diagnosis or reference to a published description or diagnosis

non vidi: not seen

nuDNA: nuclear deoxyribonucleic acid

PAL: phenylamine ammonia-lyase

PCR: polymerase chain reaction

pH: the potential of hydrogen

P.P.: Bayesian posterior probability

RAPD: random amplified polymorphic nuclear deoxyribonucleic acid

RNA: Ribonucleic acid

sect.: *sectio*, section

s.l.: *sensu lato*, in a broad sense

s.n.: *sine numero*, without a number

s.s. or *s.str.*: *sensu stricto*, in the strict sense

sp. nov.: *species novus*, a new species

stat. nov.: *status novus*, a change in rank

subg.: subgenus

var.: *varietas*, variety

vol.: *volume*, volume

!: *vidi*, I have seen it

!d: I have seen it, digital image

=: a heterotypic synonym, based on a different type

≡: a homotypic synonym based on the same type

Styles

The general style of this thesis follows the requirements of the *Thesis Submission Guideline* on the website of the Academic Registry, Trinity College Dublin, the University of Dublin. (https://www.tcd.ie/graduatestudies/assets/pdf/theses-submission-guidelines.pdf). Other specific styles are explained below.

Following *The Chicago Manual of Style* (CMS, Online 16th edition: (https://www.chicagomanualofstyle.org/home.html), Chinese names are written using Hanyu Pinyin for Romanising Chinese (Chapter 11.102 of CMS), with the family name coming before the given name based on Chinese practice when the full name is given (Chapter 8.15). Vietnamese names are written in the same order as Chinese. The standard form of author names in Latin follows the International Plant Name Index (http://www.ipni.org/ipni/authorsearchpage.do). Still, the person's family name is cited in full in the first place of citation of the taxon (with exceptions of taxa presented in the acknowledgments, figure, key, maps summary, or tables where the author's name is not cited). Nevertheless, if the collector's name is on the specimens' label, and it is unclear which family name applies, I decided to use the full name or follow the document as presented. In Index Herbarium (http://www.hear.org/pier/references/herbaria.htm), all herbaria mentioned are represented by their acronyms and highlighted in bold, with one exception: 'NUOL' indicates the Herbarium of the Department of Biology, National University of Laos, which does not appear in Index Herbarium.

Some journals do not have volume information, which is indicated by the year of publication in the 'References.' All websites cited in this thesis were accessed before 26 August 2022. Unless otherwise stated, all figures, maps, photos, and tables are taken, produced, or revised by the author.

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Table of contents

Chapter 1 General introduction and aims

1.1 The family Rosaceae

The Rosaceae AL de Jussieu (Rose family, type *Rosa*, Latin for rose) were first described by Antoine Laurent de Jussieu in Genera Plantarum (Jussieu, 1789), where he enumerated 48 genera. The Rosaceae is a large family (Robertson, 1974) with 83 genera and 3,575 species (but many of these are apomictic lines) widely distributed in Asia, Europe, and North and South America (Mabberley, 2017). It can be considered sub-cosmopolitan and is found mainly in the temperate zone and warmer regions of the Northern Hemisphere (Potter et al., 2007a; Mabberley, 2017). Christenhusz & Byng (2016) estimate that the family contains 91 genera and 2,950 species, the World Flora Online (WFO) [http://www.worldfloraonline.org] (2020) list indicates 143 genera and 6,053 species and Plants of The World Online (POWO, 2024) [https://powo.science.kew.org] indicates 110 genera and 4,831 accepted species. Therefore, the family's accepted number of genera and species remains in flux.

Hypotheses concerning the closest relative of the Rosaceae vary considerably within the literature. Some studies place the Rosaceae as an isolated family with no discernible sister group (Kania, 1973; Kalkman, 1988; Zhang, 1992). Others consider the Chrysobalanaceae and Neuradaceae (taxa sometimes included within the Rosaceae) the closest relatives (De Craene & Smets, 1995). Phylogenetic analysis of morphological and phytochemical data of Rosideae placed the Crassulaceae, Saxifragaceae, and *Penthorum* as sister-group to the Rosaceae (Hufford, 1992). Investigations of molecular data have also tried to clarify the relationships of the Rosaceae with other close families. Various analyses of the chloroplast gene *rbc*L place the Rhamnaceae, Moraceae, Ulmaceae, and Zygophyllaceae as the nearest relatives of the Rosaceae (Morgan et al., 1994; Soltis et al., 1997; Rice et al., 1998).

The Rosaceae is one of the most complex families in the Rosales because of its high diversification and wide variation in morphological characters (Potter et al., 2007a; Zhang et al., 2017). Presently, there are two general circumscriptions of the Rosaceae: (1) Rosaceae *sensu lato* (*s.l.*), including the Chrysobalanaceae according to Kalkman (1993), Vidal (1970), and Prance & Whitmore (1983) that includes 21 genera and 61 species; and (2) Rosaceae *sensu stricto* (*s.s.*) that excludes taxa of the Chrysobalanaceae and which is based on molecular findings as outlined in Potter et al. (2007a) and the papers of the Angiosperm Phylogeny Group: APG IV (Chase, 2016). Therefore, the circumscription of the Rosaceae awaits revision. Furthermore, the difficulties in family circumscription may account for some of the different estimates of generic and species numbers alluded to above.

1.1.1 Taxonomic description of the Rosaceae

The descriptions follow the Rosaceae treatment of several authors (Kubitzki, 2004; Mabberley, 2017; Simpson, 2019): habit trees, shrubs, or herbs. **Leaves** are spiral (rarely opposite), simple or compound, undivided to divided, usually stipulate (lost in some taxa), and the stipules often adnate to the petiole base. **The inflorescence** is variable. **Flowers** are bisexual (usually), actinomorphic, perigynous, or epigynous; the receptacle is sometimes expanded or sunken. **Perianth** is biseriate and dichamydeous, usually pentamerous, imbricate, with a hypanthium present. **Calyx** is aposepalous with 5 (3–10) sepals. **Corolla** is apopetalous with 5 (0, 3–10) petals. **Stamens** are 20–∞ (1–5), whorled, arising centripetally, and usually diplostemonous. **Anthers** are longitudinal or rarely poricidal in dehiscence and dithecal. **The gynoecium** is syncarpous or apocarpous, with a superior or inferior ovary, 1–∞ carpel, and 1–∞ locule. **Style(s)** are terminal or lateral. **Placentation** is axile, basal, or marginal; **ovules** are 1–∞. **Nectaries** are often present on the hypanthium. **Fruit** is a drupe, pome, hip, folliceptum, achenecetum, or capsule. **Seeds** are usually without endosperm.

The Rosaceae usually have stipulate leaves (often adnate to petiole) and actinomorphic, generally pentamerous flowers with a hypanthium present, variable in gynoecia fusion, ovary position, and fruit type. K 5[3–10] C 5[0,3–10] A 20–∞[1,5] G 1(–∞), superior or inferior, hypanthium present (Simpson, 2019).

1.1.2 Classification within the Rosaceae

Although quite diverse in vegetative and floral morphology, the family is considered monophyletic and can be distinguished by a simple or compound, usually stipitate, alternate leaves, and simple actinomorphic, primarily perfect, flowers with hypanthia surrounding a full range of superior to completely inferior ovaries (Robertson, 1974). Classification within the Rosaceae, however, varies considerably between treatments. Numerous additional species have been described since 1789 by Jussieu, and the genera and species have been reviewed several times. Schulze-Menz (1964) based his studies on fruit types and recognized four subfamilies. In comparison, Morgan et al. (1994) recognized twelve subfamilies based on morphology and phylogenetic analyses. Takhtajan (1997), incorporating some of the results of the first molecular phylogenetic relationship study across Rosaceae, recognized an expanded Amygdaloideae and Maloideae and subdivided the Rosoideae and Spiraeoideae. Subdivision of the Rosaceae has varied from four subfamilies to tribes within the subfamilies to exclusively tribes that may number as many as 20 (Evans & Dickinson, 1999). However, Potter et al. (2007b), Zhang et al. (2017), and Cole (2020) recently divided the family into three subfamilies:

1. Rosoideae, including *Filipendula*, *Rubus,* and *Rosa*, and three tribes with an apocarpous or unicarpellus gynoecium forming an achene, achenecetum, or drupaceous, including taxa in which the receptacle is expanded and fleshy (e.g., *Fragaria*) or sunken (e.g., the hips of *Rosa*)

2. Dryadoideae comprises four genera with a drupelet or achene, but all have a symbiotic relationship with the nitrogen-fixing actinomycete *Frankia* and Spiraeoideae, comprising *Lynothamnus* and seven tribes.

3. Prunoideae or Amygdaloideae Torrey & Gray is the smallest subfamily comprising as few as four genera: *Maddenia*, *Oemleria*, *Prinsepia*, and *Prunus*, following the widely accepted infrageneric classification of *Prunus* (*Padus, Laurocerasus, Pygeum,* and *Plagiospermum,* are reduced to subgenera within *Prunus s.l.*) by Rehder (1940).

All genera previously assigned to Amygdaloideae and Maloideae were included in the Spiraeoideae (Potter, 2007b; Zhang et al., 2017; Simpson, 2019). The Spiraeoideae show complicated variation in the ovary and fruit morphology, encompassing taxa with an apocarpous gynoecium forming a follicetum (*Spiraea* and relatives, classified as Spiraeeae), taxa with a single, superior-ovaried pistil bearing one ovule, the fruit a drupe (*Prunus* and relatives), classified as the tribe Amygdaleae, formerly Prunoideae), and taxa with an inferior ovary, forming a pome (*Malus* and relatives, classified as the Pyrinae, formerly Maloideae).

1.2 Classification of *Prunus* (*s.l.*)

Tournefort (1700) offered the first classification and described *Prunus* (*s.l.*). The *Prunus*-alliance in the past has sometimes been split into other genera differentiated based on fruit morphology, most of which were subsequently validated by different authors, namely *Amygdalus* L., *Armeniaca* L., *Armeniaca* Miller, *Cerasus* Miller, *Laurocerasus* Koehne., *Persica* L., and *Prunus* L. (*sensu stricto, s.s*.). Linnaeus (1753), the earliest taxonomic treatments, placed and split *Prunus* into four genera: *Amygdalus, Cerasus, Padus,* and *Prunu*s, but later, Linnaeus (1753) and Endlicher (1840) reduced these to two genera *Amygdalus* and *Prunus* by merging *Persica* into *Amygdalus* and putting the rest (including another genus, *Padus* Miller) into *Prunus*. Since then, many classifications have treated *Prunus* inclusively with several subgenera or sections following; De Candolle (1825) recognized five genera: Amygdalus, Armeniaca, Cerasus, Persica, and *Prunus*. Alternatively, Bentham & Hooker (1862) treated *Prunus* as a single genus separated into seven sections: *Amygdalus, Amygdalopsis, Armeniaca, Cerasus, Laurocerasus,* and *Prunus.* Koehne (1893) treated these sections as subgenera.

Prunus may contain five subgenera: *Amygdalus* (peaches and almonds), *Cerasus* (cherries), *Prunus* (plums), *Laurocerasus* (evergreen laurel cherries), and *Padus* (deciduous bird-cherries) or split into as many as eight genera divided into tribes (Prunea and Osmaronieae: Hutchinson, 1964). Indeed, several workers have divided *Prunus* into multiple genera, *e.g.*, Komarov, 1971; Takhtajan, 1977. The genera of Hutchinson (1964), *e.g.*, *Padus*, *Laurocerasus*, *Pygeum*, and *Plagiospermum*, are part of the *Prunus* s.l. of Rehder (1940). *Prunus* has been classified into differing subfamilies, *e.g.*, subfamily Pruneae (Bentham & Hooker, 1862; Hutchinson, 1964, and Kalkman, 1965), Amygdaleae (*e.g.*, Le Maout, Decaisne & Hooker, 1876, and Takhtajan, 1977), and Prunoideae (*e.g.*, Hutchinson, 1964), Schulze-Menz, 1964; Cronquist, 1981; and Thorne, 1983). Potter et al. (2007b) adopted a broad interpretation of *Prunus* in their infrafamilial classification of Rosaceae, including all the genera mentioned above and *Maddinia* Hook. f. & Thomson; *Pygeum* Gaertner was classified as the only genus in the tribe Amygdaeae.

During the last fifty years, the concept of a single genus, with a few exceptions (e.g., Browicz & Zohary 1966), has gained more favor; however, subgeneric classification and relationships among groups still need to be better understood. However, Komarov (1971) recognized seven genera: *Amygdalus, Armeniaca, Cerasus, Laurocerasus, Padus, Persica,* and *Prunus*.

It is usual to distinguish two subgenera, *Padus* and *Laurocerasus,* on account of three differences, as did Rehder (1940) and Kalkman (1965). I am also convinced that this is a more satisfactory subdivision than Koehne (1915) advocated below:

-- Deciduous. Leaves at the base of the racemes, domatia usually present at nerves axile…..…………………………………………………………………subgenus *Padus*

-- Evergreen. Racemes with bracts only, domatia usually absent …………….…subgenus *Laurocerasus*

Historically, most *Prunus* specie*s* native to southeast Asia have been classified under *Pygeum* (e.g., Koehne, 1911; Ridley, 1922). The two genera, *Prunus* and *Pygeum,* are now often contrasted along the same lines. As examples, we may cite:

Cardot (1920)

-- Calyx 5 lobes; petals always very different from calyx lobes; cotyledons no or moderately thick……………………………………………………………………………..… *Prunus*

-- Calyx more or less numerous; petals not very small and different little calyx lobes; very thick and fleshy cotyledons……………………………………………………………..… *Pygeum*

Backer and Bakhuizen van den Brink (1963)

-- Petals 5, distinctly different from sepals; a drupe. Leaves entire or not……………………….*Prunus*

-- Petals are not or hardly different from sepals or absent; fruit is drupaceous and dry. Leaves entire. ………………………………………………………………………………………… *Pygeum*

Kalkman (1965) demonstrated that morphological distinctions between *Pygeum* and *Prunus*, which include the degree of differentiation of the perianth segments, the nature of the leaf margins, and the shapes of the fruits, were not consistent or significant enough to warrant segregation of the two groups at the level. He transferred *Pygeum* to *Prunus*_subgenus *Laurocerasus* Duhamel, as section *Mesopygeum* Kalkman contains most of the species of the former genus *Pygeum*. It cannot be said that these formulations are untrue, but they are somewhat simplified. In the flower of *Prunus,* two whorls of perianth segments are present, and the petals are, in most species, distinctly more prominent than the sepals and different from them. In *Pygeum* the situation is more difficult to describe. The perianth segments are more or less alike in some species and are not regularly differentiated as sepals and petals. Still, in other species, there are, as well as in *Prunus,* two whorls of perianth segments distinguishable. However, in those species, sepals and petals rarely differ appreciably in their dimensions, though their shape and consistency can easily distinguish them. The difference in this respect, when accepting the old generic delimitation, would have to be formulated as follows:

-- Perianth segments 5–14, subequal, or the perianth regularly biseriate, and the whorls by their shape are distinguishable as sepals and petals. However, then the petals are not more than ½ times as long as the sepals (rarely up to twice as long)…………………………………………………………*Pygeum*

-- Perianth is always differentiated as sepals and petals (although irregularities like supernumerary petals, *etc.*, Do occur), normally 5-numerous, the petals usually at least twice as long as the sepals, rarely less than that (down to ½, and event to 1¼ times)………………………………………….*Prunus*

This key point is a difference, but it is not sharp due to overlap (as noted by Kalman, 1965); it is certainly not one that can separate two genera. Correlated differences are absent. In recent studies using molecular and phylogenetic relationships (see section 3 below for more details), *Prunus* is shown to belong to the subfamily Amygdaloideae (Zhang et al., 2017; Cole, 2020). The genus is based on a combination of characteristics, including leaf glands, a solitary carpel, a superior ovary, drupaceous fruit, and a solid pith (Chin et al., 2013). Prunus's most widely accepted infrageneric classification includes five subgenera: *Prunus*, *Amygdalus* (L.) Focke, *Cerasus* Pers., *Laurocerasus* Koehne, and *Padus* (Moench) Koehne (Rehd, 1940). However, *pyrm is usually treated as a distinct genus, but it has sometimes also been included within the prunus* (Shi et al., 2013). In recent genus-wide phylogenetic studies, it has been shown that both *Maddenia* and *Pygeum* are nested within *Prunus* s.l. (Wen et al., 2008: Chin et al., 2014; Zhao et al., 2018). *Pygeum* appears most closely allied to *Prunus* subg. In *Laurocerasus*, the 'pygeoid' character of little difference between sepals and petals is found (the other subgenera have well-known showy flowers with distinctly more prominent than the petals).

Kalkman (1965) distinguished three subsections based on anatomical characters in the sect. *Laurocerasus*. Kalkman checked some species of the former *Pygeum* but found that collenchyma in the same species may be present or absent in the leaf margin. Consequently, he tried to make another subdivision based on morphological characters. After careful consideration, the following subdivision into sections seemed the most profitable and natural, though admittedly, absolutely sharp distinctions cannot discriminate the sections, with no single character being confined to any section (Kalkman, 1965).

-- Leaves serrate or entire basal glands in the margin, the under-surface of the blade, or on the petiole. Petals are distinct, (1¼–) 2–8 times as long as sepals. Fruits are usually ellipsoid or ovoid, sometimes rounded, and rarely transversely ellipsoid. Subtropical and cool-temperate Eurasia, tropical Africa, tropical Asia from India to New Guinea……………………………………………sect. *Laurocerasus*

-- Leaves entire; basal glands on under-surface of leaf-blade, flat or more or less deeply hollowed (in some species, not in the blade proper, but in contracted of leaf-base). Petals are not or hardly different from sepals or, if distinct, not more than 1½(–2) times as long as the latter. Fruits are usually transversely ellipsoid to didymous, sometimes rounded, and rarely ellipsoid. Tropical Asia from India to the Solomon Islands. One species in Australia……………………………………sect. *Mesopygeum*

-- Leaves are entire and rarely serrated, especially to the apex (rarely distinctly dentate, P. ilicifolia); basal glands on the under-surface of the blade are flat and sometimes near the margin. Petals are distinct from sepals, 1½–4 times as long as the latter. Fruits are globular to transversely ellipsoid. Tropical America (about 25 species), few species in North America……………………………………*unnamed* section

The two last-named sections are certainly homogeneous assemblages; the tropical American species group with their North American relatives, and so do the Australasian genus *Pygeum*. *Pygeum africanum* and *P. crassifolium* have been removed from the old *Pygeum*. The former is closely related to the Asiatic *Prunus pygeoides*, and the two are indeed allied to *Prunus lusitanica*; the African species have consequently been placed in the sect. *Laurocerasus* (Kalkman, 1965).

It could be speculated that sect. *Laurocerasus* was ancestral, and two early branches have become independent enough to be considered sections of their own. However, unlike the other sections, *Laurocerasus* is less homogeneous, partly because of the transfer of the African species (Kalkman, 1965). As a result, I thought about sectional treatment. *Mesopygeum* Kalkman, for my thesis, is given as subgenus *Pygeum* because the morphological and phylogenetic reconstructions are separated very well (see more detail in Chapters 3 and 4).

1.3 Phylogenetic (especially molecular) approaches

Resolving phylogenetic relationships in the Rosaceae has long been problematic because of

a. plant breeders commonly use frequent hybridization, interspecific hybridization, to transfer genes from one species to another. Interspecific hybrids are usually obtained with more incredible difficulty than intraspecific hybrids because genetic barriers to hybridization typically increase with an increase in genetic unrelatedness (Hermsen, 1978); apomixis is an evolutionarily significant phenomenon across plant lineages. The interaction of apomixis with hybridization and polyploidy can lead to complex patterns of reticulation, complicating efforts to reconstruct evolutionary history in groups where apomixis is common (Patel, 2018) and
b. the high degree of convergent or parallel evolution of morphological characters (Shi et al., 2013).

Phylogenetic analysis of wood anatomy (Zhang, 1992) and *rbc*L sequence variation (Morgan et al., 1994) placed *Oemleria* and *Prinsepia* within the subfamily Pruniodeae. Later, phylogenetic studies were based on molecular analyses using maximum parsimony analysis of sequence polymorphism from nuclear ITS and chloroplast *trn*L-*trn*F spacer DNA. These data showed that parsimony analysis of both markers, separately and in combination, supported a close relationship between *Exochorda, Oemleria,* and *Pinsepia* but did not support a sister relationship of this clade with *Prunus* and three genera. Separation is probably not justified (Bortiri et al., 2001).

Molecular phylogenetic studies are essential in plant systematics and have been deployed in the Rosaceae. Morgan et al. (1994) performed a phylogenetic analysis of *rcb*L sequence variation across the family. They resolved several monophyletic groups that corresponded, with a fair number of modifications, to Rosoideae, Amygdaloideae, and Maloideae but found that the Spiraeoideae were polyphyletic. The results suggested that the chromosome number is a better indicator of the relationships in the Rosaceae than the fruit type.

Evans (1999) found that chloroplast *ndh*F sequences and morphological characters, including chromosome number, fruit type, and ovary, supported four subfamily clades: Maloideae, Prunoideae, Rosoideae, and Spiraeoideae. Potter et al. (2007b) studied phylogenetic relationships among 88 genera of the Rosaceae using nucleotide sequence data from six nuclear (18S, *gbssi*1, *gbssi*2, ITS, *pgip*, and *ppo*) and four chloroplasts (*matK*, *ndfF*, *rbcL*, and *trnL-trnF*) regions, separately and in various combinations, with parsimony and likelihood-based Bayesian approaches. They recognized three subfamilies in Rosaceae: Rosoideae, including *Filipendula*, *Rubus*, and *Rosa,* and three tribes; Dryadoideae, comprising four actinorhizal genera; and Spiraeoideae, comprising *Lyonothamnus* and seven tribes. All genera previously assigned to the Amygdaloideae and Maloideae were included in the Spireaeoideae.

Based on an analysis of complete plastid genomes, Zhang et al. (2017) identified four major clades in Malinae, two of which are distinct from the remaining taxa: one contains *Crataegus* L., *Mespilus* L., *Amelanchier* Medik., *Malacomeles* (Decne.) Decne, and *Peraphyllum* Nutt., the other has only *Pyracantha* M.Roem. Moreover, according to Zhang et al. (2017), *Mespilus* is embedded in *Crataegus*, as shown by the red arrow (**Figure 1**). Christenhusz et al. (2018) found that *Sorbus* L. is polyphyletic, and even though several solutions have been suggested, its taxonomy is complicated, with many unfamiliar genera and complex intergeneric hybrids. To show that these are closely related taxa, *Pyrus* L. was expanded by Christenhusz et al. (2018) to include most of Maleae, e.g., the genera *Aronia* Medik., *Chaenomeles* Lindl., *Chamaemeles* Lindl., *Chamaemespilus* Medik., *Cotoneaster* Medik., *Cydonia* Mill., *Docynia* Decne., *Eriobotrya* Lindl., *Heteromeles* M.Roem., Malus Mill., *Micromeles* Decne., *Osteomeles* Lindl., *Photinia* Lindl., *Pourthiaea* Decne., *Pseudocydonia* (C.K.Schneid.) C.K.Schneid., *Rhaphiolepis* Lindl., *Sorbus s.s.* and *Stranvaesia* Lind. This change returned more closely to the Linnaean concept of the genus *Pyrus*.

The most recent classification of *Prunus* using both plastid (*rbcL*, *matK*, *ndhF*, *rps16*, *rpl16*, *trnL-L-F*, and *trnS-S-G*) and nuclear (nrITS and *s6pdh*) sequences recognized only three subgenera: they can be supported based on inflorescence structure (Chin et al., 2014): (1) the deciduous solitary-flower group, including subg. *Prunus*, *Amygdalus*, and *Emplectocladus*; (2) the deciduous corymbose inflorescence group refers to subg. *Cerasus*; and (3) the racemose inflorescence group, containing subg. *Laurocerasus* and subg. *Padus*. Most taxa of the solitary-flower and corymbose groups are diploid ($2n = 2x = 16$), while the racemose group usually has higher ploidy levels with $2n = 4x = 32$ or sometimes $2n = 8x = 64$ [4, 11, 16–19].

Shi et al. (2013) included eighty-four species in a phylogenetic study conducted with maximum parsimony and Bayesian approaches using twelve chloroplast regions (*atpB-rbcL*, *matK*, *ndhF*, *psbA-trnH*, *rbcL*, *rpL16*, *rpoC1*, *rps16*, *trnS-G*, *trnL*, *trnL-F*, and *ycf1*) and three nuclear genes regions (ITS, *s6pdh,* and *SbeI*) to explore their infrageneric relationships. They recognized three main clades: subg. *Padus*, *Cerasus*, and *Prunus*. They recognized seven sections of the subgenus *Prunus*, *Armeniaca*, *Prunus*, *Amygdalus*, *Persica*, *Prunocerasus*, *Microcerasus*, and *Emplectocladus* (**Figure 2**).

In particular, *Prunus arborea* and *P. grisea* were described as widely distributed in Southeast Asia, and each exhibits considerable variability, with several varieties recognized (Shi et al., 2013). They were treated within *Prunus s.l.* subg. *Laurocerasus* sect. *Mesopygium* by Kalkman (1965) and Zhao et al. (2018). On the other hand, Shi et al. (2013) included them in the main clade, namely subg. *Padus*.

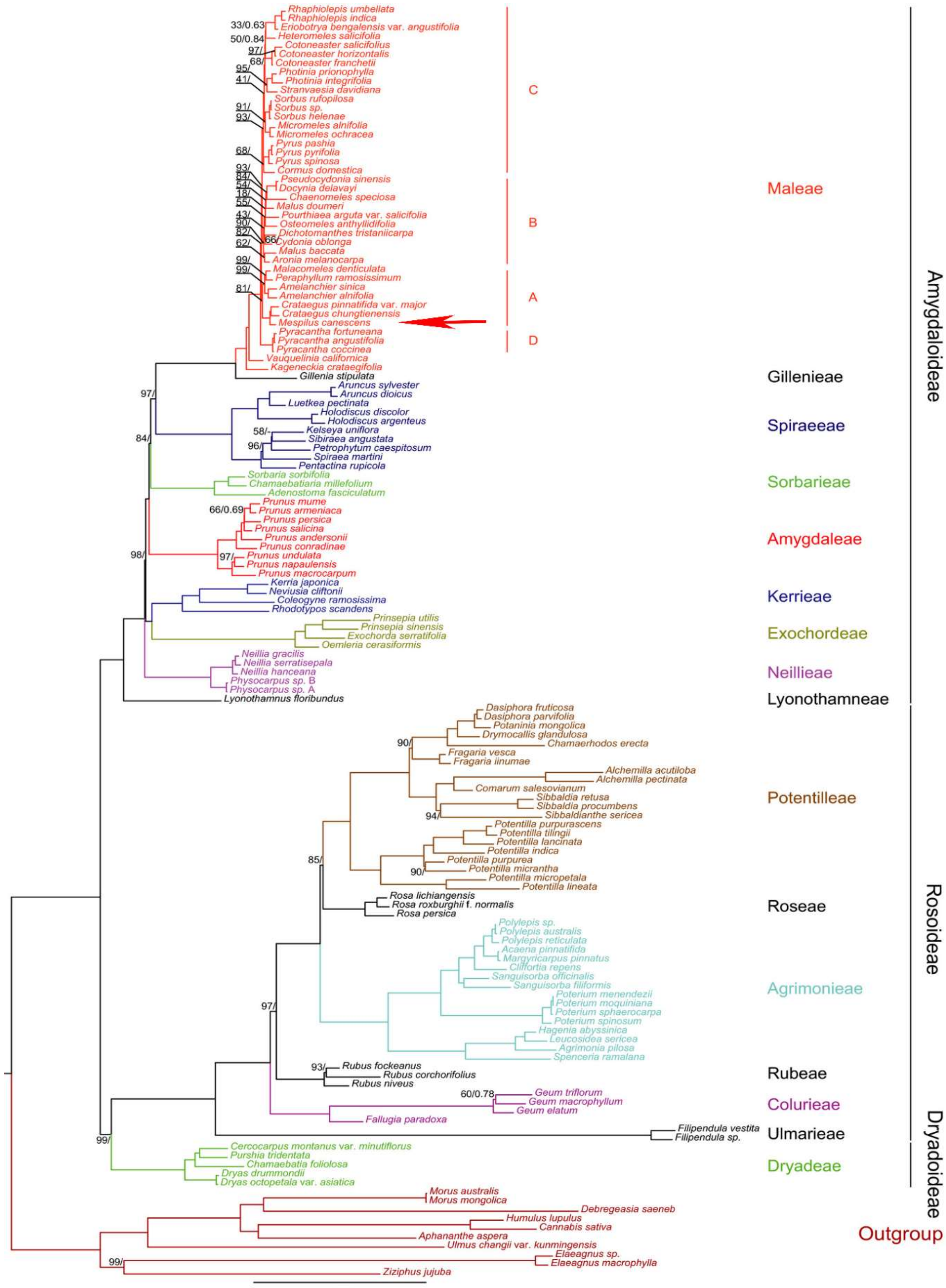


Figure 1. Maximum likelihood (ML) tree of Rosaceae from the whole plastome (WP) data set. A-D indicates the four clads in Malinae (Zhang et al., 2017). The number of nodes corresponds to ML bootstrap percentages and Bayesian inference (BI) posterior, posterior probabilities (only < 1.0 are shown; all others are greater than 1.0)

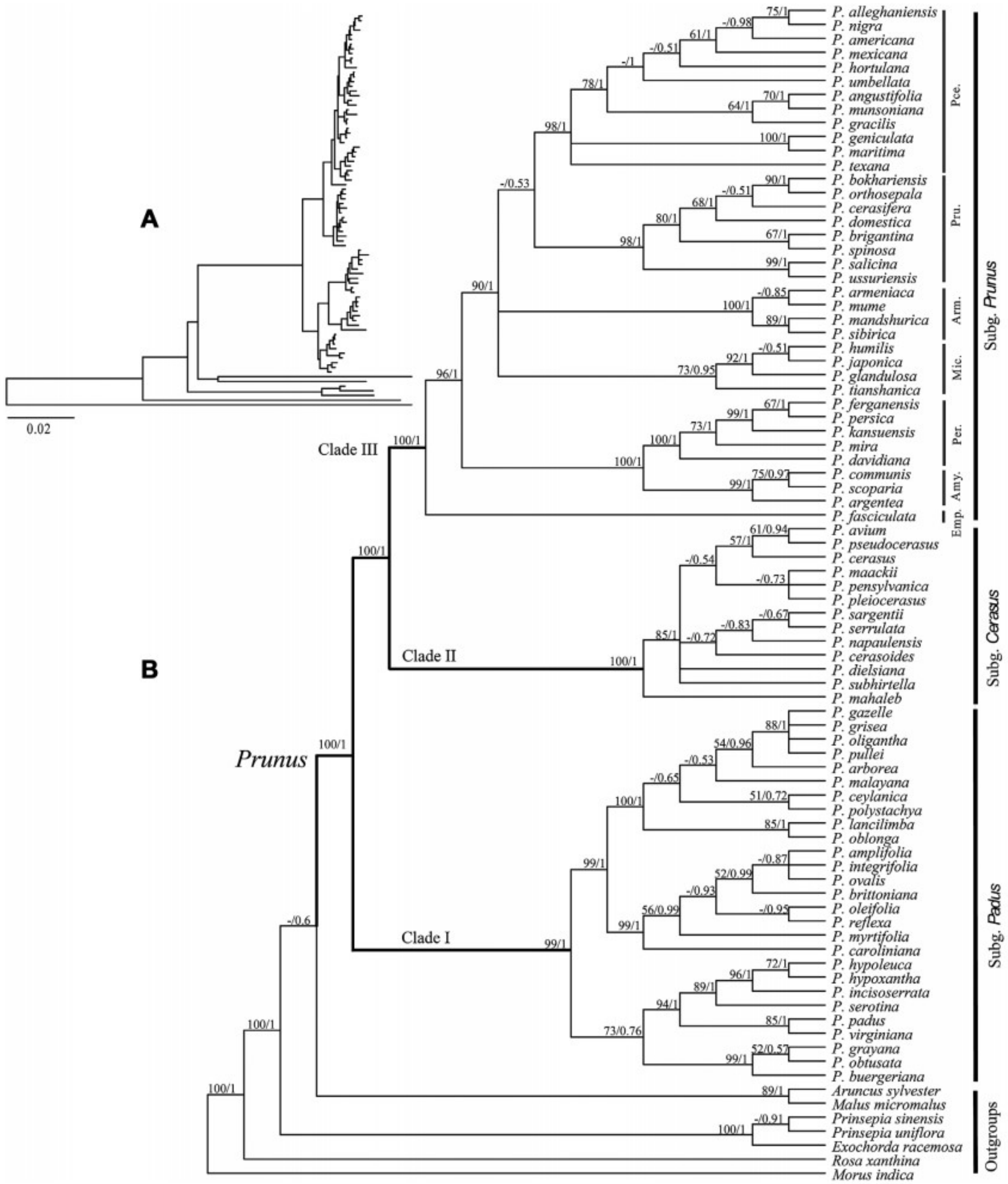


Figure 2. Phylogenetic relationships of *Prunus s.l.* Based on a concatenated dataset of chloroplast *atpB-rbcL*, *matK*, *nmdF*, *psbA-trnH*, *rbcL*, *rpL16*, *rpoC1*, *rps16*, *trnS-G*, *trnL-F and ycf1,* and nuclear ITS, *s6pdh* and *Sbl.* Values beside the branches are the bootstrap percentages for branches in the maximum parsimony trees and Bayesian posterior probabilities (Shi et al., 2013).

1.4 History of botanical works relevant to the *Prunus* (*s.l.*) in the study area and neighboring regions

Prunus L. (*s.l.*) is the largest genus of the Amygdaloideae subfamily. Its flowers are perfect, perigynous, and have a single pistil. Rehder (1904) contends that *Maddenia* flowers have two pistils, but Sterling (1964) found *Maddenia* specimens in his study to be predominantly mono-pistillate.

Pistil number, floral vasculature, and absence of stipules have been used to segregate *Oemleria* and *Prinsepia* from Prunoideae (tribe Pruneae sensu Hutchinson, 1964). *Oemleria* has been placed in the tribe Osmaronieae because of its five pistils, lack of stipules, six vascular bundles per ovary, and separation of ovule integuments (Hutchinson, 1964; Sterling, 1964; Kalkman, 1988). Sterling (1964) argued for removing *Prinsepia* to the Prinsepioideae because of the subterminal position of its style on the ovary, an open ovary suture below the point of ovule insertion, ovary vascularization, erect pleiotropic ovules, and separation of ovule integuments. Baranov (1965) studied the development of *Prinsepia* pistils and found that ovule and style position resulted from differential ovary growth. He rejected Sterling's conclusion based on its close relationship to *Oemleria* and previous floral morphology and anatomy analyses (Juel, 1918; Rehder, 1940). Phylogenetic analyses of wood anatomy (Zhang, 1992) and *rcbL* sequence variation (Morgan et al., 1994) place *Oemleria* and *Prinsepoa* within Prunoideae.

Prunus s.l. has sometimes been split into several genera, a practice which started with Tournefort (1700), who described *Prunus*, *Armeniaca*, *Persica*, *Caerasus*, *Amygdalus*, and *Laurocerasus*. Other authors who were in favor of splitting *Prunus* are Linnaeus (1753) and Endlicher (1840), who both recognized *Amygdalus* and *Prunus*; De Candolle (1852), who recognized *Prunus*, *Armeniaca*, *Persica*, *Cerasus*, and *Amygdalus*. However, Bentham & Hooker (1862) coined an inclusive genus *Prunus*. Koenhne (1893) followed this procedure. Under the influence of these authoritative works, recognition of a large genus *Prunus*, divided into a smaller or larger number of subgenera and sections, has become a common practice in recent times.

As part of a more extensive phylogenetic, biogeographic, and revisionary taxonomic study of *Prunus* (*s.l.*) native to Southeast Asia, several *Prunus* species were treated in Hooker's *Flora of British India* (Hooker, 1878). Koehne (1913) recognized 14 species of *Pygeum* from the Malay Peninsula in his revision of the genus. Ridley (1922) included one species in *Prunus* (*P. martabanica* Kurz var. *scortechinii* King = *P. javanica*) and 14 species of *Pygeum* from the Malay Peninsula. Several studies by Vidal (1949, 1968, 1970) recently recognized 14, 15, and 8 species, respectively. However, many new collections have been made since Kalkman's (1965) comprehensive treatment of *Prunus* subg. *Laurocerasus*. Kalkman (1993) recognized 34 species from the Malaysian region, eight of which are distributed in the Malay Peninsula. Recent studies by Zhao et al. (2018) and Wen and Potter (in press) followed Kalkman's (1965) concept in which all *Prunus* of the Malesian region were placed in *Prunus* subg. *Laurocerasus.* Wen and Potter (in press) found that Kalkman's species concept needed to be more inclusive, especially regarding *P. arborea* (Blume) Kalkman and *P. grisea* (Blume) Kalkman. Thus, Wen and Potter (in press) recognized four species that were treated within *P. arborea* by Kalkman (1965), as

P. kalkmanii J.Wen, *P. patens* (Ridl.) J.Wen, *P. ridleyi* J.Wen, and *P. ruthii* J.Wen, and rise Kalkman's *P. grisea* var. *tomentosa* Kalkman to the species rank as *P. maingayi* (Hook.f.) J.Wen. In addition, they concluded that *P. grisea* (*s.s.*) does not occur on the Malay Peninsula.

1.5 Biogeography and conservation

Rosaceae is widely sub-cosmopolitan and distributed in Asia, Europe, and North and South America. But is more concentrated in northern temperate regions, Asia, Europe, and North and South America. It is sub-cosmopolitan but mainly in the temperate zone and warm north (Mabberley, 2017).

Prunus (*s.l.*), as now defined, consists of approximately 250 species of trees and shrubs widely distributed throughout Asia, Europe, North America, Central America, and South America (Chin et al., 2014), with only a few species in Australia and Africa (Wen et al., 2008), including many of the most economically important fruit crops of temperate regions as well as species cultivated as ornamentals and other used as timber trees and for medicinal purposes. In Malesia, there are c. 35 species and one or two rarely cultivated ones (Kalkman, 1993); c. 400 species in Africa, America, Asia, NE Australia, Europe, and the Pacific Islands; and 9 genera and 115 species (69 endemics, nine introduced) in China (Lingdi, 2003). Best known in the temperate zone of the Northern Hemisphere, the genus is also well-represented in tropical regions in the Americas and Asia. However, the later areas' native species, especially in continental Southeast Asia, have received little attention from researchers until now. *Prunus* has a range of conservation statuses, with species varying from rare and endangered to natively distributed, including some that have become invasive in areas where they are not native (Potter, 2003).

1.6 Economic and ethnobotanical significance

Several Rosaceae species have economic significance and are essential in numerous ways, such as agricultural or ornamental plants. Some have great medical importance in treating a variety of illnesses or in maintaining good health. Several species are a significant food source, or their plant parts are food products used in the pharmaceutical industry (Mabberley, 2017)

Many species of the Rosaceae are economically significant fruits, especially *Malus* (apples), *Prunus* (includes the almonds, American plums, apricots, bird cherries, cherries, cherry-laurels, dwarf cherries, *Maddenia*, peaches and plums, *Pygium*, and wild almonds), *Rubus* (includes the blackberries, dewberry, loganberries, raspberries, etc.), *Pyrus* (pears), *Fragaria* (strawberries), *Cydonia* (quince), *Eriobotrya* (loquat), *Mespilus* (medlar), and *Oemleria,* etc. Mabberley (2017). Some are important as producers of essential oils (e.g., *Rosa*). Ornamentals include the fruit trees and bushes already mentioned and also the antelope brush, Christmasberry (crab apples, *Crataegus* (hawthorn), roes, photinias, firethorns, mountain ash, shadbush, *Spiraea* (included the bridal wreath, meadowsweet, and hardhack), and timbers (cherry, plums, and pears) (Zhang et al., 2017)

Prunus is economically important as the source of many temperate fruit and nut crops, such as almonds, cherries, plums, and peaches, but are also used for timber and ornamentals (Lee & Wen, 2001).

Examples of economically important cultivated species are *Prunus armeniaca* L. (apricot), *Prunus avium* L. (sweet cherry), and *Prunus. cerasoides* Buch.-Ham. ex D.Don, (wild Himalayan cherry or sour cherry), *Prunus cerasus* L. (sour cherry). *Prunus cerasiflora* Ehrh. (cherry plum), *Prunus domestica* L. (European plum), *Prunus insinita* (Damson plum), *Prunus. mume* (Siebold) Siebold & Zucc. (Japanese apricot), *Prunus. persica* (L.) Batsch (peach), *Prunus salicina* Lindl. (Japanese plum), *Prunus serrula* Franch. (Tibetan cherry) and *Prunus serrulata* Lindl. (Oriental cherry).

1.7 Taxonomic problems in continental Southeast Asia *Prunus* (*s.l.*)

The taxonomy of continental Southeast Asia Rosaceae and the genus *Prunus* requires revision. The previous work on the family concentrated mainly on European and South American taxa. Vidal published the last major floristic work on the Rosaceae of Southeast Asia in 1968 and 1970 in the 'Rosaceae of the Flora du Cambodge, du Laos et du Vietnam' and the 'Flora of Thailand' respectively; these accounts were based mainly on limited material collected primarily by French botanists during the French colonial period. Since then, the family has been partially revised for the whole region. In most areas, collections still need to be updated due to political issues in some countries, making it difficult for botanists to access areas. There is also a need for more active local botanists. More fieldwork is needed to gather specimens for taxonomic revision of this economically and ethnobotanically important family for continental Southeast Asia. Kalkman published the last major floristic work on the *Prunus* of Southeast Asia in 1965, whose account of the *Prunus* of the Malaysian region was published in the Flora Malesiana. However, aside from the cultivated species, Malaysian taxa differ considerably from those of the continent. According to my records, approximately 15 percent of the *Prunus* species were similar between Indo-Chinese and Malaysian elements.

1.8 Aims of the study

This thesis provides a taxonomic revision of *Prunus* in continental Southeast Asia and explores the biogeography and phylogeny of the taxa. The specific objectives are to:

1. Based on morphological and molecular analysis, clarify the phylogenetic placement of continental Southeast Asia and Thai *Prunus* species.
2. Provide a taxonomic revision of *Prunus* in Thailand.
3. Analyze the biogeography of *Prunus* taxa in Thailand.

To make my study of Thai material as robust as possible, I also studied materials from continental Southeast Asia, including Cambodia, Laos, Myanmar, Thailand, and Vietnam, but excluding the Malay Peninsular because the Rosaceae of this region were studied relatively recently by Kalkman (1993) in Flora Malesiana and by Zhao et al. (2018) in his study of *Prunus*. My study, therefore, aims to contribute to a complete account of the Rosaceae for Thailand, including data on species diversity, distribution, and phylogenetics. The results of my study provide a basis for the future completion of *Prunus* accounts for a revision of the Flora of Thailand and Flore de Cambodia du Laos et du Vietnam. The thesis is structured as follows:

Chapter 1: Introduction

This chapter reviews the literature concerning the taxonomy and morphology of Rosaceae, the genera found in Thailand, and provides a detailed description of *Prunus* and closely related genera. It also summarizes the state of knowledge concerning the phylogeny of the Amygdaloideae subfamily.

Chapter 2: General Morphology and intraspecific variation in *Prunus*

This chapter uses the morphological characteristics of herbarium specimens. One helpful output is a list of morphological characters (and a description of each) that can or cannot be reliably used for species delimitation and phylogenetic analysis.

Chapter 3: Molecular and Phylogenetics Study

This chapter combines morphological and molecular characters to test the relationships between *Prunus* taxa in Thailand. It examines *Prunus* in detail and shows its phylogenetic relationship with other genera and species; some African and New World members are included. Its infrageneric classification is assessed, and relationships of subgenera are investigated. The results also clarify the phylogenetic positions of some previously unknown taxa within the subgenus.

Chapter 4: Taxonomic treatment

Using the numerical morphological characters and phylogenetic information produced in the previous chapters, I review *Prunus* taxonomy in Thailand and make any necessary changes, e.g., new genus delimitation. This chapter includes identification keys, lectotypification when necessary, solution of synonymies, and species-level revision. Species descriptions are included in the revision of *Prunus* for the Flora of Thailand.

Chapter 5: Biogeographical and ecological conclusions

This chapter examines the distribution and biogeography of *Prunus* using a geographic information system (GIS) analysis. It looks at the influence of geology and climate on species distributions. By knowing species' population, distribution, and ecology, we can develop strategies to conserve them and hypotheses to explain their diversity.

Chapter 2 General morphology and intraspecific variation in *Prunus*

2.1 Introduction

This chapter aims to introduce the general morphological characters used in *Prunus* taxonomy and systematics. The characters described are based mainly on the taxa studied from continental Southeast Asia and surrounding regions. The characters are discussed with appropriate references to previous work from the area studied and other global studies; they form the basis for the taxonomic descriptions in Chapter 4. The terms used, specific to the study group, are explained, and figures are provided to provide a visual explanation when appropriate.

2.2 Material and methods

To obtain as many species of Rosaceae as possible, I collected 236 samples of *Prunus* and close relatives as possible. Expeditions to collect Thai Rosaceae were undertaken between the 2nd March and 29th May 2019 in various localities throughout Thailand, covering a total of 13 National Parks (Doi Inthanon, Doi Pha Hom Pok, Doi Phu Kha, Phu Hin Rong Kla, Phu Suan Sai, Phu Kradeung, Kaeng Krachan, Thong Pha Phum, Khao Yai, Khao Khitchakut, Koh Chang, Khao Luang, and Khao Ram Rom), 4 Wildlife Sanctuaries (Doi Chiang Doa, Phu Luang, Um Phang, and Hala-Bala), and 5 forest protected areas and other conservation areas (Doi Ang Khang, Doi Tung, Khao Nang Phanthurat, Khao Chong, and Khao Pok Yo). In addition, I undertook to collect fieldwork in continental Southeast Asia, for example, in Myanmar, Kalay Myo, Shin, and Mandalay; Laos, Bolaven Plateau, Dong Hua Sao National Park; Cambodia, Bokor National Parks; Vietnam, Bidoup Nui Ba National Park, Dalat.

Geographical and ecological data such as habitat and flowering periods were obtained from herbarium specimens to document the localities and suitable times for field trips. The collected materials were labeled and identified, and duplicate samples were distributed to various herbaria. Specimens kept in the following public herbaria were examined: **BK**, **BKF**, **BM**, **CMUB**, **E**, **FU**, **K**, **KYO**, **Laos PDR**, **NUOL**, **P**, **QBG**, **RAF**, **TCD**, and **VNM**. Additionally, some species were studied from various botanical gardens. Voucher specimens and photos of living specimens and silica-dried leaf pieces sampled for DNA analysis were collected in the field.

Morphological dimensions given in the descriptions are based on herbarium specimens, spirit material, and living plants, supplemented by observations of plants in natural habitats during field trips. Flowers were softened in water for dry samples with a small amount of detergent (washing-up liquid) before measurements were taken. Most of the significant Floras and publications in SE Asia and neighboring regions and those important monographs, e.g., Flora du Cambodge, du Laos et du Vietnam (Vidal, 1968); Flora of Thailand (Vidal, 1970); Tree Flora of Malaya (Prance & Whitmore, 1983); Flora Malesiana (Kalkman, 1993); Flora of China (Lu et al. 2003) were consulted.

2.3 Results

2.3.1 Habits and stems

Generally, *Prunus* species are perennial and can be deciduous, as seen in many subgenera such as *Amygdalus*, *Armeniaca*, *Cerasus*, *Maddenia*, *Padus*, and *Prunus*. They are, however, usually evergreen, as in subg. *Laurocerasus* (sect. *Laurocerasus* and *Mesopygeum*). Their habit is understory to top-canopy shrubs or small to large trees. *Prunus* plants are often small trees or have large woody stems up to 45 m tall. They are sometimes prostrate shrubs or ascending 0.3–2 m tall, as commonly seen in *Prunus prostrata* Lipsky and *P. mugus* Hand.-Mazz.

The stem is rounded or terete and of various colors. *Prunus* can be prostrate or straggling, present as numerous branches rising directly from the ground, but usually have an erect clear bole with a diameter at breast height (dbh) of 5–100 cm. The stem usually has spirally arranged branches. Stems are white, greyish-brown to dark brown, and typically have brown lenticels. The type of outer bark varies (**Figure 2.1**). However, it is generally shallow-furrowed and ridged, *e.g., P. javanica, P. maingayi, P. phaeosticta, P. poilanei, and P. undulata,* often with conspicuous prominent lenticels, *e.g., P. cerasoides, P. fordiana,* and *P. persica, P. vandebultii,* and occasionally horizontally papyraceous as found in *P. serrula. Prunus* plants typically have a single stem or several stems from a woody rootstock, as is often found in *P. mugus, P. prostrate, P. salicina, and P. serrula*. The outer bark can be smooth with small lenticels, e.g., *P. hongiaoensis*, *P. koehnei*, and *P. ridleyi*, or with distinct smooth flakes in irregular pieces, reddish-brown (pale) in color as found in *P. zippeliana*. The inner bark is whitish, yellowish, pinkish to reddish-brown, sometimes brown, and has reddish to dark red longitudinal stripes with a faint to strong alkaline almond smell. Sometimes, the sap exudes as gum. The stem color can have taxonomic value in living plants in some species, e.g., the reddish-brown papery bark across the stem in *P. serrula*. Unfortunately, these characters are usually not preserved in herbarium specimens, and as this kind of information is hardly ever recorded on herbarium labels, it is generally unavailable for taxonomic study.

Old twigs can be glabrous, glabrescent, or densely pubescent and usually have brown lenticels. Branchlets are typically without spines, though sometimes a spine is present at the ends of young twigs, or the twig is spine-like, e.g., as commonly found in *P. mume* and *Prunus spinosa* L. Branch color can be reddish-brown with prominent brown lenticels. Young twigs can be green, with densely whitish-brown hairs, and cataphylls can be absent or present (sometimes there are many persistent cataphylls at the base of the twig in *P. mugus*; these not functioning as bud-scales).

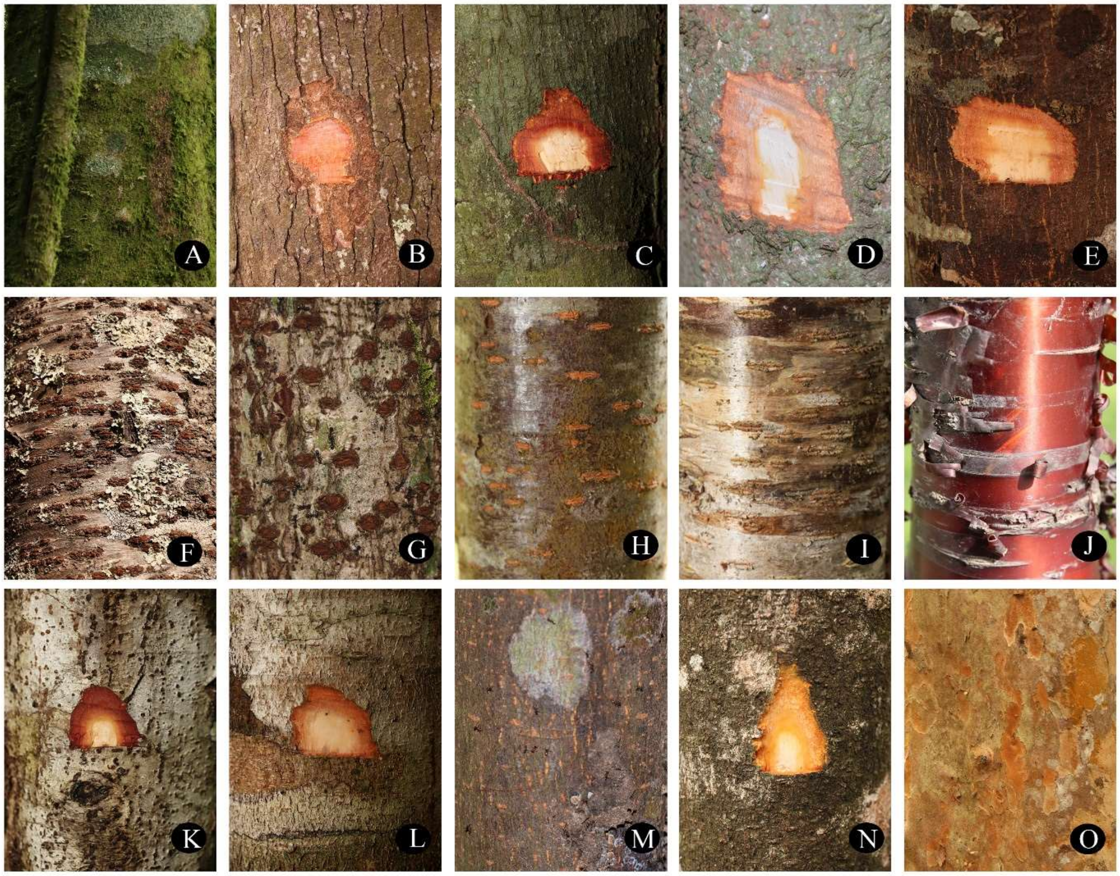


Figure 2.1. Outer bark variation of *Prunus* species: **A–E**, shallow furrows and ridges; **A**, *P. undulata*; **B**, *P. javanica*; **C**, *P. poilanei*; **D**, *P. phaeosticta*; **E**, *P. maingayi*: **F–I**, conspicuous prominent lenticels; **F**, *P. cerasoides*; **G**, *P. vandebultii*; **H**, *P. fordiana*; **I**, *P. persica*; **J**, papyraceous, *P. serrula*: **K–N**, smooth with small lenticels; **K** and **L**, *P. ridleyi*; **M**, *P. koehnei*; **N**, *P. hongiaoensis*; **O**, smooth and flakes in irregular pieces, reddish-brown (pale) in color, *P. zippeliana*. Sukid Rueangruea took all photos.

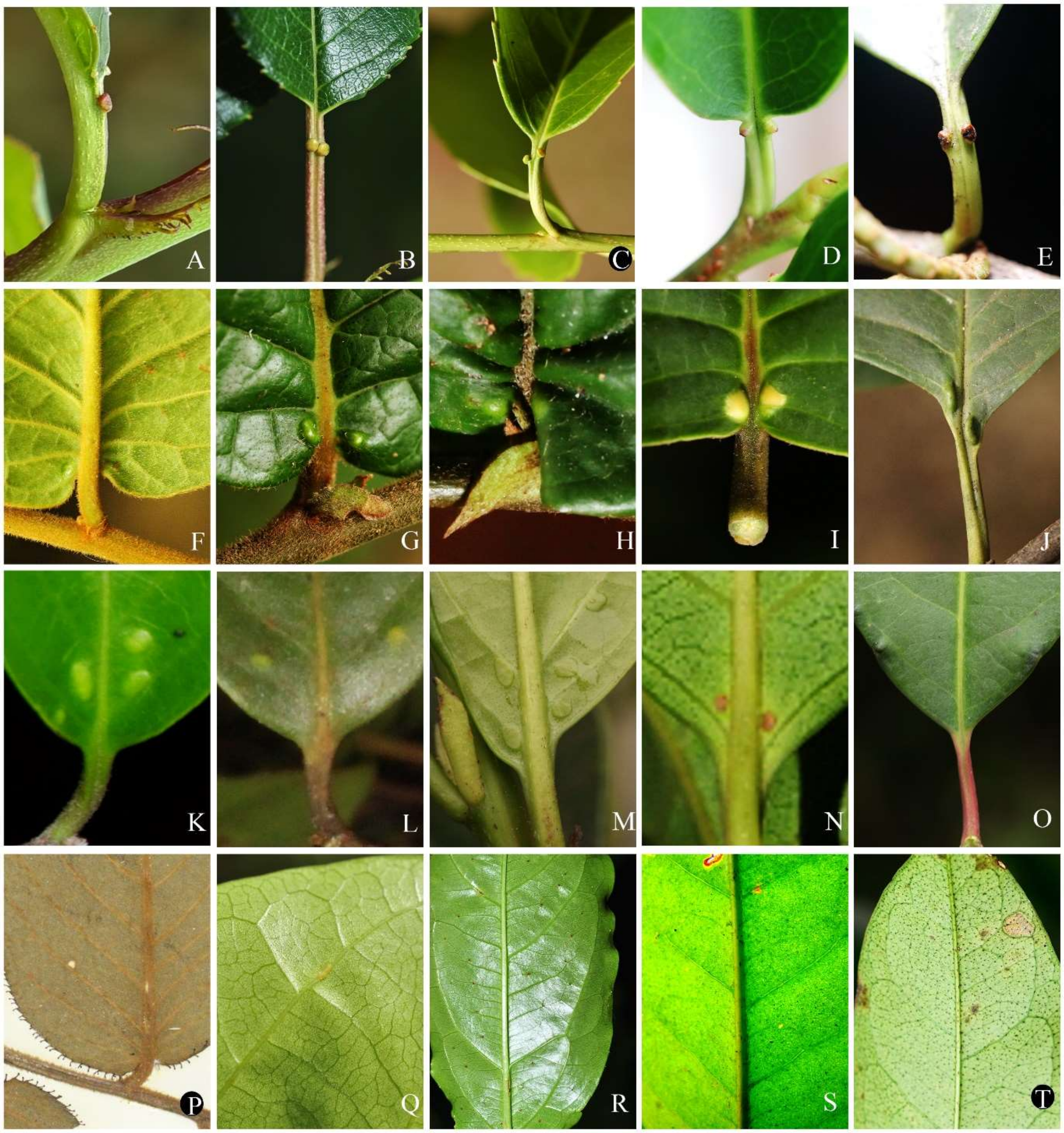


Figure 2.2. Morphological diversity of glands of *Prunus* species: **A–E**, petiolar glands; **A**, *Prunus persica*; **B**, *P. cerasoides*; **C**, *P. zippeliana*; **D**, *P. vandebultii*; **E**, *P. javanica*; **F–N**, basal glands; **F–K**, glands protruding adaxially; **F**, *P. latistipulacea*; **G**, *P. ridleyi*; **H**, *P.* "nanensis"; **I**, *P. polystachya*; **J**, *P. kaengkrachanensis*; **K**, *P. poilanei*: **L–N**, basal glands not protruding adaxially; **L**, *P. lancilimba*; **M**, *P. hongiaoensis*; **N**, *P. apiculata*: **O**, glands close to the basal margin, *P. pygioides*: **P**, glandular ciliate, *P. himalayana*: **Q–T**, other glands; **Q**, glands along margins, *P. latifructa*; **R**, glands parallel to the midrib, *P. undulata*: **S** and **T**, black dotted; **S**, *P. javanica*; **T**, *P. phaeosticta*. Photographs: all by S. Rueangruea except for **A** by A. Sinbumroong; **B** by W. Kaewbang; **C** by M. Van de Bult; **K** by S. Tagane; **L** by Em Son.

2.3.2 Glands and hairs

Glands are common in almost all members of *Prunus*. They can be found in various shapes and sizes and on multiple plant parts (**Figure 2.2**). Glands are typically small but can be large (up to 5 mm long) in some species. *Prunus* leaves characteristically have a diversity of gland types. Leaf glands or basal leaf glands are almost always present. The glands are usually flat and form various shapes and sizes; usually, there are 2(–6) glands on the under-surface of the leaf. Glands may also be situated on the margin of the serrate apex, or the glands are of different types and in other positions as follows:

a. Glands can be present as 2-flat, main glands on the abaxial leaf blade surface and never on the upper surface, as in almost all of the sect. Mesopygeum. The basal glands, numbering 3–6, may sometimes be found in *P. apiculata*, *P. hongiaoensis*, *P. poilanei*, and *P. undulata*. The basal glands are usually accompanied by additional ones placed near the margin of the leaves. However, the margins of *Mesopygeum* species are always entire and glandless.

b. Glands protrude and are deeply hollowed abaxially, cushion-shaped, or protrude but are still on the leaf blade, e.g., sect. *Mesopygeum* as in *P. indochinensis*, *P. kaengkrachanensis*, *P. koehnei*, *P. poilaneiand*, and *P. polystachya*, or are situated in the contracted leaf-blade e.g., *P. kaengkrachanensis*, *P. polystachya*, and *P. turfosa*.

c. Basal glands can be on the leaf blade margins, e.g., as in subg. *Amygdalus*, *Armeniaca*, *Cerasus*, *Padus*, and *Laurocerasus* (as found in *P. fordiana*, *P. phaeosticta*, and *P. pygeoides*), or sometimes present as stalked glands up to 2 mm long as seen in *P. himalayana* and *P. gonshanensis*.

d. Glands can be located on the petiole. Petiolar glands can be present or absent, number (0–2–4), and measure 1 x 0.5 mm in diameter, e.g., in subg. *Laurocerasus* include *P. crassistyla*, *P. javanica*, *P. vandebultii*, *P. zippeliana*, and subg. *Cerasus* as in *P. campanulata*, *P. cerasoides*, and *P. pseudocerasus*.

e. Flat glands parallel to the midrib and margin, as found in *P. undulata*.

f. Glands can be found between the anastomosing lateral veins and sometimes near the leaf margin, e.g., *P. apiculata*, *P. bokorensis*, *P. latifructa*, and *P. maingayi*.

g. Leaves can be covered with black gland dots abaxially, which are smaller than the other glands as in subg. *Laurocerasus*, e.g., *P. fordiana*, *P. javanica*, *P. phaeosticta*, and *P. racemopilosa*.

h. Pellucid glands can cover the whole of the leaf blade, e.g., in *P. fordiana* and *P. phaeosticta*.

Hairs are also common in *Prunus*. Unicellular or multicellular hairs can be found on the young and mature branchlets, petiole and adaxial, or/and abaxial leaf surfaces. These characters are useful for identification, e.g., sometimes the hairs are present on inflorescence or floral parts, e.g., on the hypanthium, sepals, petals, filaments (as in *P. indochinensis*, *P. koehnei*, *P. latifructa*, *P. laistipulacea*, *P. poilanei*, *P. santisukii* and *P. trichostoma*), or on the style or ovary, e.g., *P. arborea*, *P. ferrea*, *P. indochinensis*, *P. kalkmanii*, *P. koehnei*, *P. latistipulacea*, *P. mume*, *P. persica*, *P. poilanei*, *and P. ridleyi*. Hairy characters can also help describe the details of fruiting parts, e.g., short or long spreading on the fruiting calyx; hairy on the outer surface of the exocarp, e.g., *P. arborea*, *P. brachypoda*, *P.*

bracteopadus, *P. koehnei*, *P. mume*, *P. persica*, *P. latistipulacea*, and *P. ridleyi*; endocarp (stone) in *P. persica*; or the seedcoat may be hairy as in *P. arborea*, *P. kaengkrachanensis*, *P. latistipulace*, and *P. ridleyi*.

2.3.3 Leaves

The shape, size, and texture of leaves are very variable but always have a significant value in terms of identification when combined with other characters. Leaves are simple, and young leaves are usually plicate, though in some species, they are convolute in the bud, e.g., *P. salicina* and *P. mume*, or recurved when young (subg. *Armeniaca*, as in *P. mume*).

Leaves are usually extended before flowering, as in P. cerasoides, during flowering, or after anthesis in P. campanulata, with both spiral and alternate arrangement. They can also be fascicled on short shoots or congested at the top of branches in *P. salicina*, and leaves can be distichous on annual twigs.

The lamina apex angle is acute to obtuse, shortly acuminate, or long to caudate.

The leaf margin (**Figure 2.3**) is usually entire in sect. *Mesopygeum*, e.g., *P. apiculata*, *P. bokorensis*, *P. indochinensis*, *P. kaengkrachanensis*, *P. poilanei*, *P. polystachya*, *P. maingayi*, and *P. santisukii*, except in *Prunus africanum* (Hook.f.) Kalkman, and *Prunus crassifolia* (Hauman) Kalkman, but the margin can be slightly serrate or mixed serrate, as is often found in subg. *Laurocerasus*, e.g., *P. crassistyla*, *P. fordiana*, *P. phaeoaticta*, *P. pygeoides*, *P. vandebultii*, and *P. zippeliana*. However, the leaf margins in subg. *Armeniaca*, *Amygdalus*, *Cerasus*, and *Padus* are strongly serrulate, serrate, dentate, or incised serrate. Teeth may have regular spacing or slightly irregular to irregular spacing.

The leaf sinus is angular, rounded, or entire. The leaf teeth apex can be without glands, as in *P. brachypoda*, *P. bracteopadus*, *P. buergeriana*, *P. cornuta*, *P. crassistyla*, *P. fordiana*, *P. napaulensis*, *P. phaeosticta*, *P. pygeoides*, but are sometimes stipitate-glandular, e.g., *P. himilayana*, *P. gonshanensis*, or glandular serrate as found in subg. *Ceracus*, e.g., *P. mugus*, *P. trichantha*, *P. trichostoma*, and the leaf margins can be glabrous but sometimes ciliate as found in sect. *Mesopygeum*, e.g., *P. indochinensis*, *P. koehnei*, *P. latisipulacea*, and *P. ridleyi*.

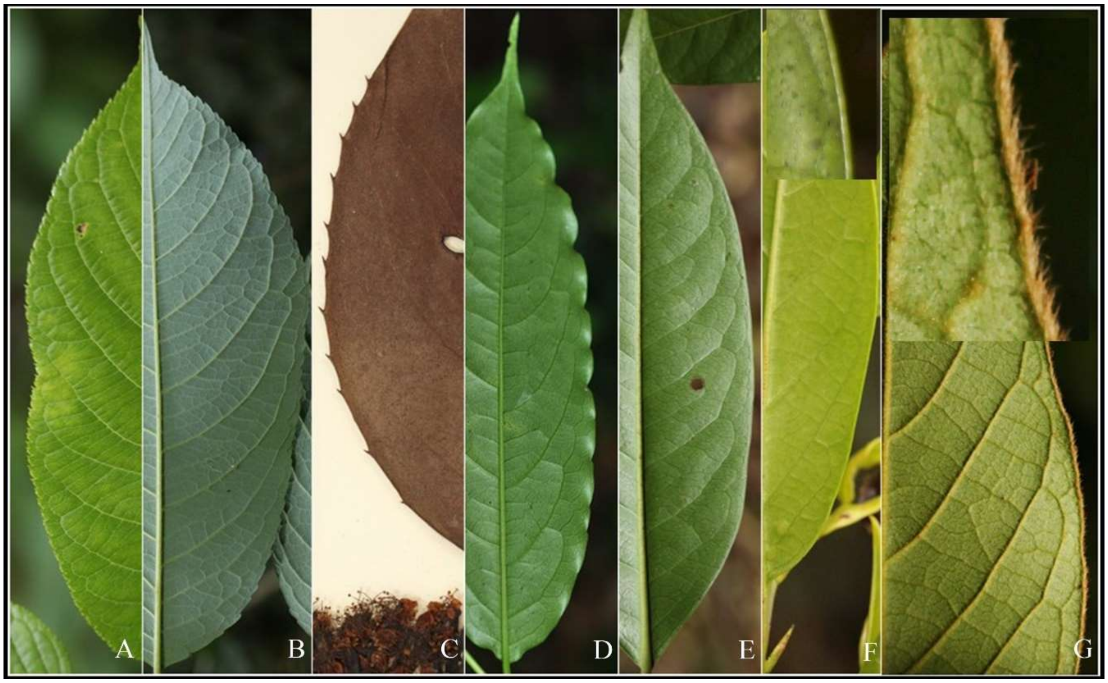


Figure 2.3. Morphological diversity of leaf margin of *Prunus* species: **A–C**, margin serrate; **A**, *Prunus cerasoides*; **B**, *P.* “inthanonensis”; **C**, spine-like, *P. crassistyla*: **D–G**, margin entire; **D**, undulate, *P. undulata*; **E**, smooth, *P. javanica*; **F**, recurved, *P. hongiaoensis*; **G**, ciliate, *P. ridleyi*—photographs: **A–C** & **E–G**, by S. Rueangruea; **D** by W. Kaewbang.

The leaf base is oblique, asymmetric or slightly asymmetric, varied concave, concavo-convex, convex, or somewhat cordate, e.g., *P. brachypoda*, *P. campanulata*, and *P. latistipulacea*, usually cuneate, decurrent, or rounded. In this study, I found that some leaf bases are semi-sagittate or semi-amplexicaul in *P.* sp. "nanensis", a remarkable shape that makes the species easily distinguishable.

Young leaves are reddish-purple (as in *P. campanulata*, *P. javanica*, and *P. undulata*) to pale green, dull green to light green adaxially, pale green to glaucous abaxially (as in *P. cornuta*, *P.* sp. "inthanonensis", *P. mugus*, and *P. poilanei*), turning yellow or reddish-brown via yellow before falling.

The texture can be chartaceous (e.g., *P. "inthanonensis"*, *P. mume* and *P. trichostoma*) to coriaceous (e.g., *P. kaengkrachanensis*, *P. latistipulacea*, and *P. polystachya*), and the leaf indumentum can be glabrous, glabrescent, sparsely pubescent to densely hairy. The midrib and lateral vein indumentum are variable and can be glabrous, glabrescent, sparsely pubescent to densely. Old leaves are variable but usually glabrous or glabrescent in all sect members. *Laurocerasus*, or sparsely pubescent to densely hairy, in sect. *Mesopygeum*, e.g., *P. ferrea, P. indochinensis, P. koehne*, and *P. ridleyi*.

Primary venation in most of *Prunus* is pinnate, and secondary venation (2°) is brochidodromous, weaky brochidodromous, craspedrodomous or looped, and anastomosing near the margin, the number of lateral veins varies (4–)8–12(–20). Veins can be flat, slightly impressed, sunken adaxially or prominent to invisible abaxially, very narrow, forming a moderate to wide-angle (25°–65°) from the midrib: tertiary venation (3°), can be simply mixed alternate and opposite percurrent, sinuous: 4° venation is alternate percurrent, veinlets reticulate or inconspicuous abaxially: 5° venation can be regular polygonal reticulate, or inconspicuous. They alternate on either side of the midrib: lateral vein arrangements are oblique, ascending or spreading, decreasing toward the base, and irregularly spaced.

Leaves are almost always petiolate with 0.2–3.5 cm long petioles, stout, grooved to shallowly canaliculate in cross-section or terete, glabrous to densely hairy. Petiolar glands are usually absent in the sect. *Mesopygeum.* They are typically present, with two petiolar glands in subg*. Amygdalus, Armeniaca, Cerasus, and Laurocerasus, Padus, and Prunus, e.g., P. brachypoda, P. cerasoides, P. cornuta, P. crassistyla, P. javanica, P. mume, P. persica, P. pseudocerasus, P. vadebultii,* and *P. zippeliana.*. However, I believe it is taxonomically significant. In some species, petiolar glands vary in number (0–)2–4 (–6) glands, e.g., in *P. cerasoides*, and *P. salicina*. Petiolar gland sizes also vary, usually 1 x 0.5 mm in diameter, or sometimes the glands are stalked and up to 2 mm long, e.g., in *P. campanulata*, *P. cerasoides*, and *P. zippeliana*.

2.3.4 Stipules

Most taxonomic descriptions ignore the stipules because they are usually small, caducous, and absent in many herbarium specimens. However, they are incredibly well represented in samples that include terminal buds or are in the process of expanding and should be considered more closely as a source of taxonomic characters.

Stipules **(Figure 2.4)** are sometimes present on the twigs or the petiole and may be provided with glands in various ways. They range from small to large, 1–25 mm long by 0.3–10 mm wide, and have multiple forms. The stipules are large and semi-persistent, e.g., *P. latistipulacea*. Their shape varies; they are semi-laciniate in *P. campanulata*, *P. cerasoides*, and *P. pseudocerasus*, linear (*P. indochinensis*, *P. poilanei*, and *P. sp*. "inthanonensis"); subulate, narrowly triangular to oblong (*P. polystachya*, and *P. zippeliana*), oblique, gibbose, ovate, circular leaf-like to subcordate, semi-persistent (*P. latistipulacea*), with an obtuse, acute to acuminate apex, a glabrous or ciliate, entire to serrate margin, without glands as in *P. indochinensis*, or with glands (*P. kalkmanii*, *P. latistipulacea*, *P. koehnei*, *P. ridleyi*, and *P*. sp. "nanensis").

The stipule's base is usually sessile and sometimes lanceolate, oblong, round to slightly cordate, or stipitate-like, glabrous to densely hairy. The stipule glands are typically absent or significant on the blade, as in *P. ferrea*, *P. kalkmanii*, *P. koehnei*, *P. latistipulacea*, *P. ridleyi*, and *P*. sp. "nanensis".

The stipule's margins or apex are usually entire, sometimes serrate as in *P. gongshanensis*, *P. himalayana*, *P. mume*, *P. serrula*, or lobed as in *P. campanulata*, *P. cerasoides,* and *P. persica*. The stipules are usually early caducous to sometimes semi-persistent in *P. latistipulacea*. In one species, *P. kalkmanii*, the stipules are typically provided with 1–3 crateriform glands on the outer surface, closely resembling the basal glands on the leaves of *Prunus beccarii* (Ridl.) Kalkman, but differ significantly from the stipule's hollowed glands. *P. beccarii* is, therefore, easy to recognize from just sterile specimens.

2.3.5 Inflorescences

The inflorescences of *Prunus* vary considerably (**Figure 2.5**), including sessile to shortly pedicellate solitary flowers; 1–2-flowered inflorescences with conspicuous pedicels; solitary short or long racemes, solitary short or long racemes, usually with a flush of leaves and cataphylls at the base; united into pseudo-panicles (leafless shoots usually remaining their terminal bud); fascicled by contraction of the central axis consisting of 1–6 racemes in the bundle; indeed compound with some side-branches or panicle-like racemes and without terminal buds. The inflorescences are usually in the axile of the leaf or the fallen leaves branches and sometimes can be positioned on the terminal part of a young twig, as found in subg. *Maddenia*, e.g., *P. gongshanensis* and *P. himalayana*, and in subg. *Padus* as in *P. bracteopadus*, *P. buergeriana*, *P. cornuta* and *P. napaulensis*.

The number of flowers within a fascicle or short raceme never exceeds 4, as follows: consistently single-flowered racemes are only found in *P. persica*; they are (2–)3(–4)-flowered in *P. salicina*, and (1–)2- flowered in *P. mume*. The raceme mostly has contracted simple flowers on short to sessile peduncles, forming an umbel-like or fascicle-like structure as found in subg. *Armeniaca*, as in *P. mume*, and subg. *Prunus*, e.g., *P. domestica*, and *P. salicina*. The character of the raceme is consequently entirely lost, fasciculate-corymbose in subg. *Cerasus*, e.g., *P. campanulata*, *P. cerasoides*, and *P. serrula*, or 1-or 2-flowered, as seen e.g., *P. mugus*, and *P. trichostoma*. Depending on the species, the inflorescences can be many-flowered; e.g., up to 85 flowers per inflorescence are found in *P. brachypoda* and *P. hongiaoensis*.

Figure 2.4. Variation of stipules in *Prunus* species: **A–E**, branched, margin with small glands; **A**. *Prunus cerasoides*; **B**, *P*. *pseudocerasus*; **C**, *P*. *persica*; **D**, *P*. *salicina*; **E**, *P*. "inthanonensis"; **F–O**, linear shape with marginal glands; **F**, *P*. *poilanei*; **G**, *P*. *indochinensis*; **H**, *P*. *latifructa*; **I**, *P*. *polystachya*; **J**, *P*. *zippeliana*; **K**, resinous stipules, *P*. *javanica*: **L–N**, marginal and small glands on stipule blades; **L**, *P*. *kaenkrachaensis*; **M**, *P*. *phaeosticta*; **N**, *P*. *hongiaoensis*; **O**, swollen and protruding glands, *P*. *kalkmani*: **P–T**, leaf-like stipules and conspicuous glands on stipule blade; **P**, *P*. "nanensis"; **Q**, *P*. *koehnei*; **R**, *P*. *ridleyi*; **S**, *P*. *ridleyi*; **T**, *P*. *latistipulacea*. Photographs: by S. Rueangruea, except for **E** by W. Kaewbang, **Q** by S. Kaithongsuk, and **T** by S. Tagane.

The racemose inflorescences vary from sessile to very short (0.2–0.5 cm found in subg. *Armeniaca*, e.g., *P. mume*, subg. *Prunus*, as in *P. domestica* and *P. salicina*) to up to 30 cm long as in *P. brachypoda*. And Sect. *Mesopygeum* can be divided into two groups using the length of the raceme. The simple racemes can be longer than 4 cm, e.g., *P. apiculata*, *P. bonyavejchewinii*, *P. ceylanica*, *P. hongiaoensis*, and *P. poilanei*, or the raceme is usually shorter than 3 mm long, e.g., *P. bokoensis*, *P. longistyla*, *P. maingayi*, *P. santisukii*, and *P. taganei*.

In its typical form, a raceme (or spike) is always present in subg. *Padus* and *Laurocerasus*, the inflorescences are mostly leafless, compound, or simple in an axillary leaf position. The racemes are, however, usually long and solitary in subg. *Padus*. The raceme can be leafy, e.g., *P. gluacifolia*, *P. cornuta*, *P. bachypoda*, and *P. bracteopadus*, though in some species, the peduncle of racemes are leafless, as in *P. buergeriana* and *P. perulata*. The primitiveness of *Padus* has been inferred due to the form of the raceme as Koehne (1915) believed the leafless raceme (as in subg. *Laurocerasus*) to be more primitive than the leafy one (as in subg. *Padus*) because it is often found together with a thin endocarp. However, Kalkman (1965) argued that this is false because, based on his phylogenetic understanding, a considerable difference may exist between evolution rates in other organs (heterogamy).

Additionally, it seems more logical to consider the raceme with leaves at the base (as in *Padus*) as the most primitive state in *Prunus*. The reduced leaf size often leads to considerably smaller leaves than typical leaves, leading to racemes with some sterile bracts at the base. Usually, these basal bracts have a slightly different form from those higher up in the raceme. In addition, the leafless solitary raceme is present in some members of subg. *Laurocerasus*, sect. *Mesopygeum*, e.g., in *P. apiculata*, *P. bokorensis*, *P. hongiaoensis*, *P. latifructa*, *P. maingayi*, *P. poilanei*, and *P. taganei*.

More complex inflorescences may originate in two ways. Either racemes may be found in the axils of lower bracts instead of flowers, which makes them fascicled in a bundle. In this case, the racemes are fascicled, sometimes becoming a compound consisting of 2–10 racemes in a bundle (fascicle) as in sect. *Mesopygeum*, e.g., *P. arborea*, *P. indochinensis*, *P. patents*, and *P. ridleyi*, some species in subg. *Laurocerasus*, e.g., *P. javanica*, *P. undulata*, and *P. zippeliana*. The typical development may be a compound raceme or one united into pseudo-panicles, such as in sect. *Mesopygeum*, e.g., *P. kaengkrachanensis*, *P. koehnei*, *P. lanceifolia*, and proably *P. polystachya*. Species in the Malaysian region include *P. malayana* and *P. oocarpa*. The racemes are occasionally solitary and mixed with other bundle racemes, as found in *P. malayana*.

Several studies suggested that honeybees, bumblebees, and flies are the primary insect pollinator species richness of many other *Prunus* species in orchard settings. For example, the genus Lasioglossum was the most abundant flower visitor, followed by the less abundant genera Xyloccopa spp., Andrena spp., Megachile spp., Syrphus spp., and Musca spp. respectively (Dar Showket et al., 2018). In addition, from my observation during my *Prunus* field trip collection, I have not seen any pollinators. However, I noticed that the inflorescence of *Prunus* species from low altitudes is likely to be short inflorescence, short pedicel, or erect inflorescences, so it is suited for insect pollinators. On the contrary, the inflorescences of *Prunus* species from high altitudes usually cluster with long inflorescences (panicle or long raceme, long pedicel or pendulous) that suit wind-pollinated flowers or anemophilous. In addition, the anthers may produce many pollen grains, while the stamens are generally long and protrude out of flower.

2.3.6 Bracts and bracteoles

Bracts are defined here as the structures that subtend inflorescences. Their size and shape are variable. They may be triangular, ovate to semi-circular, with an acute apex, or with a 3-lobed apex, e.g., *P. javanica*, *P. phaeosticta* (specimens from Cambodia), *P. vandebultii*, or tripartite, as found in *P. lancilimba* and *P. lanceifolia*. Most species of Asian *Prunus* have (1–)2–5 bracts or sometimes 3–10 involucral bracts (a whorl of bracts subtending the inflorescence or flower cluster). They are usually soon caducous but may occasionally be conspicuously persistent at anthesis, as in *P. bracteopadus*, *P. jenkinsii*, *P. persica*, *P. racemopilosa*, and *P. taganei*.

Bracteoles are here defined as the structures that subtend flowers within *Prunus* racemes. They are brownish, whitish to pale green, densely brown to white hairy or glabrescent to glabrous, and usually caducous. They are always present in the young inflorescence, and their shape varies. They may be triangular, boat-shaped, elliptic, ovate to semi-circular, flabellate to leaf-like, and concave or flat. The apex can be obtuse, acute, or with 3-lobes; their margin varies from entire to serrate.

Bracts sometimes proved taxonomically crucial for this study for species with showy or large flowers, as found in the subgenus Cearasus. I found that many *Prunus* species could be separated by the bract's shape, size, and number or by the presence or nature of the involucral bracts in the inflorescence. Bracteoles have only been observed in young inflorescences. They are easily observed in living plants. However, they are usually caducous and hardly ever seen on pressed herbarium specimens, and the labels on sheets rarely provide this information.

Figure 2.5. Morphological diversity of inflorescences and flowers of *Prunus* species: **A**, solitary flower, shortly pedicellate, *Prunus persica*; **B**, 1–2-flowered, pedicellate, *P. mume*; **C**, fascicle, 2–5-flowered, pedicellate, *P. domestica*: **D–F**, solitary and short racemes or corymbs, few up to 10 flowered; **D**, *P. serrata*; **E** and **F**, *P. cerasoides*: **G**, long racemes, rachis base usually with leaves, *P. padus*: **H–K**, solitary short racemes, rachis base leafless; **H**, *P. maingayi*; **I**, *P. bokorensis*; **J**, *P. taganei*; **K**, P. "yalaensis": **L–N**, solitary long raceme; **L**, *P. latifructa*; **M**, *P. undulata*; **N**, *P. vandebultii*: **O–Q**, racemes, 1–6 in the bundle; **O**, *P. indochinensis*; **P**, *P. javanica*; **Q**, *P. zippeliana*; **R–T**, panicle-like racemes; **R** and **S**, *P. koehnei*; **T**, *P. kaengkrachanensis*. Photographs: All by S. Rueangruea except for **E** by W. Keawbang; **I** and **J** by S. Tagane; **L** by N. Tetsana; **N** and **Q** by M. Van de Bult; **P** by S. Ruksue; **R** and **S** by S. Kraithongsuk; and **T** by U. Veesommai.

2.3.7 Flowers

The flower is extraordinarily uniform throughout the genus *Prunus*. Variation is mainly found in the hypanthium's shape and dimensions of the perianth segments, the number of stamens, and the indumentum of the hypanthium, perianth, and pistil **(Figure 2.5).**

Flowers are usually bisexual or maybe polygamo-dioecious, sometimes unisexual, or imperfect, with functionally male flowers with a slight to minute pistillodium such as in many species of sect. *Mesopygeum*, e.g., in *P. latifructa*, *P. indochinensis*, *P. koehnei*, *P. poilanei*, and *P. polystachya*. Functionally, male flowers are found less commonly in the sect. *Laurocerasus*, such as in *P. undulata*. Male and bisexual flowers are mainly of the same raceme or at least one on the same twig. Still, some herbarium specimens have only male flowers, such as *P. gazelle-peninsulae* (Kalkman, 1965).

Flowers usually open with mature leaves, though they can open before or simultaneously as new leaves. The flower color is generally white but can be pale yellow, pink, reddish-pink, or red. The flower usually has a faint, unpleasant smell or is sometimes fragrant. The pedicels vary from 0–30 mm long and are occasionally sessile, as in *P. salicina*. They are usually short to long pedicellate; sometimes, the pedicel elongates at anthesis as in subg. *Cerasus*, e.g., *P. cerasoides*, *P. pseuocerasus*, *P. trichantha*, *P. trichostoma*, and *P. serrula*. The pedicels are usually slender or sometimes short/ stout, as in *P. persica*. They vary in indumentum but are usually densely covered with grey or brown pubescence or are glabrescent to glabrous.

The hypanthium is a cup-shaped extension of the floral axis usually formed from the union of the calyx, corolla, and androecium's basal parts, commonly surrounding or enclosing the pistils. It is formed by the fusion of the base of perianth and stamens and is campanulate, obconic, urceolate, broadly cup-shaped, cyathiform, or funnel-shaped in subg. *Amygdalus*, *Ameniaca*, and *Laurocerasus*. The hypanthium of *Maddenia* and *Padus* is often tubular, as is also the case in some species of subg. *Caerasus*. The outer surface may be anything from glabrous to densely hairy. The inner surface is usually glabrous. There are many species, however, with a ring of hairs around the insertion of the ovary. The inner surface of the hypanthial cup is lined with a nectary. For an anatomical description of the hypanthium in *P. Laurocerasus*, see Radtke (1926).

The perianth is here defined as the structure that collectively includes the calyx and corolla of a flower, especially when they are similar in appearance. The petals are sometimes not distinctive. They are sometimes slightly different, indistinguishable from sepals, perianth, or somewhat distinct. The segments usually number 5–12. They are occasionally subequal or unequal but rarely somewhat regularly differentiated by their shape, such as sepals and petals (or undifferentiated in shape and size), as found in subg. *Padus*, in *P. gongshanensis*, *P. himalayana*, and sometimes as in subg. *Laurocerasus*, sect. *Mesopygeum*, e.g., *P. bokorensis*, *P. indochinensis*, *P. lancilimba*, *P. koehnei*, *P. latistipulacea*, *P. maingayi*, and *P. ridleyi*.

Calyces are the outer perianth whorl, the collective term for all the flower sepals. The calyces in *Prunus* are gamosepalous, with the basal parts of the calyx fused to the hypanthium, and the apex of the calyx is lobed. The wild species usually have 5(–12) lobes that can be regular or subregular, with the 5 lobes equal to subequal. The calyx has various shapes and sizes, and its margins sometimes have irregular dentation, such as in *P. cerasoides* and *P. campanulata*. Calyx lobes are usually narrowly triangular, elliptic-ovate to ovate-oblong to suborbicular. They may be greenish to reddish, such as in *P. persica*. They range in size and can be minute, moderate to large, and sometimes extended at anthesis. The calyx lobe's symmetrical patterns are unequal to subequal; the apex can be acuminate, acute, obtuse, and sometimes somewhat glandular-fimbriate; the margins vary and are usually entire, occasionally ciliate, or marginal glandular serrate. The base is generally truncated or oblong, with the calyx adnate at the base on the hypanthium rim. Calyx lobes are usually separate arrangements, sometimes valvate or imbricate in the bud (e.g., as found in *P. campanulata*). They can be spreading, slightly reflexed, or incurved when mature. They are usually deciduous or persistent on fruit, shortly hairy or glabrescent to glabrous outside, inside, or with hairs on the bottom inside. The calyx characters are of great taxonomic importance, but they are variable and should be used with great care and not alone for generic delimitation.

The corolla is the collective name of all flower petals and the inner perianth whorl. The corolla lobe is one of the free portions of a corolla of united petals. The perianth of Asian *Prunus* is usually showy, and the calyx is distinctly different from the corolla, as in almost all of the subgenera, e.g., subg. *Amygdalus*, *Armeniaca*, *Cerasus*, *Laurocerasus*, *Padus*, and *Prunus*, and in the economic crop species, e.g., *P. mume*, *P. persica*, *P. pseudocerasus*, and *P. salicina*, or in many ornamental trees, e.g., *P. campanulate*, *P. cerasoides*, and *P. serrula*.

In subgenus *Laurocerasus*, the calyx distinctly differs from the corolla lobes in all sect members. *Laurocerasus* while sect. *Mesopygeum* can be divided into 2 groups using the difference between the calyx and corolla. Firstly, the calyx is distinctly different from the corolla or a slightly distinct whorl as in *P. apiculata*, *P. kaengkrachanensis*, *P. latifructa*, *P. poilanei*, *P. polystachya*, *P. santisukii*, and *P. tagane*. Secondly, the calyx and corolla of a flower are similar in appearance (perianth) as found in *P. arborea*, *P. bokorensis*, *P. kalkmanii*, *P. ferrea*, *P. indochinensis*, *P. lanceifolia*, *P. lancilimba*, *P. latistipulacea*, *P. maingayi*, *P. koehnei*, and *P. ridleyi*.

The corolla lobes or petals are usually yellowish-white, white, or pink, and sometimes purple-veined or rarely greenish. Wild species' flowers are often not showy like their conspecific cultivated counterparts, which may have distinct and relatively large petals as in many species, for example, subg. *Cerasus*. The basic pattern is of two 5-merous whorls of perianth segments. Petals usually spread, drooping, or upright; the margins are concave or recurved. The petals are accessible on the hypanthium rim, 5 (–0) -merous or forming a perianth, and may consist of irregular segments 5–10(–14). They vary from small to large, 0.3–15 mm long by 0.3–11.5 mm wide, and can be unequal to subequal. Petals are usually 1–6 times the length of the calyx lobes and adnate on the hypanthium rim, sinus lobes, or between the calyx lobes. They may be broadly ovate, elliptic-oblong, triangular, orbicular, sometimes with 3–8 nerves, usually sessile or unguiculate 1–3 mm long. Their apex can be acute, obtuse, retuse, or slightly erose. The petal margins are typically glabrous, entire to sparsely hairy, or are sometimes erose. The petal base can be cuneate, truncated to rounded, or sometimes shortly unguiculate, e.g., subg. *Amygdalus*, *Armeniaca*, *Cerasus*, *Padus*, *Prunus*, and some members in *Laurocerasus*. Petals are usually alternate, or sometimes opposite, and the calyx lobes, if there is more than one whorl, are found in ornamental plants or cultivars. The indumentum varies; petals can be hairy, glabrescent, or glabrous outside and sometimes hairy, glabrescent, or glabrous inside.

The number of stamens varies, ranging from 10 to 85. A fixed number of 10 (as, e.g., in *P. buergeriana* of subg. *Padus*) has been considered primitive (Kalkman, 1965), but small numbers are also found within subg. *Laurocerasus*. The stamens are usually in 1 to 3 or many series and usually extended, equal, or longer than the petal length. The filaments are filiform, typically white or reddish to pink, unequal, and free. The stamens from herbarium material are protogynous, with the stigma receptive before the anthers release pollen. The stamens are still incurved when the style has grown to its full length and is exerted above the bud (Kalkman, 1965). The filament varies from 1 to 12 mm long and is usually glabrous or sometimes sparsely tomentose on the lower half, e.g., as found in *P. indochinensis*, *P. koehnei*, and *P. ridleyi*. The anthers are 2 lobed, oblong to globose, 0.2–1 mm long, basifixed, longitudinally split, and usually white, pale yellow to brown.

There is usually one carpel, rarely 2 or more. The ovary is superior, free, glabrous, sparsely or densely hairy. It is rarely more densely hairy or sometimes villose. In some species, however, the variational range in ovary hairs is high and of limited taxonomic value. The point of insertion of the ovary usually has a ring of hairs, sometimes with some long hairs higher up, often on one side only. The ovary is 1- or occasionally 2-locular, sometimes developing into twin fruits, glabrous to pubescent, 2-ovulate per locule, pendulous, and enclosed in the hypanthium. A single terminal style is elongate, filiform, slender, or stout. It is 1.5–19.5 mm long and as long as, shorter, or longer than stamens. It is usually glabrous to sparsely hairy, e.g., as in subg. *Cerasus* such as *P. trichantha*. The stigma can be conspicuous enlarged, globose, capitate to sub-peltate, discoid, or unilaterally peltate.

2.3.8 Fruits

The infructescence is 0.1–30 cm long, glabrous to densely hairy, and one to many-fruited. Fruits are drupes (**Figures 2.6 & 2.7**) and are usually fleshy or (relatively) dry, as in *P. amygdalus* (almond, dry fruits, and dehiscent). They are typically indehiscent (usually not splitting) or dehiscent, splitting when ripe, found in almonds. They are sessile to stipitate up to 45 mm long, with lenticels present or absent.

Young fruits are green or yellowish to greenish-white. They remain green or turn black, and when mature or ripe, they turn dark purple, red, or yellow (cultivated).

The fruit's shape can be ellipsoid to ovoid, e.g., *P. cerasoides*, *P. serrula*; globose, spherical, or subglobular; *P. pygeoides*, *P. phaeosticta* in subg. *Laurocerasus*; transversely ellipsoid or sometimes didymous, e.g., almost all in sect. *Mesopygeum* (except for *P. lancilimba* and *P. oocarpa*, which have ellipsoid or ovoid fruits).

Fruits may be 0.5–7(–12) cm long and 1–8 cm wide, with an acute, obtuse, or retuse apex. Young fruits are glabrous or hairy (sparsely tomentose), and mature fruits are glabrous or hairy (sparsely tomentose). The exocarp is smooth, shiny, and ventral, usually with a longitudinal groove. The mesocarp is fleshy, succulent, sour or bitter tasting, white, pale green, with a red to yellow, generally smelling of bitter almonds. In most species, the endocarp is thick, hard, woody, and stone-like, but in some species, it is more or less bony and usually easy to break. Outside, the endocarp is generally glabrous, but in some species, it is densely hairy, e.g., in subg. *Amygdalus*, and *Armeniaca*. The endocarp inside is usually glabrous (**Figure 2.8**), but in some species, it has more or less dense indumentum, e.g., as found in species of sect. *Mesopygeum*, densely hairy as in *P. arborea*, *P. kaengkrachanensis*, *P. latistipulacea*, and sparsely hairy, e.g., as found in *P. koehnei*, *P. polystachya*, and *P. ridleyi*. The calyx in fruit is usually deciduous or sometimes persistent, e.g., as seen in *subg*., *Padus*, as in *P. buergeriana* (including *Prunus* perulata Koehne and *Prunus stellipila* Koehne. from China). The style of the fruit is absent or present and peaked (or the fruit is apiculate).

Figure 2.6. Morphological diversity of fruit shapes of *Prunus* species: **A–D**, oval; **A**, *Prunus persica*; **B**, *P. mume*; **C**, *P. salicina*; **D**, *P. domestica*: **E–F**, globose; **E**, *P. phaeosticta*; **F**, *P. pygeoides*: **G–O**, elliptic to oval; **G** and **H**, *P. cerasoides*; **I**, *P. jamasakura*; **J**, *P. phaeosticta*; **K**, *P. undulata*; **L**, *P.*

javanica; M, *P. zippeliana*; **N**, *P. vandebultii*; **O**, *P. lancilimba*. Photographs: **A–F** and **H–M** by S. Ruenangruea; **G** by W. Khambai; **N** by M. Van de Bult; **O** by Em Son.

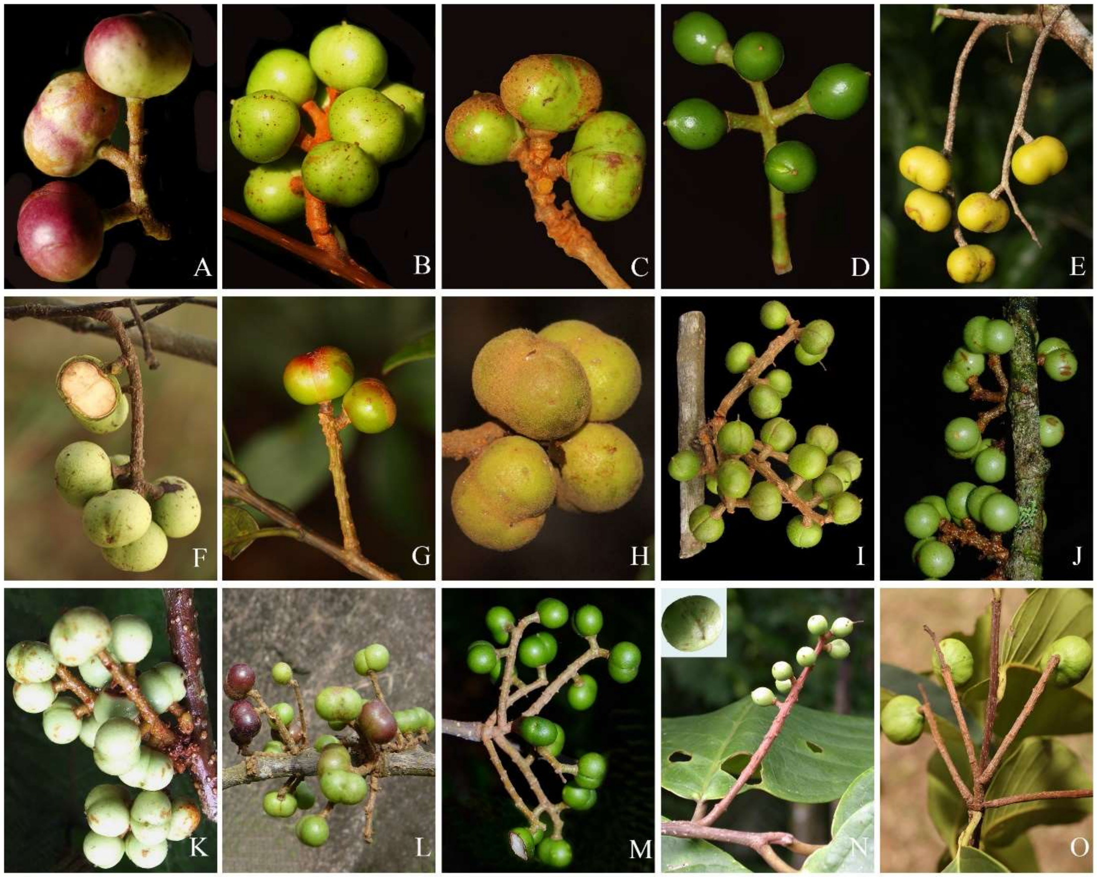


Figure 2.7. Morphological diversity of fruit shapes of *Prunus* species, transverse-ellipsoid; **A–C**, short solitary raceme; **A**, *Prunus maingayi*; **B**, *P. bokorensis*; **C**, *P. taganei*: **D–H**, solitary long raceme; **D**, *P. apiculata*; **E**, *P. latifructa*; **F**, *P. poilanei*; **G**, *P. hongiaoensis*; **H**, *P. latistipulacea*: **I–L**, 2–6 racemes in the bundle; **I**, *P. indochianesis*; **J**, *P. ferrea*; **K**, *P. arborea*; **L**, *P. ridleyi*: **M–O**, panicle-like; **M**, *P. koehnei*; **N**, *P. polystachya*; **O**, *P. kaengkrachanensis*. Photographs: **A**, **E**, **F**, **I–K**, and **O** by S. Rueangruea; **B–D**, **G**, and **H** by S. Tagane; **L** by A. Sinbumroong; **N** by M. Poopath.

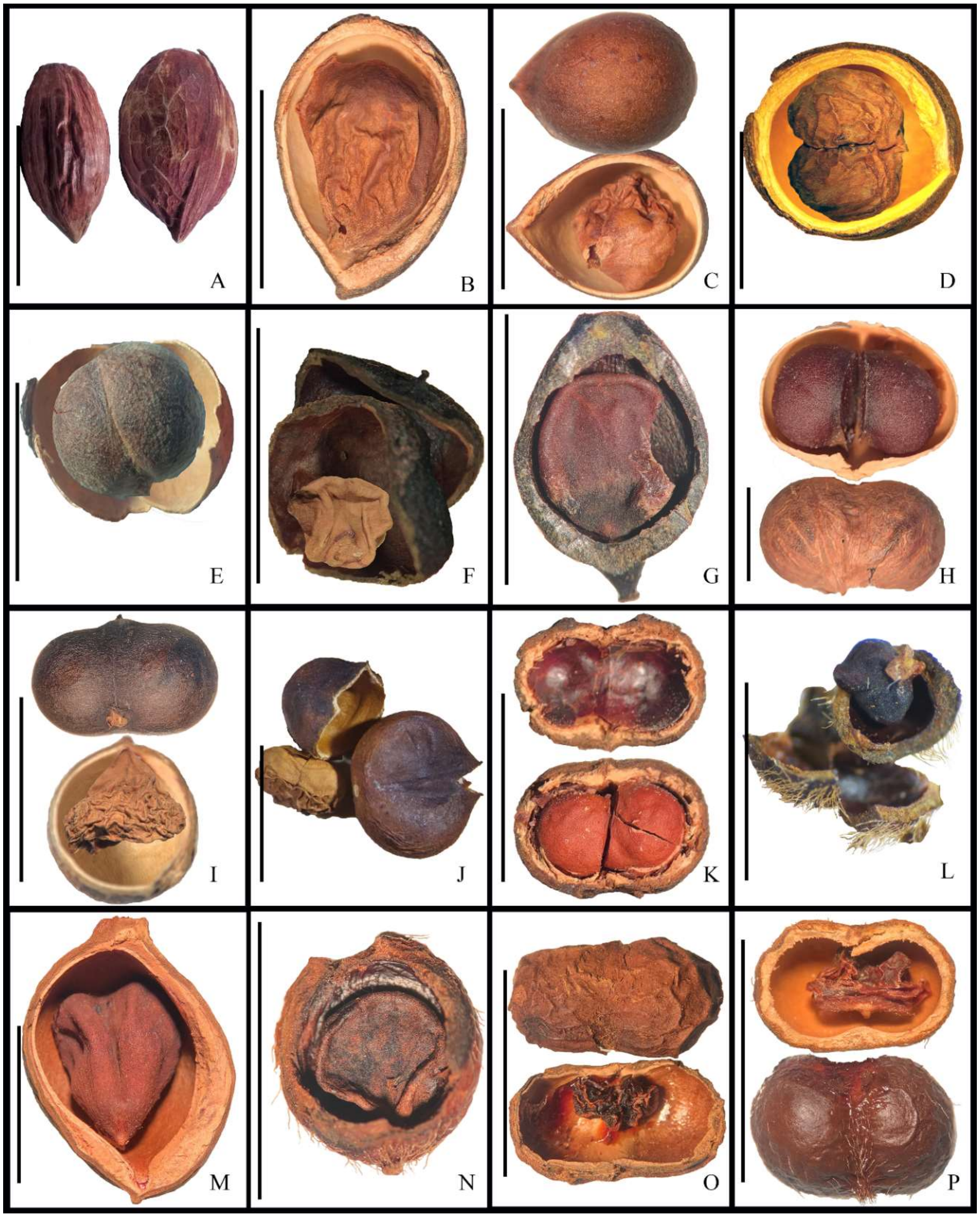


Figure 2.8. Morphological diversity of fruits, inside of endocarp and seed coat indumentum of *Prunus* species: **A–J**, all glabrous; **A**, *Prunus javanica*; **B**, *P. undulata*; **C**, *P. bokorensis*; **D**, *P. poilanei*; **E**, *P. maingayi*; **F**, *P. longistyla*; **G**, *P. apiculata*; **H**, *P. latifructa*; **I**, *P. taganei*; **J**, *P. willsonii*: **K–P**, endocarp and seed coat glabrescent; **K**, fruit glabrous, endocarp glabrescent, *P. koehnei*; **L**, fruits hairy, endocarp and seed coat glabrous, *P. kalkmanii*; **M**, fruits glabrous, endocarp and seed coat sparsely hairy at the end, *P. polystachya*: **N–P**, fruits hairy, endocarp and seedcoat glabrescent; **N**, *P. indochinensis*; **O**, *P. ferrea*; **P**, *P. ridleyi*. Photographs: **A**, **D**, **E**, **F**, **J**, and **L** by S. Rueangruea; **B**, **C**, **G**–**I**, **K**, **M**–**P** by T. Thananthaisong and K. Daonurai. Scale bars = 1 cm.

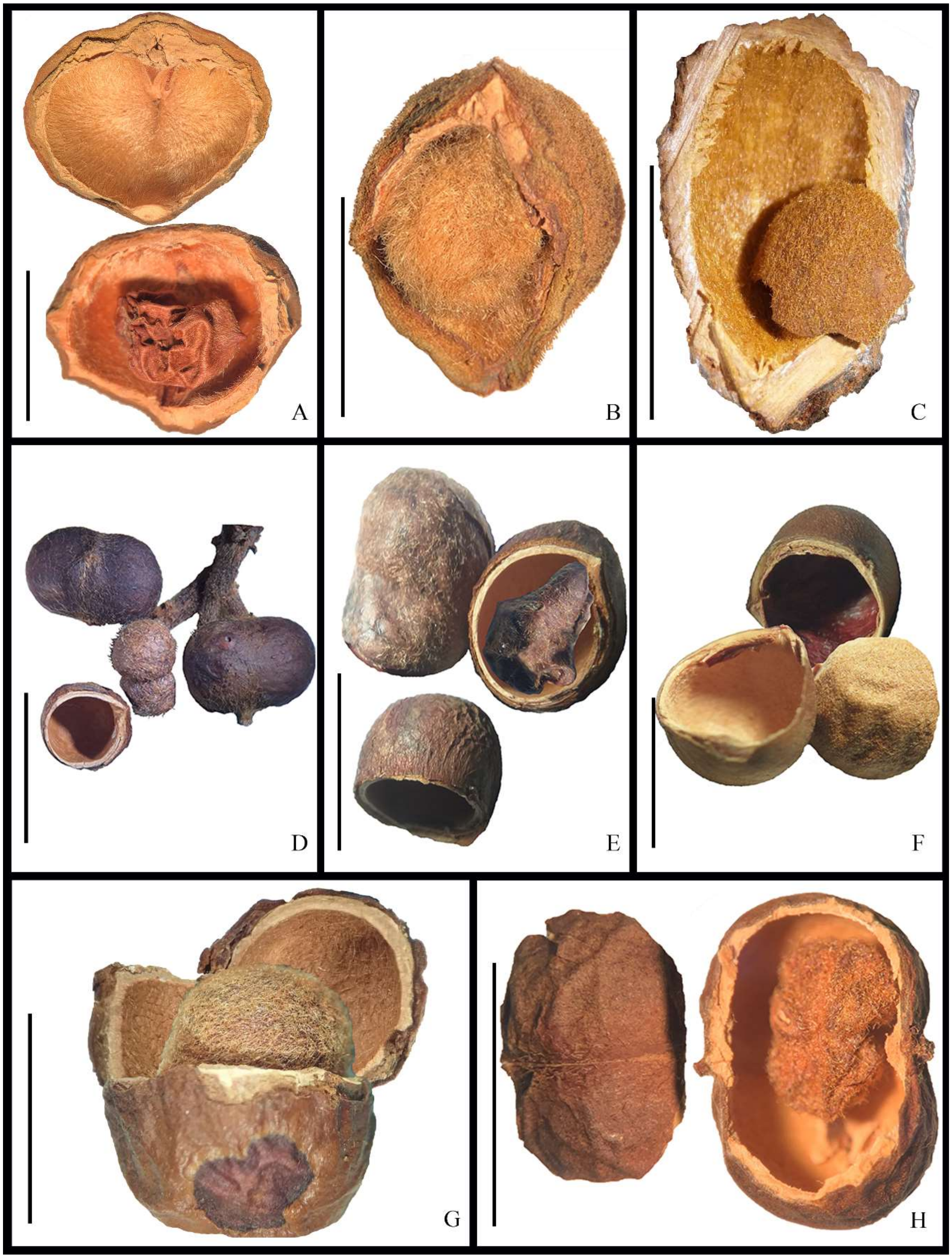


Figure 2.9. Morphological diversity of fruits, inside of endocarp and seed coat indumentum of *Prunus* species: **A–H**, all hairy; **A**, *Prunus kaengkrachanensis*; **B**, *P. latistipulacea*; **C**, *P. turneriana*, **D**, *P. ridleyi*; **E**, *P. topengii*; **F**, *P. grazell-peninsulare*; **G** and **H**, *P. areborea*. Photographs: **A**, **B**, and **H** by T. Thananthaisong and K. Daonurai; **C**, **D**, **E**, **F**, and **G** by S. Rueangruea. Scale bars = 1 cm.

2.3.9 Seeds

The fruit is usually 1(–2)-seeded, and the seed is cartilaginous to woody (stone), thin to thick and stiff, and is generally 2-valved, but in some species, it is 3-angled and swollen. The color is brown to whitish-brown. As the seeds are solitary, they have the same shape as the fruit and are usually transversely ellipsoid or didymous, e.g., almost all species in the sect. *Mesopygeum*. They are sometimes globose, e.g., as in *P. phaeosticta*, or slightly triangular, as found in *P. pygeoides*, oval to circular in cross-section, laterally slightly compressed on both surfaces, or laterally compressed, e.g., as in subg. *Amygdalus*: thick or thin, with the ventral suture somewhat obtuse and almost longitudinally furrowed on the ventral and dorsal sides. The seed coat is slim, usually glabrous, e.g., as in all subgenera, but sometimes sparsely to densely hairy, especially in some sect members. *Mesopygeum*, e.g., *P. arborea*, *P. kaengkrachanensis*, *P. latistipulacea*, and *P. ridleyi*. The seed coat surface is usually pitted. The base can be cuneate, obtuse, or rounded. The apex is obtuse and abruptly mucronulate. The seed is exalbuminous, and without endosperm, the embryo has thick, semi-globular cotyledons and a basal plumule.

2.4 Conclusions

Some essential characteristics are evident in *Prunus* plants but are sometimes not preserved in herbarium specimens, e.g., bracts and bracteoles, inner and outer bark, and stipules. Such characters should be recorded in the field to make the information available to botanists, as they are helpful for identification purposes. Additional vegetative organ characteristics, e.g., glands, stipules, and leaves, especially glands, are common in almost all members of *Prunus*. They can be found in various shapes and sizes on multiple plant parts. They can be taxonomically essential, aid species identification in fieldwork, or insufficient specimens of reproductive organs should be recorded in herbarium specimens. Such characteristics include the leaves' defoliation and the colour of ripe fruit. However, the essential characteristics for identifying *Prunus* species are the reproductive organs such as the calyx, corolla, stamen, ovary, and fruit because they appear to be less subject to environmental influence.

Chapter 3 Molecular phylogenetics of *Prunus*

3.1 Introduction

Since the 1980s, DNA sequencing has gained significant attention as a source of repeatable phylogenetically informative characters that can give less ambiguous information on the phylogeny of plant groups than other types of data, such as morphology or anatomy (Ritland & Clegg, 1987). Of the three plant genomes, mitochondrial DNA (mtDNA) has a prolonged nucleotide substitution rate (Wolfe et al., 1987). It is less commonly used as chloroplast DNA (cpDNA) or nuclear DNA (nuDNA) in phylogenetic analyses (CBOL Plant Working Group, 2009; Diekmann et al., 2012). However, Pervaiz et al. (2015) investigated the genetic diversity of *Prunus* genotypes using simple sequence repeat (SSR) markers targeting the chloroplast and mitochondria genomes. These results demonstrated high chloroplast and mitochondrial genome conservation among *Prunus* species. Several molecular phylogenetic studies have been conducted on *Prunus* (Bortiri et al., 2001; Lee & Wen, 2001; Shaw & Small, 2005; Bortiri et al., 2006; Wen et al., 2008; Chin et al., 2010, 2013, 2014; Liu et al., 2013; Hodel et al., 2021) and have supported a broadly defined *Prunus*, but most of these studies have not sampled species native to tropical regions well (Wen & Potter, in press). Chin et al. (2014) recommended a broader circumscription of *Prunus* (including a strongly supported *Amygdalus*, *Armeniaca*, *Cerasus*, *Laurocerasus*, and *Padus* group), which was further divided into 'racemose' and 'corymbose + solitary' clades. During the last ten years, molecular phylogenetic studies of the Rosaceae have supported both the monophyly of section *Mesopygeum* and its inclusion in the genus *Prunus* (Chin et al., 2013, 2014; Liu et al., 2013; Zhao et al., 2018).

The relationships within *Prunus* and between the Asian members and those in Europe, South America, and the New World are poorly understood. Significantly, the relationships within the subgenus *Laurocerasus* (Kalkman, 1965) in continental Southeast Asia must be better known. Zhang et al. (2017) highlight the importance of improving sequence alignment and using the appropriate substitution models in plastid phylogenomics. In their analysis, three subfamilies and 16 tribes were strongly supported as monophyletic, and their relationships were resolved and strongly supported at most nodes. Phylogenetic relationships between taxa from these regions have been suggested based on morphology (Zhao et al., 2018) and need to be tested using a molecular approach.

Phylogenetic relationships in the Rosaceae were studied in this chapter using the analysis of nucleotide sequence data from regions of the chloroplast genome, including the *psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN* regions. These regions have been used in previously published phylogenetic reconstructions of the Rosaceae (Potter et al., 2007a; Zhao et al., 2018). Moreover, they were chosen to allow us to compare and combine information already studied in the *Prunus* species in Malaysia by Zhao et al. (2018). These regions were selected because of their rapid rate of evolutionary changes, which help assess relationships at lower taxonomic levels (Gielly & Taberlet, 1994; Kelleher et al., 2004; Potter et al., 2007a). The new data were analyzed under maximum likelihood using an online tool (CIPRES Science Gateway) (Miller et al., 2015) or MEGA X and with Bayesian inference using Mr. Bayes (Huelsenbeck & Ronquist, 2001). These analyses (molecular data alone and combined matrices with morphology and anatomy) reconstructed a phylogeny for Rosaceae and its related groups, and the existing classifications were assessed.

DNA was extracted from silica-gel-dried leaf pieces collected during the fieldwork. Herbarium specimens were utilized if no fresh or silica material was available. The modified CTAB method from Doyle (1987) was used for DNA extraction, following Hodkinson et al. (2007) and Hodkinson et al. (2010). Nuclear ITS and chloroplast markers (*e.g.*, *trnL-F*) were used initially, and other markers were tested before settling on the regions included in this thesis. Long-read plastid PCR combined with sequencing was tested for a subset of the taxa (following Hodkinson et al., 2019) but not continued because of insufficient amplification.

The nuclear gene region, *ETS,* was chosen as a target region for sequencing in this chapter because it had been used successfully by Cho et al. (2014) and Zhao et al. (2018) for phylogenetic studies in this group. Nuclear ribosomal ITS was also tested but not continued in this study. Four chloroplast regions were also sequenced, namely the *psbA-trnH* (Sang et al., 1997); the intergenic region, the *rpl16* intron, and the *rps16* intron have been used successfully by Shaw and Small (2004), and *trnC-petN* intergenic region (Lee & Wen, 2004) because they had also been shown to be phylogenetically informative by Zhao et al., 2018; Wen & Potter (in press) respectively.

From March 2nd to May 17th, 2019, I undertook fieldwork in Thailand. Before field collection, I consulted the BRAHMS database (2017), which provides an integrated management system for herbaria. Approximately 400 specimen data records from BKF were analyzed. This evidence highlighted two dominant periods of flowering per year: March and May and September and December. This information was essential for effective field collection in Thailand and other continental Southeast Asian countries.

Thailand's study areas included Cambodia, Laos, Myanmar, and Vietnam. The Malay Peninsula and the other Malaysian regions were excluded because an account of the family in this area had already been published (Kalkman, 1993; Zhao, 2018). The continental taxa are different from the Malaysian taxa, poorly known, and must need revision. However, specimens and literature from the surrounding regions were also studied for comparison.

This chapter aimed to study the phylogenetics of *Prunus* species included in this thesis and those centered on Southeast Asia. More specifically, it aimed to:

- Clarify the phylogenetic placement of continental Southeast Asia and Thai *Prunus* species based on molecular analysis of nuclear ETS and a combination of plastid gene regions.
- Assess the infrageneric classifications of *Prunus*, especially subgenus *Laurocerasus*, section *Laurocerasus,* and sect. *Mesopygeum.*

- Test nuclear and plastid (chloroplast) gene regions for DNA barcoding applications in *Prunus* and provide new sequences for species identification.

Table 3.1 Voucher information for the ingroup taxa and outgroup sampled and their country of origin. GenBank number is provided for the outgroup.

Taxa	Voucher	Country	Code	ETS	psbA-trnH	rpl16	rps16	trnC-petN
P. mume	SR248	Thailand	Ame_mumeSR248	1	1	1	1	-
P. persica	SR133	Thailand	Amy_persSR133	-	1	1	1	-
P. cerasoides	MY5714	Myanmar	Cer_ceramajMY5714	1	1	1	1	1
P. cerasoides	5474	Thailand	Cer_cerasoi5474	1	1	1	1	1
P. pseudocerasus	SR246	Thailand	Cer_pseudoSR246	1	1	1	1	1
P. crassistyla	7178	Vietnam	Lau_crassi7178	1	1	1	1	-
P. fordiana	L2773	Laos	Lau_fordbalaL2773	1	1	1	1	1
P. fordiana	L3718	Laos	Lau_fordL3718	1	1	1	1	1
P. javanica	5833	Thailand	Lau_java5833	1	1	1	1	1
P. phaeosticta	5501	Thailand	Lau_phae5501_DIN	1	1	1	1	1
P. phaeosticta	V9051	Vietnam	Lau_phaeV9051	1	1	1	1	1
P. pygeoides	5476	Thailand	Lau_pygeoi5476_Tak	1	-	1	1	1
P. javanica	SR251	Thailand	Lau_suddeeSR251	1	1	1	1	-
P. vandebultii	SR245	Thailand	Lau_vandebSR245	1	1	1	1	1
P. undulata	187	Thailand	Lau_undula187	-	1	1	1	1
P. zippeliana	1225	Japan	Lau_zipp1225_JP	1	1	-	1	1
P. zippeliana	SR255	Thailand	Lau_zippSR255_TPP	-	1	1	1	1
P. arborea	SR224	Thailand	Mes_arboreSR224_Hala	1	1	1	1	1
P. ferrea	T4252	Thailand	Mes_ferreaT4252	1	1	1	1	1
P. hongiaoensis	V9338	Vietnam	Mes_hongV9338	1	1	1	1	1
P. indochinensis	7322	Cambodia	Mes_indoch7322	1	1	1	1	1
P. indochinensis	L3298	Laos	Mes_indochL3298	1	1	1	1	1
P. kaengkrachanensis	SR254	Thailand	Mes_kaengSR254	1	1	1	1	1
P. kalkmanii	SR228	Thailand	Mes_kalkmaSR228	1	1	1	1	1
P. latifructa	5480	Thailand	Mes_latifr5480	1	1	1	1	1
P. latifructa	SR242	Thailand	Mes_latifSR242	1	1	1	1	1
P. maingayi	SR238	Thailand	Mes_maingSR238_PY	1	-	1	1	1
P. polystachya	SR230	Thailand	Mes_polystSR230	1	1	1	1	1
P. ridleyi	SR252	Thailand	Mes_ridleyMY433	-	1	-	1	-
P. ridleyi	SR252	Thailand	Mes_ridleySR252	1	1	1	1	1
P. taganei	V9337	Vietnam	Mes_taganeV9337	1	1	1	1	1
P. "yalaensis"	SR233	Thailand	Mes_yalaeSR233	1	1	1	1	1
Outgruop_*Pyrus communis*				MN577903.1	JQ390743.1	DQ860442.1	DQ848708.1	JQ391855.1

3.2 Materials and methods

3.2.1 Taxonomic sampling

In this study, we used the treatment of *Prunus* in continental Southeast Asia as it appears in various floras, e.g., Kalkman (1965; 1993), Vidal (1968; 19970), and Lu et al. (2003) to guide our sampling strategy. We sampled leaves from 250 plant accessions in total, of which 96 comprised 34 species in 4 genera as follows: *Armeniaca* (1), *Amygdalus* (1), *Cerasus* (2), *Padus* (1), and 2 sections: *Laurocerasus* (9) and *Mesopygeum* (*Pygeum*) (21), from throughout their geographic range and representing as many elements as possible of morphological diversity. *Pyrus communis* was selected and sampled as an outgroup as it is phylogenetically separate from *Prunus* (Mekrini & Thongam, 2023). Access information is provided in Table 3.1, which includes 1 outgroup species from GenBank data.

A total of 236 samples were collected in natural forests or other field situations during my fieldwork in Cambodia, Laos, Myanmar, Thailand, Vietnam, and Japan, where I was supported by Dr. Shuichiro Tagane and Dr. Hironori Toyama under Professor Tetsukazu Yahara Kyushu University. Clean, young, healthy, fresh leaves were collected and dried in silica gel for preservation following Chase and Hills (1991). All samples were preserved at –30°C for DNA extraction. Voucher specimens were deposited in the herbaria shown in **Table 2.1** (e.g., Bangkok Forest Herbarium (BKF), Kyushu University, Fukuoka (FU), and in the School of Botany herbarium, Trinity College Dublin (TCD)). The samples were generally identified using the classification of Kalkman (1965, 1993), Lingdi et al. (2003), and Wen and Potter (in press). Overall, a narrow species circumscription was used in the molecular analysis.

3.2.2 DNA extraction

DNA extraction could be problematic if the herbarium specimens are old and could also be influenced by the characteristics of individual species. I tested different DNA extraction methods to determine the best protocol, especially the hot CTAB method (modified from Hodkinson et al., 2007; Hodkinson et al., 2010). I experimented with other conditions by varying several factors:

- Sample origin: herbarium specimens, dried in the field with silica gel beads, fresh material
- Species specimens Rosaceae, some species from the sister families, *e.g.*, Cannabaceae, Elaeagnaceae, Moraceae, Rhamnaceae, Ulmaceae, and Urticaceae. In addition, some family Chrysobalanaceae that were ever included in Rosaceae were used for DNA extraction.
- Sample size: 0.005 g to 0.01 g (dried weight)
- Purification methods: with or without mercapto-ethanol and PVP (to remove secondary metabolites). I also tested another DNA extraction method with the DNeasy Plant Mini kit QIAGEN (2021). The best result regarding total DNA quantity and quality was obtained with fresh material

and silica gel samples. The DNA was degraded on all herbarium specimens. The DNeasy kits are more expensive and less flexible than the CTAB method, but they yield results much faster.

Following the above experimentation, I extracted most of the DNA following a protocol adapted from the one developed by Hodkinson et al. (2007) as outlined below:

1. 3–12 mg of dry plant material was ground in a mixer mill with stainless steel beads for 4 minutes at a frequency of 20 Hz.
2. The leaf powder was placed in 750 µl of 2% CTAB isolation buffer (100 mM Tris-HCL pH 8.0, 1.4 M NaCl, 20 mM EDTA (Na ethylene-diamine-tetra-acetate), 2% w/v CTAB (hexadecyl-trimethyl-ammonium bromide)) which had been pre-heated at 65°C, then left to incubate for 30 minutes at 60–65°C in a water bath.
3. A 750 µl solution of 24 parts chloroform for one part isoamyl alcohol was added to the CTAB + leaf powder mixture.
4. The solution was agitated for at least 30 minutes on an orbital shaker at 250 revolutions/minute and then centrifuged at 13,000 rpm for 15 minutes.
5. The supernatant (containing the DNA suspended in CTAB) was transferred to a 1.5 ml microcentrifuge tube, to which 500 µl of isopropanol (2/3 of the volume of supernatant) was added. It was left to precipitate the DNA at –20°C overnight.
6. The sample was centrifuged at 13,000 rpm for 15 minutes, and the solution was discarded, leaving the DNA pellet at the bottom of the tube.
7. The pellet was cleaned with ethanol by adding 750 µl of 70% ethanol to the tube, centrifuging at 13,000 rpm for 15 minutes, and then discarding the ethanol. This step was done twice.
8. To remove any trace of ethanol, the tubes were dried (tubes open, ~15 min)
9. The DNA pellet was then resuspended in 60–200 µl of TE buffer (10 mM Tris-HCL, 1.0 M EDTA) and then incubated for 30 minutes at 65°C in a water bath to ensure the DNA was entirely suspended.
10. The total DNA (tDNA) thus obtained was placed in a freezer at –80°C for long-term storage.

3.2.3 DNA cleaning

Before PCR, the tDNA was cleaned with AMPure XP™ beads (solid phase reversible immobilization paramagnetic beads, Beckman Coulter) using the following protocol:

1. The beads and tDNA were placed at room temperature for at least 30 minutes.
2. An equal volume of tDNA and beads (50 µl each) was established in a PCR plate's wells and then thoroughly mixed with a micropipette.

3. The mixture was left to rest for at least 5 minutes, allowing the DNA fragments to bind to the beads.
4. The PCR plate was then placed on a magnetic rack until all the beads had migrated to the side of each well and the solution was evident (5–55 minutes, depending on the viscosity of the tDNA solution).
5. The liquid phase was discarded with a micropipette, and the beads were cleaned with 200 µl of 80% ethanol. This step was done twice.
6. The beads were left to dry for 5 minutes to allow ethanol to evaporate without completely desiccating the beads (which would prevent DNA from being released at the next step).
7. The PCR plates were removed from the magnetic rack, and 50 µl of Buffer EB™ (10 mM TE elution buffer, Qiagen) was added to each well and thoroughly mixed with a micropipette.
8. The PCR plate was left at room temperature for 20 minutes to allow for DNA to elute into the buffer, then placed back on the magnetic rack until all the beads had migrated to the side of each well and the solution was evident (5 minutes to overnight depending on the viscosity of the solution).
9. The elution buffer containing the clean tDNA was transferred to DNA LoBind™ tubes (Eppendorf) and then placed in a freezer at –80 °C for long-term storage.

3.2.4 DNA amplification using PCR

Primers

Primers for amplification and sequencing were "Rosf" and "IGS6" for the nuclear ribosomal *ETS* region (Cho et al., 2014), and the primers for the nuclear ribosomal *ITS* region followed Hodkinson et al. (2018). For the chloroplast DNA regions, "psbAF" and "trnHR" were used for the *psbA-trnH* intergenic region (Sang et al., 1997), "F71" and "R1516" for the *rpl16* intron, "rps16_F" and "rps16_R" for the *rps16* intron, (Shaw & Small, 2004), and "trnC" and "petN1R for the *trnC-petN* intergenic region (Lee & Wen, 2004). Previous studies have shown these primers to work well in *Prunus* (Zhao, 2018).

The PCR amplifications were conducted using the following protocol:

1. A master mix was prepared by adding 12.5 µl of BioMix™ solution (ready-to-use reaction solution containing a buffer, the four deoxynucleoside triphosphates (dNTPs), *Taq* DNA polymerase and Mg^{2+} at 5 mM; Bioline) and 0.25 µl each of the forward and reverse primers (at a concentration of 20 pmol/µl) to 10 µl of ultra-pure water per sample.
2. For each sample, 24 µl of the master mix and 1 µl of tDNA were placed in a PCR tube. This quantity was modified for problematic samples to 2 µl of tDNA and 23 µl of master mix.

3. The PCR tubes were quickly spun down in a centrifuge (until they reached 1,000 rpm) to ensure everything was at the bottom of the tubes.
4. The PCR tubes were then placed in a thermocycler using the cycling parameters presented in Table 10.
5. PCR products were kept in a freezer at -80°C for long-term storage.

Table 3.1 PCR cycling parameters used for the different sets of primers. Note that some sequences were obtained for ITS but insufficient for the subsequent phylogenetic analyses (so they are omitted further here); however, they are used in DNA barcoding applications.

Primers	Steps											
	Premelt		Denaturation		Annealing		Extension		Final extension		Cycles	Soak
	(°C)	(mins)	(°C)	(mins)	(°C)	(mins)	(°C)	(mins)	(°C)	(mins)	(No.)	(°C)
ITS	95	1.30	95	0.30	55	0.30	72	1.00	72	7.00	30	4
ETS	95	1.30	95	0.30	55	0.30	72	1.00	72	7.00	30	4
psbA-trnH	95	1.30	95	0.45	55	1.00	72	1.00	72	7.00	30	4
rpl16	95	1.30	95	0.45	50	0.45	65	1.00	72	7.00	30	4
rps16	95	1.30	95	0.30	56	0.30	72	1.00	72	7.00	30	4
trnC-petN	95	1.30	95	0.45	50	0.45	65	1.00	72	7.00	30	4

3.2.5 PCR product cleaning

To remove residues of primers and dNTPs, the PCR products were cleaned using the following ExoSAP^{TM} protocol (ThermoFisher). From this, 3 µl of cleaned PCR product is usually sufficient for performing a DNA sequencing reaction using BigDye terminator chemistry. This protocol can be Adapted by reducing the ultra-pure MiliQ water volume added to the ExoSAP master mix should a smaller PCR volume be used.

1. An ExoSAP master mix was prepared by combining 0.3 µl of exonuclease I (20 units/µl; New et al.), 2 µl of alkaline phosphatase (1 unit/µl; Roche), and 2.7 µl of ultrapure water per sample.
2. An equal amount of PCR product and master mix (5 µl) was placed in PCR tubes, which were quickly pulsed in a centrifuge (until it reached 1,000 rpm) to ensure everything was at the bottom of the tubes.

3. The PCR tubes were incubated in a thermocycler at 37°C for 30 minutes and 82°C for 20 minutes.
4. PCR products were kept in a freezer at -80°C for long-term storage.

3.2.6 Sequencing

The DNA concentration of the PCR products was measured with a Nanodrop™ microvolume UV spectrophotometer (ThermoFisher). The samples were diluted to 10 ng/µl (when necessary) before being sent to Source BioScience for Sanger sequencing on an Applied Biosystems Automated DNA sequencer.

3.2.7 Analysis

Sequences assembly, alignment, and clean-up

Sequences were selected for assembly and alignment only if both forward and reverse sequences were successfully obtained. Samples for which only one of the two was retrieved were considered less reliable and were not included in the analysis because the beginning and the end of sequence traces often accumulate errors, and proofreading against the other sequence was impossible.

For each DNA region and each sample, the forward and reverse sequences were assembled using Geneious Prime (Zhao et a. 2016; Biomatters Ltd., version 2023.0.4), using the De Novo Assemble function, and then checked carefully by eye. The obtained consensus sequences were first aligned using the Global Alignment function, available in global and local variants. A global alignment ensures that every part of two sequences is aligned. The alignments were then trimmed to the same length for all samples and checked manually by looking at the traces and sequences to ensure the correct bases had been inferred and optimize the gaps.

Alignments were undertaken for a nuclear *ETS* region and four chloroplast regions (*psbA-trnH, rpl16, rps16,* and *trnC-petN*). Each plastid region was analyzed separately and combined in a concatenated matrix. Then, both nuclear and plastid alignments were combined into a third matrix for total evidence analysis. In addition, the combined data lacking in some taxa were treated as missing.

The best-fit nucleotide substitution model was assessed for each alignment in MEGA X (Kumar et al., 2018, version 10.1.8). The best-fit model for *ETS* was K2P+G (Kimura 2 parameters, with a variation of evolutionary rates among sites estimated from a gamma (+G) distribution) (Kimura, 1980). For *psbA-trnH* and *rpl16*, the best-fit models were T92 (Tamura 3 parameters with a uniform rate of variation among sites) (Tamura, 1992). For *rps16* and *trnC-petN*, the best-fit models were T92+G (Tamura 3 parameters with a constant rate of variation among sites estimated from a gamma distribution). The best nucleotide substitution model for the combined alignment was T92 (Tamura 3 parameters with a uniform rate of variation among sites).

The phylogenetic relationships between the taxa and the seven datasets were investigated through Bayesian inference (BI) and maximum Likelihood (ML) analysis methods. Both methods were applied to the combined datasets, and only ML was used for the single gene region analyses. The Bayesian inference treats the parameter values as random variables with probability distributions, while ML assumes they are fixed and unknown constants. Bayesian inference calculates the posterior probability distribution of the parameter values, while ML calculates the values that maximize the likelihood function (Ronquist et al., 2012). The Bayesian interface analyses were performed using a Markov chain Monte Carlo (MCMC) sampling method in MrBayes (Ronquist et al., 2012, version 3.2.7a). All the analyses were run for 2,000,000 generations, with convergence diagnostics calculated every 1,000 cycles and trees sampled every 100 cycles (ensuring the standard deviation of split frequencies was below 0.01 and 25% of trees were discarded as burn-in; following guidelines in MrBayes handbook, Ronquist et al., 2012). The models of molecular evolution were selected using the Akaike Information Criterion (AIC). Bayesian analysis was undertaken using MrBayes v. 3.2.7a (Ronquist et al., 2012) through the CIPRES Science Gateway (http://www.phylo.org/; Miller et al., 2015). A 50 % majority rule consensus tree was produced to visualize the posterior probabilities (PP). For *ETS*, the nucleotide substitution model was set as K2+G. The T92 model cannot be implemented in MrBayes, so the best next-fit model, HKY, was used for *psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN*. A partitioned analysis combed all alignments, *ETS, psbA-trnH, rpl16*, *rps16*, and *trnC-petN*, and set the nucleotide substitution model as HKY.

The ML analyses were aligned in MEGA X (Kumar et al., 2018, version 10.1.8). The analysis was performed using RAxML HPC2 Workflow on XSEDE (v. 8.2.12) on the CIPRES Science Gateway (Stamatakis, 2014). In addition, the individual and the concatenated dataset files were saved in Phylip format and uploaded to the CIPRES site. The search was conducted for the best-scoring ML tree in a single program run under the GAMMA Model of rate heterogeneity. All generated trees of the analyses with branch lengths and bootstrap values were viewed with FigTree v. 4.0 (http://tree.bio.ed.ac.uk/software/figtree/; Rambaut, 2010).

3.3 Results and discussion

The success of DNA extraction and amplification from herbarium materials could have been improved. Unsurprisingly, the DNA was often highly degraded, with fragments commonly < 500 bp long. However, many silica-dried samples also yielded similarly degraded DNA. Small quantities of leaf material (5–10 mg dry weight) for DNA extraction yielded better amplification than larger leaf fragments (10–15 mg). DNA extraction from dry herbarium specimens proved very difficult. I found it difficult to get good-quality DNA, and it was also challenging to clean or purify it. Many factors could have influenced DNA extraction success, including latex, carbohydrates, or secondary metabolites (Hodkinson et al., 2007).

Out of 96 samples, forward or/ and reverse DNA sequences were successfully obtained for 28 samples (representing 24 taxa) for nuclear *ETS* and *trnC-petN*, 29 samples (23 taxa) for *psbA-trnH*, 29 samples (23 taxa) for *rpl16*, 31 samples (23 taxa) for *rps16*, 26 samples (23 taxa) for *trnC-petN*, and 30 samples (representing 26 taxa) for all combined (**Appendix 1**). The sequencing of nrITS did not produce consistent results and needs further examination.

After trimming, the length (bp) of the final alignments for *ETS*, *psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN* was 569, 443, 740, 877, and 1,091 bp, respectively. The combined chloroplast matrix and nuclear and plastid region analysis matrix were 3,136 bp and 3,677 bp, respectively.

3.3.1 Phylogenetic reconstructions

Results of the single gene region analyses of nuclear ETS and plastid DNA regions (*psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN*) are shown in **Figures 3.1 to 3.7.** The maximum likelihood bootstrap values (%) are provided above the branches. For the combined analyses, additional Bayesian posterior probability (PP) values are displayed next to the backslash of the branches (**Figures 3.6 and 3.7**). A few incongruences appeared between the phylogenies based on the nuclear region, *ETS*, chloroplast regions, *psbA-trnH*, *rpl16*, and *rps16,* respectively *trnC-petN* (**Figures 3.1**–**3.**5). However, as detailed below, the result is much more informative when each of these regions was combined for the chloroplast regions (**Figure 3.6**) and all the gene regions (both nuclear and plastid) combined (**Figure 3.7**).

For each region, there was no incongruence between the consensus trees obtained with the Bayesian interface (BI) and Maximum Likelihood (ML) analysis, except for the analyses using the combination of both regions (**Figure 3.7**). Each region had more variable sites, which could have overrun the information in more regions. The topologies of the trees using either nuclear or chloroplast region were almost identical with both analysis methods, the only difference being that *rps16* inference yielded more resolved trees with fewer polytomies, in the case of the all combined both nuclear (*ETS*) and chloroplast sequences (*psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN*). In addition to this, the combined chloroplast region represents both the BI and ML analysis inference, yielding an intermediate topology with more effective resolved trees than the individual gene regions.

The consensus trees illustrated in **Figures 3.1 to 3.7** are obtained through the bootstrap values of the ML analyses interface. The Bayesian posterior probabilities support is displayed at each node next to the bootstrap value for comparison (taken from the separate Bayesian analysis and combined on the same tree). The code of the sample is concise, brief, and comprises the initial letters of the subgeneric classification, usually followed by the first 6 letters of the specific epithet, except for "yalae" which stands for *P.* "yalaensis" the ambiguous species with sterile specimens. Moreover, the code includes the collector number, country code, and more information about the location. For example, “Mes_arbreSR224_Hala” stands for the sample from sect. *Mesopygeum,* the taxon is *Prunus arborea*, and the collector code is **SR** (stands for the collector, **S**ukid **R**ueangruea), followed by the collector number **224**. The location is **Hala**-Bala Wildlife Sanctuary, Thailand. In addition, more information on

30 samples (representing 26 taxa) is presented in **Appendix 1**. Furthermore, the subgeneric groupings are also color-coded to aid visual comparisons.

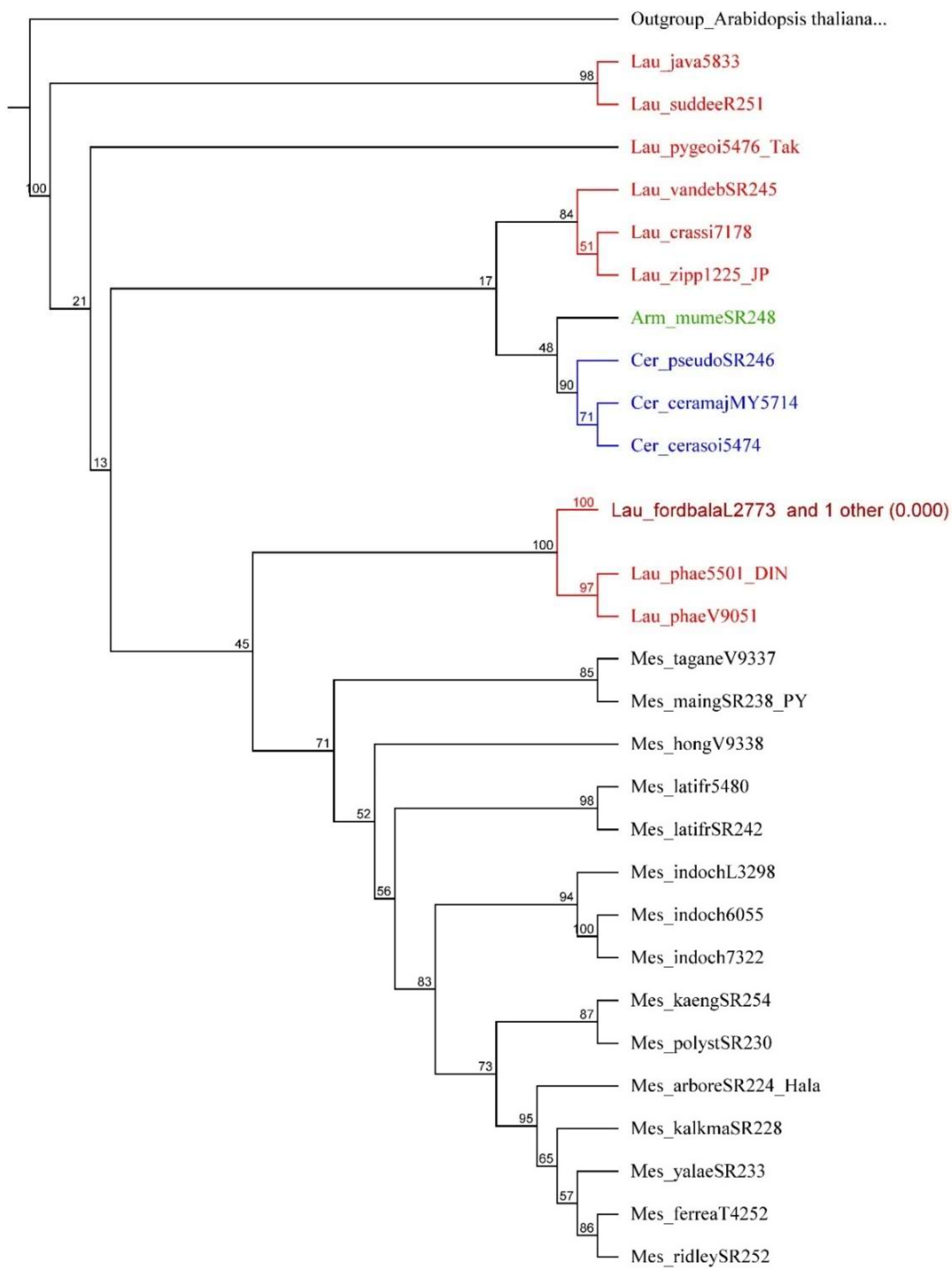


Figure 3.1 Maximum likelihood consensus tree based on the *ETS* region. The corresponding ML analysis's Bootstrap support values are indicated above the branch. Arm = subg. *Armeniaca*, Cer = subg. *Cerasus*, Lau. = sect. *Laurocerasus*, and Mes. = sect. *Mesopygeum*.

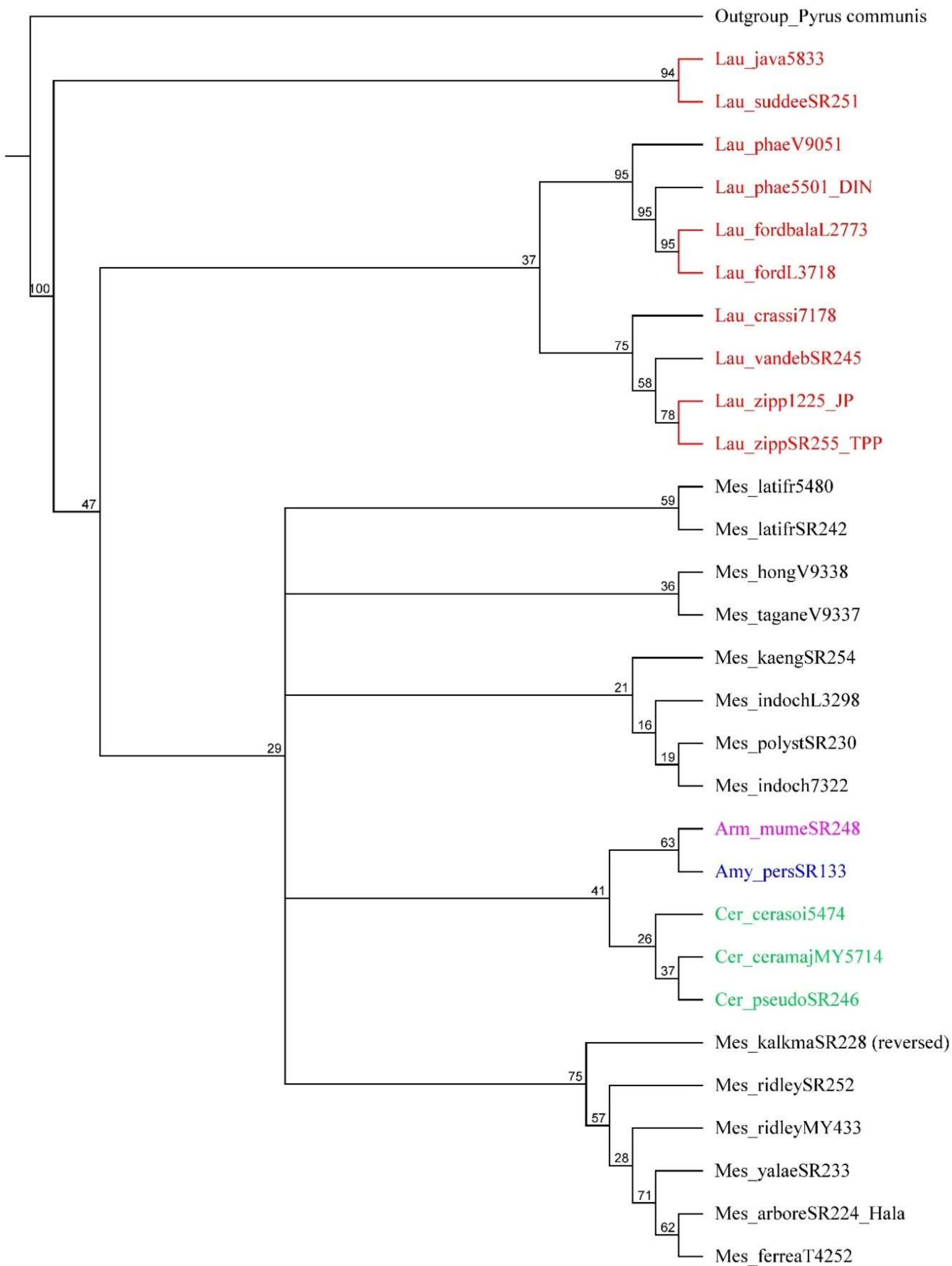


Figure 3.2 Maximum likelihood consensus tree based on the *psbA-trnH* region. The corresponding ML analysis's bootstrap support values are indicated above the branch. Amy = subg. *Amygdalus*, Arm = subg. *Armeniaca*, Cer = subg. *Cerasus*, Lau. = sect. *Laurocerasus*, and Mes. = sect. *Mesopygeum*.

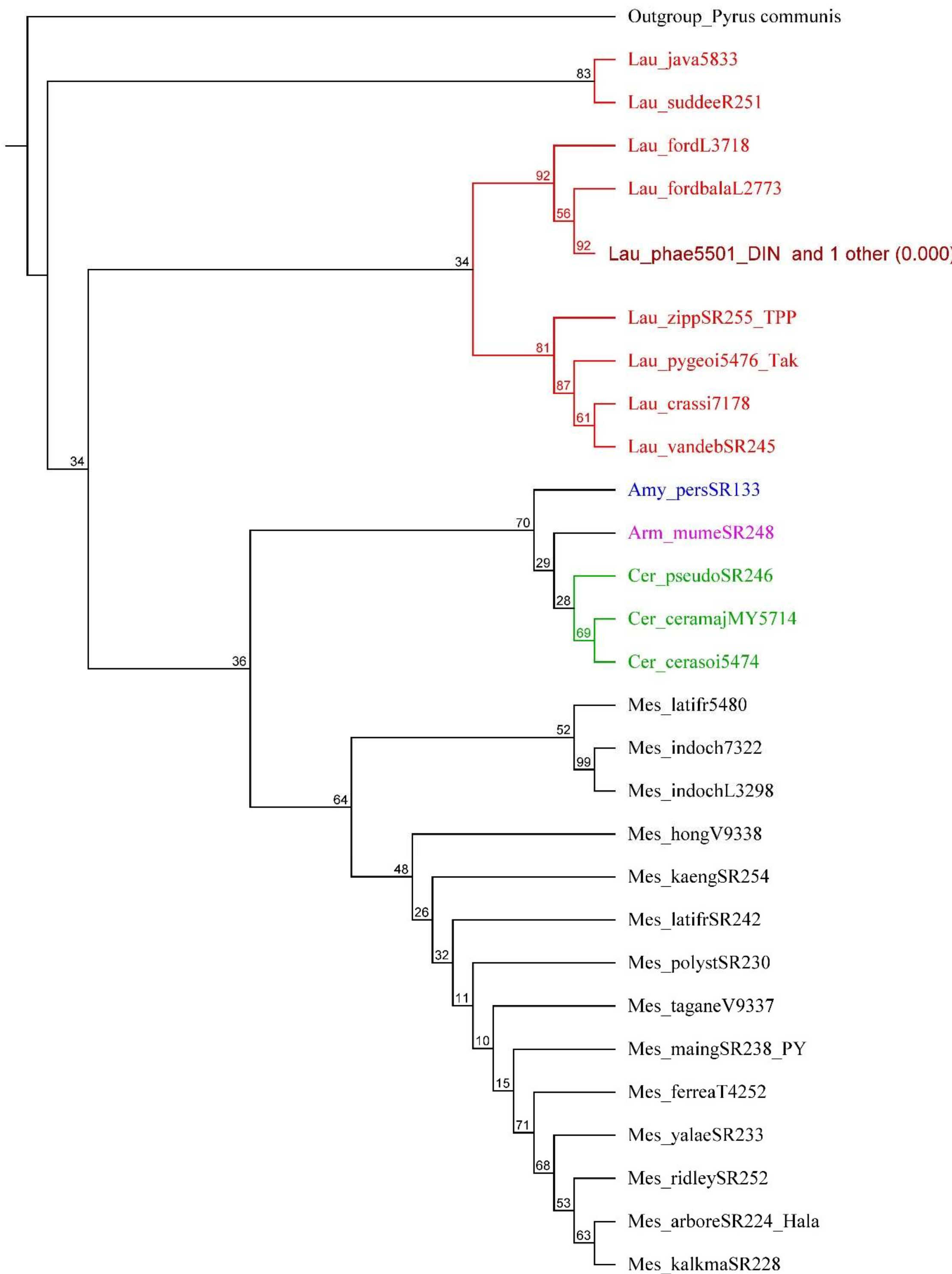


Figure 3.3 Maximum likelihood consensus tree based on the *rpl16* region. The corresponding ML analysis's bootstrap support values are indicated above the branch. Amy = subg. *Amygdalus*, Arm = subg. *Armeniaca*, Cer = subg. *Cerasus*, Lau. = sect. *Laurocerasus*, and Mes. = sect. *Mesopygeum*.

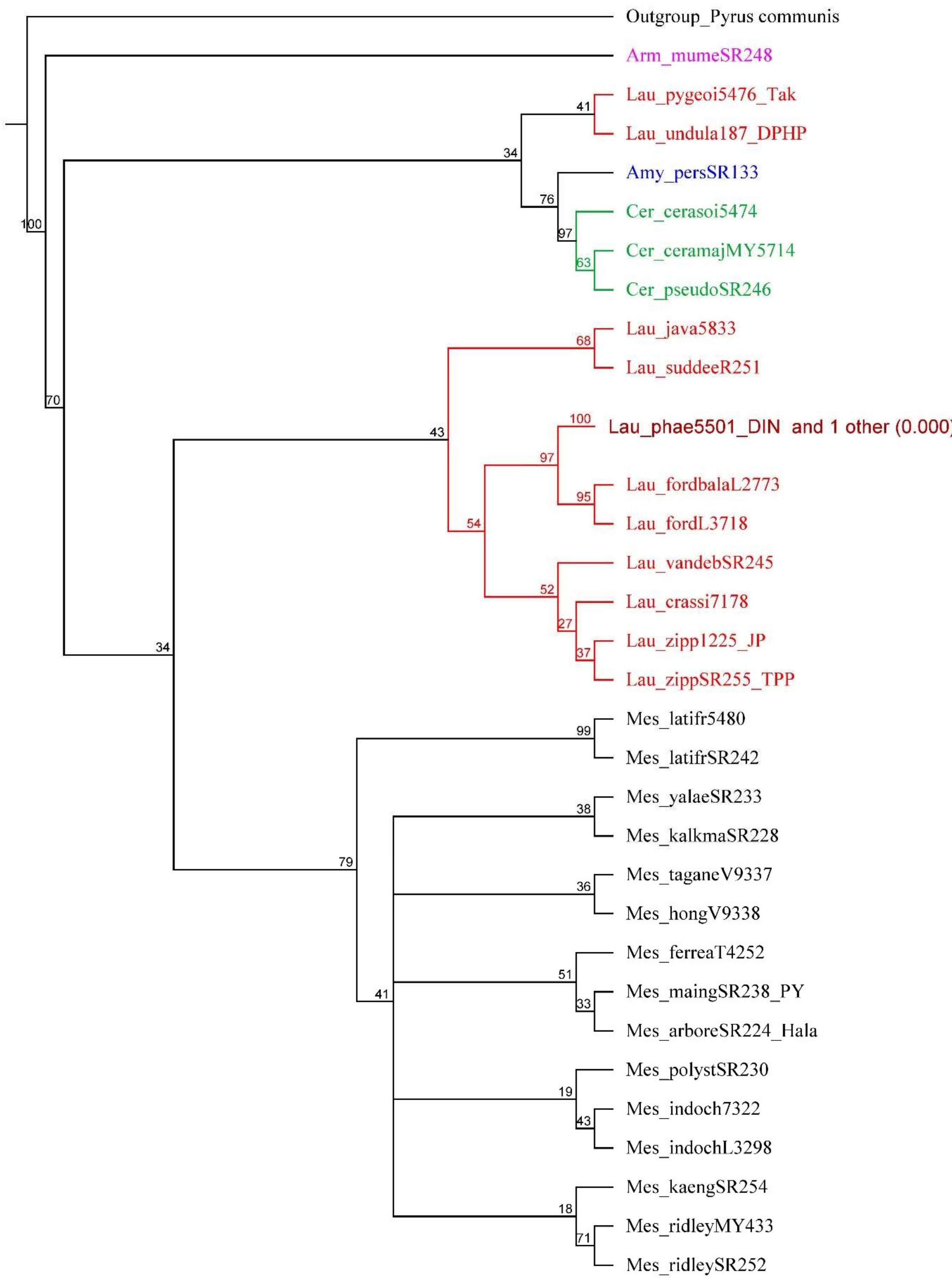


Figure 3.4 Maximum likelihood consensus tree based on the *rps16* region. The corresponding ML analysis's Bootstrap support values are indicated above the branch. Amy = subg. *Amygdalus*, Arm = subg. *Armeniaca*, Cer = subg. *Cerasus*, Lau. = sect. *Laurocerasus*, and Mes. = sect. *Mesopygeum*.

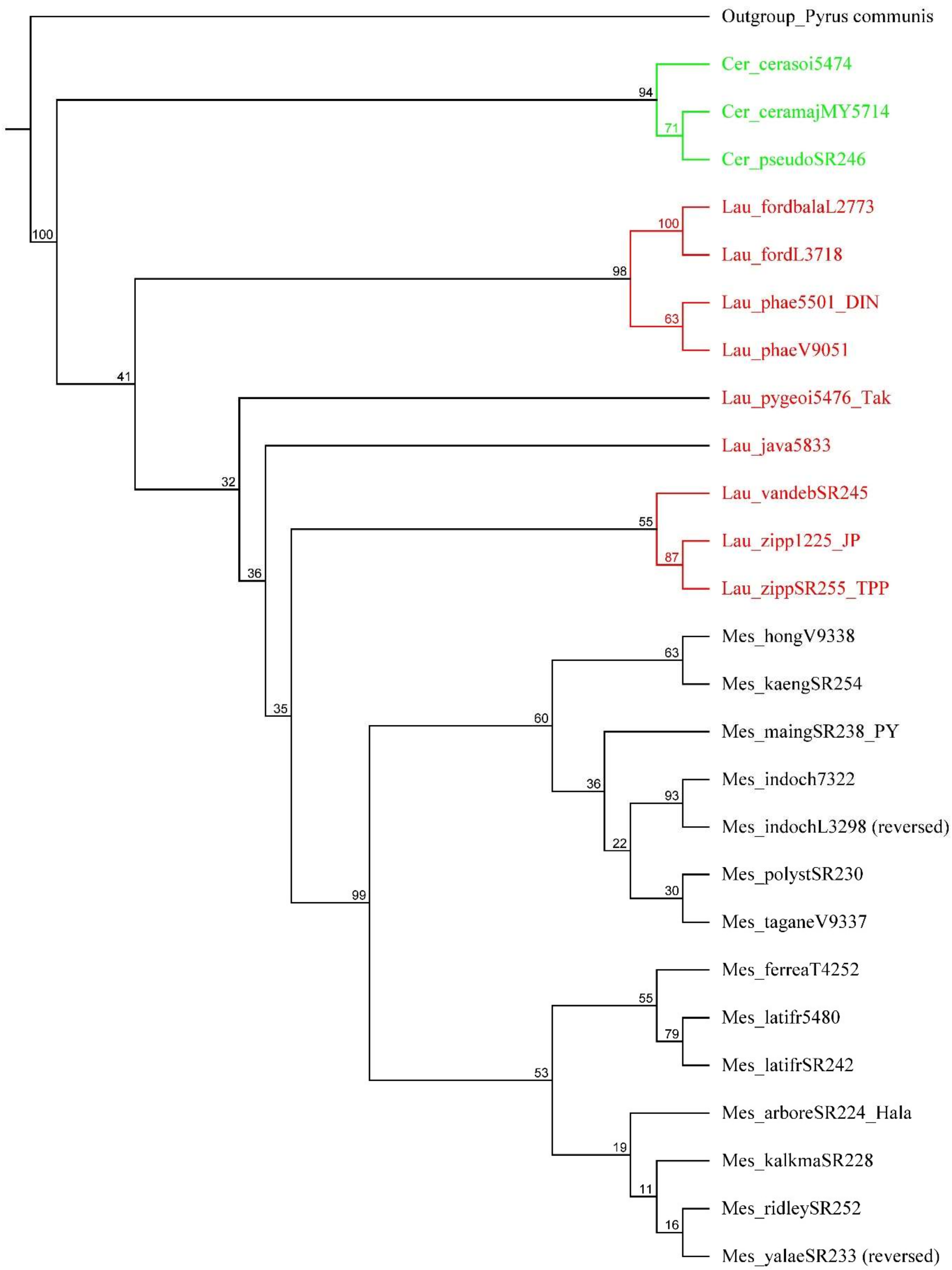


Figure 3.5 Maximum likelihood consensus tree based on the *trnC-petN* region. The corresponding ML analysis's bootstrap support values are indicated above the branch. Amy = subg. *Amygdalus*, Arm = subg. *Armeniaca*, Cer = subg. *Cerasus*, Lau. = sect. *Laurocerasus*, and Mes. = sect. *Mesopygeum*.

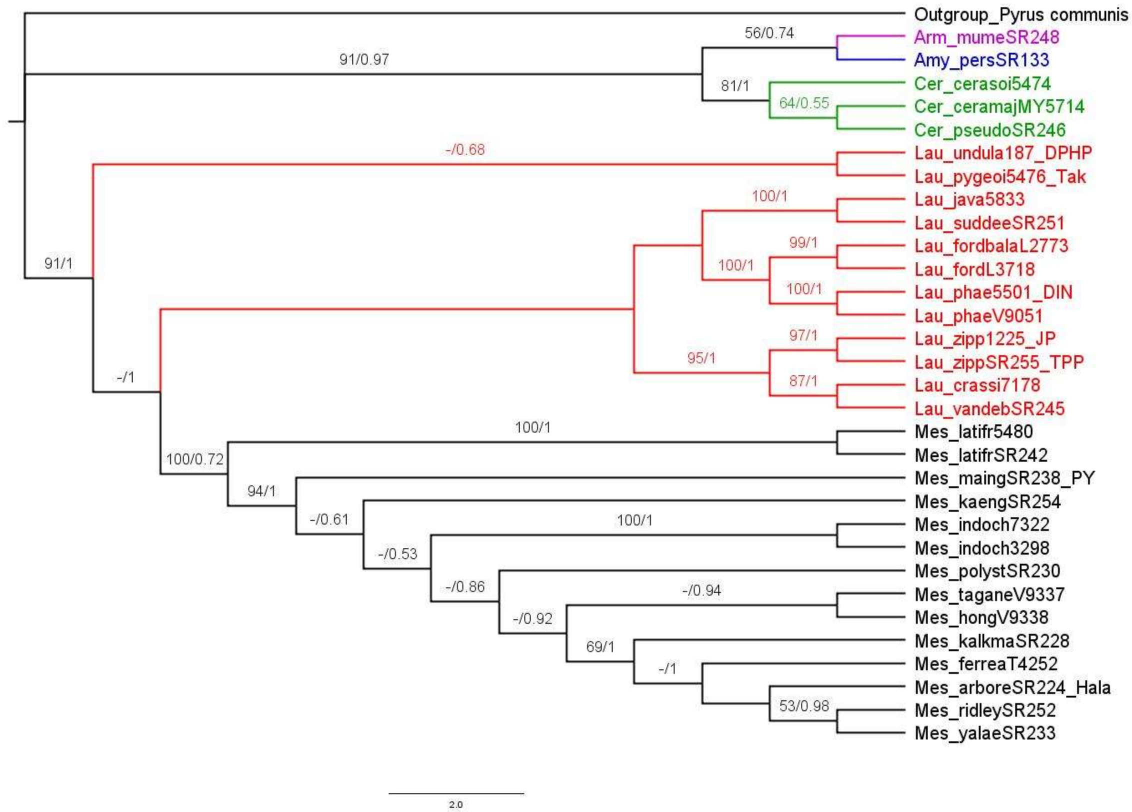


Figure 3.6 Maximum likelihood consensus tree based on the combined chloroplast gene region analyses. The corresponding ML analysis's bootstrap support values are indicated above the branch. Bayesian posterior probability (PP) support values are displayed next to the backslash; values < 50 % and < 0.5 PP are not shown. Amy = subg. *Amygdalus*, Arm = subg. *Armeniaca*, Cer = subg. *Cerasus*, Lau. = sect. *Laurocerasus*, and Mes. = sect. *Mesopygeum*.

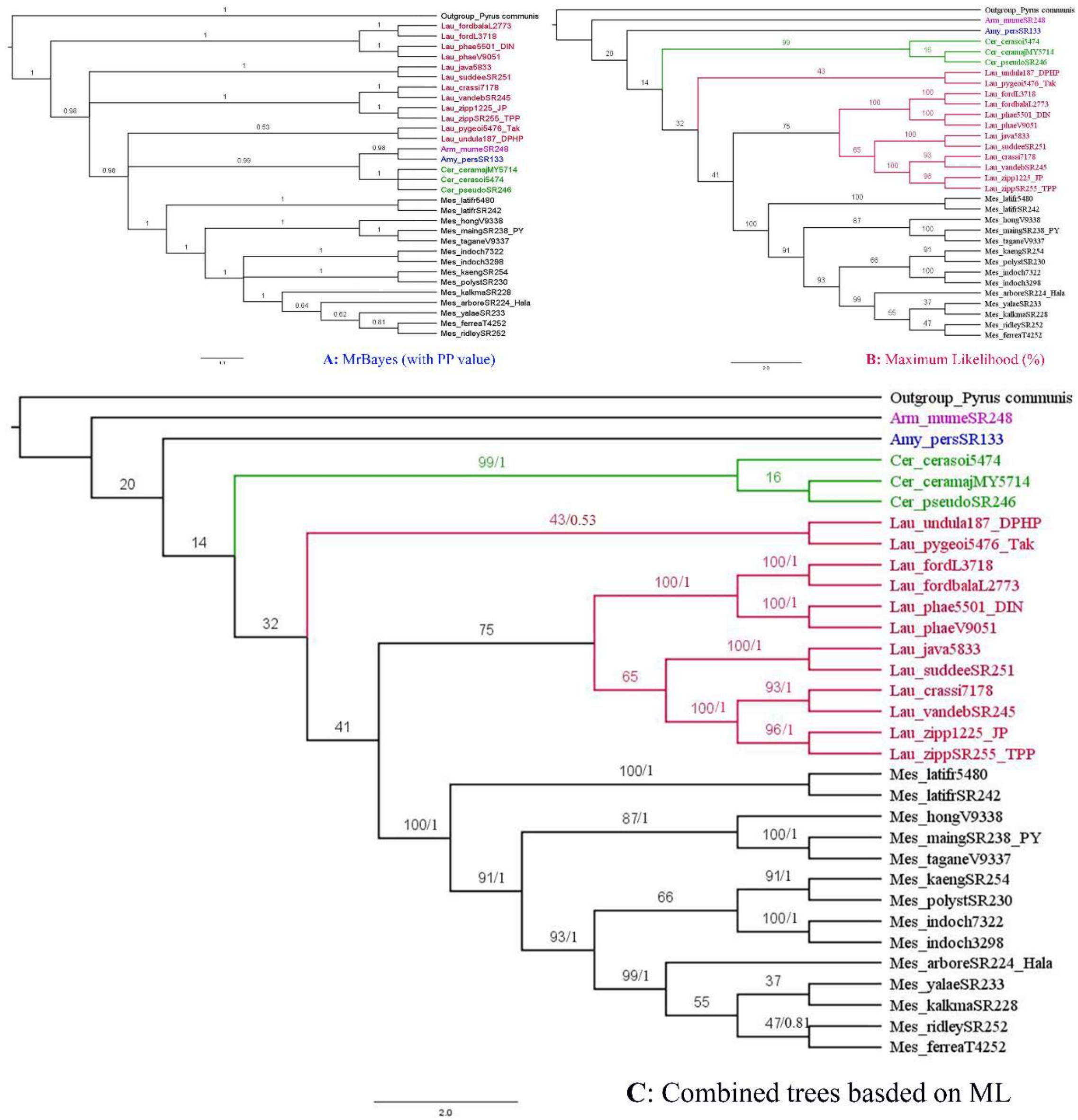


Figure 3.7 The consensus trees based on the combined analysis of all gene regions. A; Bayesian with posterior probability support values (PP). B; The corresponding ML analysis with Bootstrap support values (%). C. Combined tree based on ML, Bootstrap support values are indicated above the branch, and Bayesian posterior probability (PP) support values are displayed next to backslash; values < 10 % and < 0.5 PP are not shown. **Note**: in Figure C (combined trees based on ML) support values can only be combined (as x/x) if that same group is present in both.

3.3.2 Relationships at subgeneric and sectional levels

This study focused on the main group in the subgenus *Laurocerasus* sect. *Laurocerasus* and sect. *Mesopygeum* because there is a lack of DNA samples from subgenera *Padus* and *Maddenia*, which are distributed in the Indo-Burma floristic region. The subgenera formed monophyletic groups in almost all the trees (**Figures 3.2, 3.3, 3.6,** and **3.7**), regardless of the DNA region or phylogenetic reconstruction method with moderate to high support values (posterior probability from Bayesian inference and bootstrap values from maximum likelihood). An uncertainly arose concerning the monophyly of subgenus *Laurocerasus* section *Laurocerasus*, as the phylogenies based on the *ETS*, and *trnC-petN* (**Figure 3.1, 3.4, and 3.5**) suggest that sect. *Laurocerasus* may be embedded within the section *Mesopygeum.* Moreover, the phylogenies based on the *psbA-trnH*, *rpl16*, and combined chloroplast, and all combined regions indicate that sect. *Laurocerasus* is polyphyletic. By comparison, sect. *Mesopygeum* is separately monophyletic (**Figures 3.2, 3.3, 3.6, and 3.7**). The *ETS* region (**Figure 3.1**) suggests that sect. *Laurocerasus* may be embedded within the section *Mesopygeum*. The sections sister groups are *Mesopygeum, P. fordiana, and P. phaeosticta*. *Mesopygeum* with consensus supporting value at 40 %. In this case, sect. *Laurocerasus* is paraphyletic. The *psbA-trnH* and *rps16* region (**Figures 3.2 and 3.4**) show sect. *Mesopygeum* with polytomies. While *psbA-trnH*, *rps16*, and *rpl16* (**Figures 3.2, 3.3, and 3.4**) show sect*.* *Laurocerasus* as paraphyletic with *P. javanica* (including Lau_suddeeSR251) as the sister group. Both combined consensus tree (**Figure 3.6 and 3.7)** suggests that sect. *Laurocerasus* is paraphyletic, with *P. pygeoides* and *P. undulata* as the sister groups and Sect. *Mesopygeum* is monophyletic and separated from the sect. *Laurocerasus*.

Both ML and BI methods gave similar results for the combined chloroplast analyses (**Figure 3.6**), allowing tree merging. They do not show hard incongruence (well-supported incongruence), so they can be combined. The tree shows support values (bootstrap support values (%) and Bayesian posterior probability, PP). The substructure of *Laurocerasus*, sect. *Laurocerasus* and sect. *Mesopygeum* was not entirely resolved with either DNA region, but the sect. *Mesopygeum* groupings were confirmed in all the trees. As discussed below, a few minor incongruences existed between the trees obtained with *ETS*, *rps16*, and *trnC-petN.*

The delimitation of the subgenera and their relationships were unequally supported among the trees. In contrast, the one constant was that sect. *Mesopygeum* formed a monophyletic group (with 64 % bootstrap support with *rpl16*; 99 %with *trnC-petN*; 100 %/0.72 PP with all plastid regions combined; and 100 %/1 PP with all nuclear and plastid regions combined). *Laurocerasus* had very low bootstrap support in all regions and generally was paraphyletic.

Cerasoides was sometimes placed as a sister subgenus to sect. *Laurocerasus* (**Figures 3.1 and 3.4**) with a low consensus-supported values (17 % with *ETS*, 34 % with *rps16*). However, sometimes it was placed as a sister subgenus to the sect. *Mesopygeum* **(Figure 3.2 and 3.3)** with low support values (29 % with *psbA-trnH*, and 36 % with *rpl16*). In contrast, this was a monophyletic group (**Figure 3.5**) with a high, supported values (97 % with *trnC-petN*, 81 % /1 PP within combined chloroplast regions, and 99 % /1 PP with the combined ETS and plastid region dataset.

3.3.3 Species-level relationships

Subgenus *Amygdalus*

Only one sample of subg. *Amygdalus* was successfully sequenced. Moreover, *P. persica* was not successfully amplified for the *ETS* region; consequently, the phylogenies built using this region can neither confirm nor refute the relationships between taxa in subg. *Amygdalus*. However, *Prunus persica* has a close relationship with subg. *Armeniaca* (**Figures 3.2 and 3.3**) (63 % with *psbA-trnH*, 29 % with *rpl16*, 59 % with all combined regions), and have a relationship with subg. *Cerasus* (**Figures 3.2 and 3.4**) (63 % with *psbA-trnH*, 70 % with *rps16*) which formed as a sister group of subg. *Armeniaca* and *Cerasus* (**Figures 3.3, 3.6,** and **3.7)** (70 % with *rpl16*, 81 % / 1 PP with the combined chloroplast region analysis, and 20 % / 0.99 PP with all combined regions).

Subgenus *Armeniaca*

Only one sample of subg. *Armenica* was successfully sequenced. Moreover, *P. mume* was not successfully amplified for the plastid *trnC-petN* region; consequently, the phylogenies built using this region can neither confirm nor refute the relationships between taxa in subg. *Armeniaca*. However, *P. mume* has a slightly close relationship with subg. *Cerasus* (**Figure 3.1**) (48 % with *ETS*-Ros *IGS6*, 29 % with *rpl16*, 59 % with all combined regions) has a relationship with subg. *Amygdalus* (**Figure 3.2**) (63 % with *psbA-trnH*) and was strongly separated from other subgenera (**Figure 3.4**) (100 % with *rps16*), 56 % / 0.74 pp with the combined analysis of the chloroplast region (**Figure 3.6)**.

Subgenus *Laurocerasus*

Section *Laurocerasus*

The precise relationships between taxa in sect. *Laurocerasus* were often incongruent between the trees produced from the *ETS*, rps16, and *trnC-petN* regions (**Figure 3.1, 3.4, 3.5**).

All trees (**Figures 3.1-- 3.**7) grouped the Southeast Asia *Prunus* samples with different support values. *Prunus javanica* from Cambodia grouped with *P. suddeei* from Thailand. Consequently, this study treated *P. suddeei* under *P. javanica*. This study treated samples of *P. fordiana* var. *balanse* and *P. fordiana* as the same species as *P. fordiana.* In addition, *P. fordiana* from Laos is a close relative to *P. phaeosticta.* In addition, *P. zippeliana* from Japan and Thailand grouped with *P. vandebultii* from Thailand and *P. crassistyla* from Vietnam. Species of similar morphology within the sect. *Laurocerasus* are apparent, especially the serrate leaved group; *P. zippeliana, P. crassistyla* (*comb. nov.*)*,* and *P. vandebultii* (*sp. nov*.) were distinguished as a separate sister group, 95 % / 1 with combined chloroplast, and 100% / 1 with the combined ETS and plastid dataset (**Figure 3.6** and **3.7**).

Prunus pygeoides is slightly related to P. undulata / 1 PP with all combined chloroplast regions (**Figure 3.7**) and 43% / 0.53 PP with all combined regions (**Figure 3.7**), forming a sister group to sect. *Laurocerasus* and sect. *Mesopygeum* (**Figures 3.6 and 3.7**). On the other hand, *P. pygeoides* is shown to be a close relative of *P. undulata* (with 41%) (**Figure 3.4**).

In the combined plastid region trees (**Figure 3.6**) and the combined nuclear and plastid trees (**Figure 3.7**), *P. javanica* from Cambodia and *P. javanica* (including Lau_suddeeiR251) from Thailand have a close relationship with 100 % / 1 PP supported value. As a result, we treated the material as the same species: *P. javanica*.

Section *Mesopygeum*

Sect. *Mesopygeum* was monophyletic in all trees (**Figures 3.1–3.7**) with different levels of support. However, relationships between taxa in this section were generally not resolved in any of the trees from the individual regions; though the combined trees grouped *P. latifructa* from the Thai Myanmar border that has big leaves and is sparsely hairy with *P. latifructa*, from Northern Thailand that has small leaves and is glabrescent, 98% with *rps*16, 79% with *trnC-petN* (**Figure 3.5**), 100% /1 PP with the combined chloroplast region (**Figure 3.6**), and 100% /1 PP with combined chloroplast and ETS regions (**Figure 3.7**). So, I treat it all as the same species: *P. latifructa.*

Furthermore, from **Figure 3.7,** *Prunus. hongiaoensis* from Vietnam grouped with *P. maingayi* from Thailand and *P. taganei* from Vietnam (with 87 % / 1 PP). In addition, the Indochinese species, *P. indochinensis* from Laos and Cambodia, were grouped with 100%/ 1 PP. Moreover, though *P. indochinensis* has been considered a variety of *P. arborea* and *P. arborea* var. *montana* (Kalkman, 1965), my trees resolved *P. indochinensis* from the Indochinese floristic region and justified it being lifted to species rank. In comparison, *P. arborea* is the sister group of *P. kalkmanii*, *P.* "yalaensis", *P. ferrea,* and *P. ridleyi* with 91% / 1 PP. Furthermore, the two largest leaved species, *P. kaengkrachanensis,* and *P. polystachya* were grouped with 91 % / 1 PP.

3.4 Conclusions and further research

This chapter has generated new nuclear and plastid (chloroplast) gene regions for DNA barcoding applications in *Prunus* (CBOL Plant Working Group, 2009). The sequences can accurately identify the taxa and will be submitted to GenBank upon publication with supporting vouchers so other researchers can use them for DNA barcoding and phylogenetics. Sequences deposited in databases must be well identified to species level. The sequences generated here are accurately identified through the morphological studies in the other thesis chapters.

Our phylogenetic studies show that *Prunus fordiana* and *P. phaeosticta* are embedded in the *Mesopygeum* group. In addition, the relationships within *Prunus s.l.* were not well resolved in the individual gene region analyses. The nuclear dataset analysis, *ETS* (**Figure 3.1**) suggested some sections were not monophyletic. In addition, the plastid dataset analyses, *psbA-trnH*, *rpl16*, *rps16*, and *trnC-petN*, provide well-resolved or supported trees compared to their individual analysis. Moreover, the combined region is much more effective for grouping or separating taxa.

By comparison, the *Laurocerasus* group did not form distinct clades. Our analyses have divided section *Luaurocerasus* into two subclades, although the relationships within each subclade are not well resolved (**Figures 3.6** and **3.7**).

The members from *Cerasus* and *Amygdalus*-*Armeniaca* formed two clades. The phylogenetic resolution of *Prunus s.l.* in continental Southeast Asia based on the plastid dataset was not fully resolved in both ML and Bayesian analyses. However, the section *Mesopygeum* was monophyletic with a high supported value (with 100 % bootstrap support).

In this study, amplification was unsuccessful with both forward and reverse sets of *ITS* primers. ITS was initially chosen because of its sequence variation and because it is more likely to be intact even in degraded DNA (Hodkinson et al., 2018). A few ITS samples were sent for sequencing but yielded many unreadable sequence traces with superimposed traces that could not be distinguished from each other. This region remains a good candidate for future work; one must excise the two bands individually from the electrophoresis gel plate before preparing them for sequencing or designing more specific primers – or clone them. Alternatively, these could be included as part of a high throughput sequencing project that incorporates many genes from both nuclear and plastid genomes (Hodkinson et al., 2019).

Chapter 4: Taxonomic treatment

Based on the observations discussed in Chapter 2 and the phylogenetic results from Chapter 3, a new classification for categorizing species of *Prunus* in continental Southeast Asia is elaborated here. Each taxon is described with the literature-cited specimens (especially type materials) examined, their synonyms (if any), distribution map, and nomenclatural notes are provided.

4.1 Material and methods

4.1.1 Examination of specimens and literature

Specimens kept in the following public herbaria were examined: **BK**, **BKF**, **BM**, **CMUB**, **E**, **FU**, **K**, **KYO**, **Laos PDR, NUOL, P**, **QBG**, **RAF**, **TCD**, and **VNM**. Digital images of specimens were examined on their websites (see their links below). I also studied specimen photos from **A**, **CAS**, **G**, **GH**, **HAS, HIB, HNL, HUH**, **IBER**, **L**, **MO**, **MPU**, **MUS**, **MW**, **NMNH**, **NMNS**, **NY**, **PlutoF**, **PNH**, **SING**, **SN**, **SNSB-M**, **U**, **UN**, **US, W**, **WAG**, and **WU** on the website of JSTOR (https://plants.jstor.org/), BioPortal (https://bioportal.naturalis.nl/), and GBIF (https://www.gbif.org/) that provided high-quality images of type specimens, specimens, and living plants.

The primary data attached to the specimens I have listed are the collector's family name and relevant collection number, printed in italics. The herbaria are usually listed by the herbarium number, herbarium barcode number, serial number (**BKF**), or QR-code number (**L**). The localities of collections cited are presented in a 'zoom in' order: Country (in bold capital type in 'Additional specimens examined'), followed by province (or state), district, and conservation/protected area name, respectively. fl. equals flowering specimen, fr. equals fruiting specimen, and lvs. equals leaves but no flowers or fruits. If the last location cited is the exact location of the former, the (; – *ibid* (*ibidem*) notation was used to mean the same or in the same place. The exclamation mark (!) means that I examined the physical specimen, whereas a dagger (†) indicates that only an image or photo of that specimen was examined. Digital images were sourced from the following websites:

A: http://kiki.huh.harvard.edu/databases/specimen

BM: http://data.nhm.ac.uk/dataset/collection-specimens/

E: http://elmer.rbge.org.uk/bgbase/vherb/

GBIF: (the Global Biodiversity Information Facility): https://www.gbif.org/

JSTOR: Global Plants (some types): https://plants.jstor.org/

K: http://apps.kew.org/herbcat/

L: http://bioportal.naturalis.nl/

LINN: http://linnean-online.org/

MO: http://www.tropicos.org/ImageSearch.aspx

NY: http://sweetgum.nybg.org/science/vh/

P: https://science.mnhn.fr/institution/mnhn/collection/p/item/search/form

US: http://collections.nmnh.si.edu/search/botany/

The protologue of each name was read, and the nomenclatural status of the name was judged based on the ICN (Turland et al., 2019). Information in the taxonomic literature was searched using Taxonomic Literature II online (http://www.sil.si.edu/DigitalCollections/tl-2/index.cfm), The Plant List (http://www.theplantlist.org/), International Plant Name Index (IPNI: https://www.ipni.org/?), The World Flora Online (http://www.worldfloraonline.org/), Plants of the World Online (https://powo.science.kew.org/), and BPH*Online* (http://fmhibd.library.cmu.edu/). Some critical literature was found on the website of the Biodiversity Heritage Library (http://www.biodiversitylibrary.org), JSTOR (https://www.jstor.org/action/doBasicSearch), and Google Books (https://books.google.ie/), ResearchGate (https://www.researchgate.net/), and Z-library (https://z-lib.org/). Literature not written in English was generally read with help from Google Translate (https://translate.google.com/). The author's information was verified on IPNI (http://www.ipni.org/ipni/authorsearchpage.do).

4.1.2 Names and typification

The single correct name for each living taxon of *Prunus* was recognized based on the ICN (McNeill et al., 2012) and The Code Decoded (Turland, 2019). The identity sign indicates homotypic synonyms (≡), whereas the equality sign indicates heterotypic ones (=), and synonyms are indicated by the dash sign (–). Names that need typification were identified, and their types were selected according to Art. 9.3. Types are indicated immediately after the basionym with homotypic and heterotypic synonyms following in that order, and within these categories, synonyms are ordered by date of publication. The type of a name in a rank higher than species (e.g., name of the section, subgenus, or genus) is cited as the species name (Art. 10.1). The type (holotype, lectotype, or neotype) of a name of a species or infraspecific taxon is cited as a single specimen or an illustration (Art. 8.1). Citation of author names followed Turland (2019). Earlier accounts sometimes specified a single gathering but not a specimen when undertaking lectotypification. In these cases, where possible, I have therefore undertaken a second step of lectotypification (Turland, 2019).

I cite the examined protologue and other taxonomic literature where the name is present for the accepted term, synonym, and botanical name. The standard form of the author name cited here follows IPNI. However, the collector's name is usually mentioned as the abbreviation for the forename, followed by the family name.

4.1.3 Description

The description of each taxon was based on my examination of the corresponding dry specimens, the label on the specimen sheet, my fieldwork records of new characters (notes and photos) from fresh material, and other published data and online images where available. The study uses long-form descriptions, and while I started using short-form descriptions, I lengthened these because the process of gathering the morphological information was helpful to their understanding of the group. The taste and smell of inner bark, twigs, leaves, flowers, fruits, or seeds after cutting and chewing were described by myself or obtained from the recorded data of other people. The two-dimensional size was recorded as length × width from mature samples. The color of each described character is that recorded on living plants except in the cases of punctate tissue and hairs described from dry specimens; data from dried collections was mainly used here because of the unavailability of living plants. General morphological characters, such as the variation of outer bark, stipule, leaf margin, glands, inflorescences, fruits, indumentum on the endocarp, and seedcoat, are illustrated as photos in Figures 2.1–2.6 as in Chapter 2. The morphological glossaries of Ash et al. (1999), Harris & Harris (2001), Stuppy (2004), Radcliffe-Smith (2006), and Beentje & William (2016) were followed.

The morphological character matrix for 51 species descriptions and ca. 260 characters was recorded in the Excel spreadsheet and then used lettering mail merge from Microsoft Word (2010) (**Appendix 2**). The study used short-form descriptions and chose to lengthen these because the process of gathering the morphological information helped them understand the *Prunus* group.

4.1.4 Mapping of distribution data

Distribution data were retrieved from the record on each specimen sheet. CoBortiri collections from natural forests with detailed localities but without geographic coordinate data were re-located on Google Maps (https://www.google.com/maps), from which the rough data of latitude and longitude were retrieved. The distribution data was mapped using SimpleMappr (https://www.simplemappr.net). The conservation that where possible, I have performed a preliminary IUCN (2019) assessment (https://www.iucnredlist.org.).

4.2 Subgenus division of subfamily Prunoideae Fock

Description: Subfamily Prunoideae Fock characteristically are trees or shrubs. Stipules present. Leaves simple; leaf blade margin serrate or rarely entire. The ovary is superior; carpels 1(–5), with 2 pendulous anatropus ovules per carpel. Fruit a drupe; mesocarp succulent, fleshy, not dry, not splitting, or more rarely splitting when ripe. Consists of 10 subgenera and about 400 species. It is distributed in Africa, America, Asia, Northeast Australia, Europe, and the Pacific Islands. The genus *Prunus* in continental Southeast Asia contains 51 species and can be divided into seven subgenera (*Amygdalus, Armeniaca, Cerasus, Maddenia, Laurocersus Padus,* and *Prunus*). The subgenus *Laurocerasus* can be divided into two sections: sect. *Laurocerasus* and *Mesopygeum*. A key to the subgenus, sections, and a key to species are presented here.

4.2.1 Key to subgenera in continental Southeast Asia

1a. Deciduous tree. Terminal or axillary winter bud present. Leaves almost always serrate. Flowering with a leafless branch or with young leaves. .... **(2)**

1b. Evergreen tree. Terminal or axillary winter bud absent. Leaves are usually entire or sometimes serrated. Flowering with mature leaves. .... **Subg. *Laurocerasus***

2a. Leaf blade margin with gland-tipped teeth. Sepals and petals are minute and ± indistinguishable. .... **Subg. *Maddenia***

2b. Leaf blade margin without gland-tipped teeth. Sepals and petals prominent and distinguishable. .... **(3)**

3a. Axillary winter buds (1) 2–3 with 2 lateral flower buds and 1 central leaf bud. Drupe grooved, endocarp distinctly laterally compressed. .... **(4)**

3b. Axillary winter bud single. Drupe not grooved, endocarp hardly compressed. .... **(5)**

4a. Leaves reduplicate when young. Flowers solitary, or sometimes 2-flowered, usually sessile or very shortly pedicellate. Ovary usually hairy. The endocarp is often pitted, rarely smooth. .... **Subg. *Amydalus* 3. *P. persica***

4b. Leaves involute or slightly revolute when young. Flowers 1–3, pedicellate. Ovary glabrous. The endocarp is inconspicuously pitted or usually smooth. .... **(6)**

5a. Terminal branchlets spineless. Flower distinctly pedicellate. Ovary and fruit glabrous and glaucous. .... **Subg. *Prunus* 4. *P. salicina***

5b. Terminal branchlets spine-like. Flowers sessile or shortly pedicellate. Ovary and fruit are densely and shortly pubescent. .... **Subg. *Armeniaca* 5. *P. mume***

6a. Inflorescences in short racemes or corymbs, solitary, few to several flowered, usually up to 10-flowers in racemes. Rachis base leafless. .... **Subg. *Cerasus***

6b. Inflorescences in long racemes on branchlets or terminal part of new branchlet, usually more than 10-flowers in racemes. Rachis base usually has leaves, but it is rarely leafless. .... **Subg. *Padus***

7a. Leaves serrate, slightly serrate to entire basal glands on the margin, the under-surface of the blade, or on the petiole. Sepals and petals distinguishably. Fruits sub-globose, ellipsoid, and rarely transverse ellipsoid; apex acute or obtuse. .... **Subg. *Laurocerasus* sect. *Lauroserasus***

7b. Leaves usually entire or minutely serrate: basal glands on the under-surface of leaf-blade, flat or more or less deeply hollowed (in some species, not on the blade proper, but on contracted leaf-base). Sepals and petals ± indistinguishable. Fruits sub-globose, transversely-ellipsoid to didymous, and rarely ellipsoid; apex retuse. .... **Subg. *Laurocerasus* sect. *Mesopygeum***

4.2.2 Key to *Prunus* in continental Southeast Asia

1a. Deciduous tree. Terminal or axillary winter bud present. Leaves almost always serrate. Flowering with leafless branches or with young leaves. .... **(2)**

1b. Evergreen tree. Terminal or axillary winter bud absent. Leaves usually entire or sometimes serrated. Flowering with mature leaves. .... **Subg. *Laurocerasus* (19)**

2a. Leaf blade margin with gland-tipped teeth. Sepals and petals are minute and ± indistinguishable. .... **Subg. *Maddenia* (3)**

2b. Leaf blade margin without gland-tipped teeth. Sepals and petals prominent and distinguishable. .... **(4)**

3a. Leaf blade pubescent to villous abaxially, or at least pubescent on veins, lateral vein axils without tufts of hairs. .... **1. *P. himalayana***

3b. Leaf blade glabrous abaxially, lateral vein axils with tufts of pubescence. .... **2. *P. gongshanensis***

4a. Axillary winter buds (1) 2–3 with 2 lateral flower buds and 1 central leaf bud. Drupe grooved, endocarp distinctly laterally compressed. .... **(5)**

4b. Axillary winter bud single. Drupe not grooved, endocarp hardly compressed. .... **(7)**

5a. Leaves reduplicate when young. Flowers solitary, or sometimes 2-flowered, usually sessile or very shortly pedicellate. Ovary usually hairy. Endocarp often pitted, rarely smooth. .... **Subg. *Amydalus* 3. *P. persica***

5b. Leaves involute or slightly revolute when young. Flowers 1–3, pedicellate. Ovary glabrous. Endocarp is inconspicuously pitted or usually smooth. .... **(6)**

6a. Terminal branchlets spineless. Flower distinctly pedicellate. Ovary and fruit glabrous and glaucous. .... **Subg. *Prunus* 4. *P. salicina***

6b. Terminal branchlets spine-like. Flowers sessile or shortly pedicellate. Ovary and fruit are densely and shortly pubescent. .... **Subg. *Armeniaca* 5. *P. mume***

7a. Inflorescences in short racemes or corymbs, solitary, few to several flowered, usually up to 10-flowers in racemes. Rachis base leafless. .... **Subg. *Cerasus* (8)**

7b. Inflorescences in long racemes on branchlets or terminal part of new branchlet, usually more than 10-flowers in racemes. Rachis base usually has leaves, but it is rarely leafless. .... **Subg. *Padus* (15)**

8a. Petals apex lobed to retuse. Petiolar glands are usually present. Stipules are deeply lobed or branching at the base. .... **(9)**

8b. Petals apex acute, obtuse, or erose. Petiolar glands are absent or sometimes present on the contracted leaf base. Stipules without deep lobes or branching at the bottom. .... **(11)**

9a. Petals white, style up to 6 mm long, as long as stamens or slightly shorter. Fruit stalk is usually longer than 3 cm. .... **6. *P. pseudocerasus***

9b. Petals reddish to whitish-pink, rarely white; style longer than 10 mm, longer than stamens. Fruit stalk up to 3 cm long. .... **(10)**

10a. Flowers open simultaneously as new leaves; calyx lobes separate to valvate in the bud. The apex of marginal stipule serrated or short filiform glandular. Drupe purplish-black; endocarp apex obtuse. .... **7**. ***P*. *cerasoides***

10b. Flowers opening before new leaves; calyx lobes imbricate in the bud. Apex of marginal stipule long filiform glandular. Drupe red; endocarp apex acute. .... **8**. ***P*. *campanulata***

11a. Leaves papyraceous and glaucous abaxially. .... **9**. ***P*. sp. "inthanonensis"**

11b. Leaves herbaceous to coriaceous, glaucescent to pale green abaxially. .... **(12)**

12a. Style glabrous. .... **(13)**

12b. Style sparsely pilose at the base. .... **(14)**

13a. Prostrate shrub; cataphylls persistent on the twig; twig and bark greyish-to-dark grey. Leaf apex acuminate to long acuminate. 1(–2) flowered. .... **10**. ***P*. *mugus***

13b. Shrub to small tree; cataphylls caducous; twig and bark reddish-brown; greyish-to-dark grey. Leaf apex obtuse to acute. (1)2–4 flowered. .... **11**. ***P*. *serrula***

14a. Leaves sub-coriaceous; leaf blade (3–)5–12 cm long; margin serrate. Lateral veins 9–12 alternate on either side of the midrib. Stipules 8–15 mm long. Bracteoles obovate-oblong, elliptic, 2–5 mm long; styles 4–9 mm long. .... **12**. ***P*. *trichantha***

14b. Leaves papery to herbaceous; leaf blade 1.5–5 cm long; margin coarsely incised, double-serrate, or lobed; lateral veins 6–10 on either midrib. Stipules 3–5 mm long. Bracteoles rhomboid, obovate-oblong, 5–15 mm long; styles 8–16 mm long. .... **13**. ***P*. *trichostoma***

15a. Racemes basally leafless; sepals persistent in fruit. .... **14**. ***P*. *buergeriana***

15b. Racemes are basally leafy; sepals soon caducous in fruit. .... **(16)**

16a. Peduncles and pedicels are not thickened and not lenticellate in fruit. .... **15**. ***P*. *napaulensis***

16b. Peduncles and pedicels thickened, conspicuously lenticellate in fruit. .... **(17)**

17a. Leaf blade margin serrulate. .... **16**. ***P*. *cornuta***

17b. Leaf blade margin entire, crenate, or serrate. .... **(18)**

18a. Leaf blade margin aristate serrate. Inflorescences 16–30 cm long; involucral bracts caducous. .... **17**. ***P*. *brachypoda***

18b. Leaf blade margin not aristate serrate. Inflorescences 8–15 cm long; involucral bracts persistent at anthesis. .... **18**. ***P*. *bracteopadus***

19a. Leaves serrate, slightly serrate to entire basal glands in the margin, the under-surface of the blade, or on the petiole. Sepals and petals distinguishably. Fruits sub-globose, ellipsoid, and rarely transverse ellipsoid; apex acute. .... **Subg. *Laurocerasus* sect. *Lauroserasus* (20)**

19b. Leaves usually entire or minutely serrate: basal glands on the under-surface of leaf-blade, flat or more or less deeply hollowed (in some species, not on the blade proper, but on contracted leaf-base). Sepals and petals ± indistinguishable. Fruits sub-globose, transversely-ellipsoid to didymous, and rarely ellipsoid; apex retuse. .... **Subg. *Laurocerasus* sect. *Mesopygeum* (29)**

20a. Leaves densely dark-dotted beneath. .... **(21)**

20b. Leaves not dark-dotted beneath. **(24)**

21a. Basal glands 2 are often very close to the margin on lower blade surfaces. Stipules free, length to width index 6–10. Fruits sub-globose, ovate to ovate-oblong. **19**. ***P*. *javanica***

21b. Basal leaf marginal glands or petiolar glands absent. Stipules intrapetiolarly connate, length to width index 2–4. Fruits ovoid to elliptic-oblong. **(22)**

22a. Leaf apex long caudate. Racemes without involucral bracts basally. Fruits sub-globose, 0.8–1.1 times as long as wide; endocarp smooth. **20**. ***P*. *phaeosticta***

22b. Leaf apex acute to shortly acuminate. Racemes subtended by involucral bracts basally 3–10. Fruits elongated ovoid to ellipsoid; 1–1.7 times as long as wide; endocarp reticulately rugose. **(23)**

23a. Racemes glabrous; involucral bracts early caducous at anthesis. 21. ***P*. *fordiana***

23b. Racemes densely covered with hairs; involucral bracts persistent at anthesis. **22**. ***P*. *racemopilosa***

24a. Glands present on the petiole. **(25)**

24b. Glands absent on the petiole. **(27)**

25a. Leaf margin serrate or dentate. Stamens 18–30. Inflorescences are solitary or compound racemes in 2–4 bundles. Involucral bracts 1–3, peduncle densely hairy. **23**. ***P*. *zippeliana***

25b. Leaf margin entire or mixed with scarce spine-like serration. Stamens more than 30. Inflorescence is a solitary raceme. Involucral bracts 3–8, peduncle glabrescent. **(26)**

26a. Branchlets whitish-grey. Peduncle, rachis, pedicel, hypanthium, and bracts are usually glabrous or glabrescent. Involucral bracts 4–10, persistent at anthesis. **24**. ***P*. *crassistyla***

26b. Branchlets brown. Peduncle, rachis, pedicel, hypanthium, and bracts are hairy. Involucral bracts 3–5, caducous. **25**. ***P*. *vandebultii***

27a. Leaves with basal marginal glands. Fruits globose to sub-globose. **26**. ***P*. *pygeoides***

27b. Leaves without basal marginal glands. Fruits ellipsoid or ovoid, longer than wide. **(28)**

28a. Basal glands 2, without other glands parallel to the midrib. Inflorescences densely tomentose. Involucral bracts 5–10, usually persistent at anthesis. **27**. ***P*. *jenkinsii***

28b. Basal glands 2 or more, other glands often many, in 2 rows more or less parallel to the midrib. Inflorescences are sparsely hairy to glabrous. Involucral bracts 3–5, caducous. **28**. ***P*. *undulata***

29a. Racemes solitary and simple. **(30)**

29b. Racemes in 2–6 bundles or compounds. **(41)**

30a. Racemes up to 4 cm long, densely flowered; pedicels sessile to short, up to 2 mm long at anthesis. All perianth segments are similar. **(31)**

30b. Racemes more than 5 cm long; lax-flowered; pedicels distinct longer than 3 mm at anthesis. Perianth differentiated into sepals and petals. **(37)**

31a. Mature leaves are usually pubescent, although sometimes sparsely hairy, hardly glabrescent, leaf margin ciliate. **(32)**

31b. Mature leaves rapidly glabrescent to glabrous, leaf margin glabrous, entire. **(33)**

32a. Young twig terete, dark brown. Leaves oblong-lanceolate, margins slightly serrate, Stipules (3)5–8 × 0.5–1.5 mm, margin entire, ciliate. Involucral bracts early caducous. **29**. ***P*. sp**. **“yalaensis”**

32b. Young twig slightly ridged, whitish-grey. Leaves sub-coriaceous, margin entire. Stipules 6–10 × 1–2.5 mm, margin entire or with a few teeth near the base, not early caducous. Involucral bracts persistent at anthesis. **30**. ***P*. *taganei***

33a. Bracts tripartite, 3.5–5 mm long. Fruit elliptic-oblong. **31**. ***P*. *lancilimba***

33b. Bracts not tripartite, Fruit transversely ellipsoid or didymous. **(34)**

34a. Leaves thick, sub-coriaceous to coriaceous; apex rounded, base decurrent. Calyx lobes 0.3–0.6 by 0.3–0.6 mm. **(35)**

34b. Leaves thin, papyraceous to herbaceous; apex acute to acuminate, base not decurrent. Calyx lobes 0.6–1 by 0.5–1 mm. **(38)**

35a. Basal leaf glands 2. Stamens 44–55. Style short, 1.5 – 2.5 cm long. **32**. ***P*. *santisukii***

35b. Basal leaf glands 2–4. Stamens 20–35. Style long, 3–6 cm long. **(36)**

36a. Young twigs terete, dark brown. Inflorescence 2.5–6 cm long. Ovary glabrous with a ring of hairs at the base. **33**. ***P*. *apiculat*a**

36b. Young twigs with conspicuous ridges, greyish-white. Inflorescence 1–2.5 cm long. Ovary densely hairy **34**. ***P*. *longistyla***

37a. Leaves 4–14 by 1.5–6 cm, ratio 1.5–3. Basal leaf glands up to 1 mm long; bracteoles up to 2 mm long. Stamens 20–30. **35**. ***P*. *maingayi***

37b. Leaves 6–14 by 1.5–4.5 cm, ratio 3–5. Basal leaf glands 0.8–2 mm long; bracteoles 2–4 mm long. Stamens 30–36. **36**. ***P*. *bokorenesis***

38a. Leaves spiral, coriaceous; stipules 7–16 mm long, glabrous; petals 2.5–3x calyx lobe length; hypanthium 3.5–5 mm long. **37**. ***P*. *hongiaoensis***

38b. Leaves alternate, herbaceous to sub-coriaceous, stipules less than 7 mm long, sparsely to densely hairy; petals 1–1.5x calyx lobe length, hypanthium up to 2 mm long. **(39)**

39a. Young twig ridged. Leaf base obtuse to subcordate; tertiary veins and veinlets obscure abaxially; margin recurved. Stamens 10–22. **38. *P. ceylanica*** (Sri Lanka)

39b. Young twig terete. Leaf base acute to broadly acute with conspicuous, rough, and raised tertiary veins and veinlets abaxially; margin not recurved. Stamens 25–45. **(40)**

40a. Leaf basal glands 2 (–3), flat, lateral veins moderately angled, 45°–60°. Inflorescences are usually 5–12 cm long. Fruits 0.8–1.8 by 1.8–2.5 cm wide. **39**. ***P*. *latifructa***

40b. Leaf basal glands (1–) 2–3 (–5), slightly protruding above; lateral veins narrowly angled, less than 45°. Inflorescences up to 6 cm long, Fruits 0.8–1.2 by 1.2–1.6 cm wide. **40**. ***P*. *poilanei***

41a. Basal leaf glands are distinctly and deeply hollowed. **(42)**

41b. Basal leaf glands are flat, slightly hollowed, or absent in all leaves. **(46)**

42a. Leaves usually glabrous or glabrescent beneath; leaf margin entire. **(43)**

42b. Leaves densely covered with hairs beneath, leaf margin ciliate. **(44)**

43a. Basal glands not on the blade proper, but on the contracted leaf-base. . **41**. ***P. kaengkrachanensis***

43b. Basal glands on the leaf blade itself. .... **42**. ***P. polystachya***

44a. Petioles sessile or very short; leaf base semi-sagittate. .... **43**. ***P.* sp. "nanensis"**

44b. Petioles are usually longer than 5 mm; leaf base obtuse to subcordate. .... **(45)**

45a. Racemes not in bundle, 2–4 panicle-like. Ovary glabrous or hairy at point of insertion only. Endocarp with adpressed hairs inside. .... **44**. ***P. koehnei***

45b. Racemes 2–6 in bundles. Ovary hairy. Endocarp glabrous inside. .... **45**. ***P. indochinensis***

46a. Stipules linear, oblong-lanceolate to triangular, without or inconspicuous glands. .... **(46)**

46b. Stipule leaf-like, oblique, ovate-lanceolate, ovate to broadly ovate, usually with conspicuous glands. .... **(48)**

47a. Leaves ovate-lanceolate or lanceolate, narrow, up to 3.5 cm wide. Stipules 6-10 mm long. Seedcoat glabrous. .... **46**. ***P. lancifolia***

47b. Leaves elliptic to elliptic-lanceolate, broad, up to 3–6 cm wide. Stipules 2–3(–5) mm long. Seedcoat hairy. .... **(49)**

48a. Mature leaves pubescent abaxially; lateral veins 6–8, forming a narrow-angle (< 45°) with the midrib, incomplete loops. Endocarp glabrous inside. .... ***P. topengii*** (China)

48b. Mature leaves usually glabrous abaxially; lateral veins (7–)8–12; forming a moderate angle (45°–60°) with the midrib, anastomosing. Endocarp densely pubescent inside. .... **47**. ***P. arborea***

49a. Mature leaves sparsely hairy to glabrous beneath, margin entire. Leaf base acute to obtuse. Stipules shorter than 1 cm, caducous. Seedcoat glabrous. .... **(50)**

49b. Mature leaves densely covered with hairs beneath, margin ciliate. Leaf base obtuse to subcordate. Stipules longer than 1 cm, persistent on young branches. Seedcoat glabrescent to densely hairy. .... **(51)**

50a. Leaf base margin not curved. Stipules densely covered with brown hairs and sparse glands on the margin and the blade. Pedicels 2–4 mm long. Stamens 35–40. .... **48**. ***P. ferrea***

50b. Leaf base margin often recurved. Stipules sparsely pubescent to glabrous, outer surface with 1-3 crateriform glands, swollen and protruding inside, and small brown marginal glands. Pedicels 0.5–1.5 mm long, Stamens 20–30. .... **49**. ***P. kalkmanii***

51a. Lateral veins 8–12 pairs. Fruits 0.7–0.9 cm long, 0.8–1 cm wide; endocarp densely hairy; seedcoat glabrescent. .... **50**. ***P. ridleyi***

51b. Lateral veins 12–18 pairs. Fruits 1.1–1.6 cm long, 1.5–2 cm wide. Endocarp and seedcoat are densely pubescent. .... **51**. ***P. latistipulacea***

4.3 Taxonomic treatment and species descriptions of *Prunus s.l.* in continental Southeast Asia

4.3.1. Subgenus *Maddenia* J. D. Hooker & T. Thomson, Hooker's J. Bot. Kew Gard. Misc. 6: 381. 1854. – genus *Maddenia* Koehnei in Sarg., Plantae Wilsonianae. 1: 56–69. 1912; Cuizhi & Bartholomew in Lu et al. Flora of China. 2003. – subgenus *Laourocerasus* and *Padus*, *pro parte*, Chin S. W., Wen J., Johnson G. & Potter D., Merging *Maddenia* with the morphologically diverse *Prunus* (Rosaceae). 2010; *pro parte*, Wen J. & Shi W. Revision of the *Maddenia* clade of *Prunus* (Rosaceae). 2012. – genus *Maddenia* Cuizhi and Bartholomew.

Description: Trees or shrubs, deciduous. Winter buds are ovoid, with several scales. Stipules large, caducous, margin glandular, at least on the lower part. Branchlet of first year's growth pubescent. Leaves alternate, simple; leaf blade abaxially glabrous to tomentose; leaf margin toothed, lower part with a few to many glandular teeth; teeth simple, irregularly doubly serrate or incised-serrate. Inflorescence is a terminal raceme, and 8–20 flowered. Hypanthium campanulate, pubescent. Perianth segments are usually 10, narrowly triangular, caducous, and pubescent, not differentiated into sepals and petals. Stamens 20–45, in 2 whorls, irregularly inserted on the rim of hypanthium. Style terminal, slender, glabrous, stigma disc-shape. Flowers are usually bisexual, sometimes polygamo-dioecious, female flowers with staminodes, a style much shorter than staminode, and stigma capitate. Ovary 1- to rarely 2-locular, glabrous. Drupe ovoid, glabrous, dark purple to black. Four species are distributed in temperate regions of the Himalayas and eastern to western China. (Chin et al., 2010; Wen & Shi, 2012). Note: -- The *Maddenia* group has been shown recently to be nested within *Prunus* L. Chin et al. (2010) showed *Maddenia* Hook.f. & Thomson as a monophyletic group closely allied with the temperate members in subgenera *Laurocerasus* and *Padus* of *Prunus,* and they transferred species of *Maddenia* to *Prunus.* The *Maddenia* clade contains a small group of trees distributed in temperate regions of the Himalayas and eastern to western China (Rehder, 1940; Yu et al., 1986; Chin et al., 2010).

Hooker and Thomson (1854) described the genus *Maddenia* in honor of Major E. Madden for his contribution to the botany of the Himalayan region. *Maddenia* was distinguished from *Prunus* by its flowers with ten sepaloid perianth segments, *e.g.,* petals not differentiated from sepals (Rehder, 1940). The variable number of indistinguishable perianth segments was used as a diagnostic character.

1. ***Prunus himalayana* (Hook. f. & Thomson) J.Wen,** in Botanical Journal of the Linnean Society. 164: 243. 2010; Watson, M.F. et al. (eds.). Flora of Nepal 3: 1–425. 2011; Merr., Brittonia; a Series of Botanical Papers. 4: 88. 1941; Lu Lu et al. in Z. Wu & P.H. Raven (eds.). Flora of China 9: 1–494. 2003; J.Wen, Phytokeys. 11: 54–57 f. 4. 2012. Type as for the basionym below.

≡ *Maddenia himalaica* Hook.f. & Thomson, in Hooker's Journal of Botany and Kew Garden Miscellany. 6: 381, P. 7. 1851; *ibid.*, 6: 380. t. 12. 1854; Hook.f., The Flora of British-India 2:

318. 1878; Merr., Brittonia; a Series of Botanical Papers. 4: 88. 1941, non *Prunus himalaica* Kitam., Acta Phytotaxonomica et Geobotanica. 15(5): 131. 1954.

Typification**: INDIA, Sikkim Lachen**, 8–1,000 ft alt., 9 July 1849, *J.D. Hooker, s.n.* (lectotype **K**000396855!, designated by J.Wen, 2010, isolectotype **K**000396856!).

Description: Deciduous, understory, shrub to small tree (2–)3.5–10 m tall, canopy shape oval, broad horizontally spreading. **Stem** erect or straggling; outer bark dark brown, smooth with prominent brown horizontal lenticels, spines absent; inner bark, strong almond smell. **Branchlets** greyish-brown with brown lenticels; young twigs reddish-purple, usually densely brown pubescent to sparsely hairy, with many cataphylls at the base; old twigs densely pubescent. *Axillary winter bud* solitary, purplish-brown, ovoid, scales 3–23 mm long, 3–12 mm wide, broad to narrowly ovate, outside brown pubescent; *terminal winter bud* present. **Leaves** plicate in bud and extended during flowering, fascicled on short shoots, spiral and alternate on annual twigs, ovate-oblong, elliptic to ovate, 6.5–13.5 cm long × 2.7–6 cm wide; *lamina apex* acute; *margin* doubly serrate to serrulate in the upper 2/3, glandular serrate in the lower 1/3, with sharp irregularly spaced teeth, sinus angular, stipitate at base and apex glandular serrate, glabrous; *base* asymmetrical or slightly asymmetrical, subcordate to broadly cuneate; young leaves reddish-purple turning to pale green, light green to sub-glossy green adaxially, pale green abaxially, long pubescent along the veins, turning yellow before falling, chartaceous, densely pubescent; old leaves densely pubescent, pubescent along veins adaxially and abaxially; *basal glands* many, up to 2 mm long, stalk, capitate, basal margin glandularly serrulate in the lower 1/3, sometimes up to 3/4, apex serrate; *2° venation* weakly brochidodromous, 12–20 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, impressed adaxially, prominent abaxially, forming a narrow angle (< 45°); *3° venation* mixed alternate and opposite percurrent, impressed adaxially; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.2–0.5 cm long, shallowly canaliculate in cross-section, densely brown hairy; *petiolar glands* absent. **Stipules** large, 12–25 mm long × 2–5.5 mm wide, lanceolate to broadly oblong, leaf-like, membranaceous, apex acuminate to acute, marginal teeth glandular, base rounded, pubescent abaxially, glabrescent adaxially, with glandular teeth in the lower 1/3 - 1/2, or sparsely glandular on the stipule blade, caducous. **Inflorescences** compound, solitary raceme, dense-flowered, flowering shoot with leaf blade, usually terminal on new branchlets, opening with young leaf blade ovate to ovate-lanceolate, 5–10 cm long, 2–5 cm wide, apex acuminate to caudate, 3.5–6 cm long, 8–18-flowered, densely brown pubescent, bracts broadly lanceolate, narrowly ovate, 6–14 × 2–5 mm, membranaceous, pubescent on both surfaces, margin with sparse glandular teeth, caducous. **Flowers** bisexual or female with stamens reduced to staminodes, opening at the same time as new leaves, whitish-brown; pedicels stout and short, 2.5–5 mm long, densely brown pubescent; *bracteoles* ovate to linear-triangular, up to 4 mm long, greyish-green to brown, densely pilose, whitish-brown hairs outside, glabrescent to glabrous inside, margin ciliate, caducous after anthesis; *hypanthium* campanulate to broadly campanulate, 3–4 mm long, greenish-brown, densely brownish-pubescent; *perianth* petals equal or slightly different in shape and size from calyx lobes; *calyx* lobes 10, narrowly triangular, minute, 1.5–2 mm long × 1–1.5 mm wide, subequal, apex acute to sub-obtuse, margin entire, ciliate, base oblong, separate or valvate in bud, spreading when mature, deciduous, densely brown pubescent outside, glabrescent inside; *corolla* spreading to upright, petals, elliptic-oblong, shortly unguiculate, apex acute to obtuse, margin entire, ciliate, base truncate to oblong, alternate or opposite calyx lobes, sparsely pubescent outside, sparsely hairy inside; *stamens* 30–40, in 3 to many series, exserted; filament filiform, white, 4–7.5 mm long, glabrous; anthers oblong, 0.5–0.6 mm long, pale yellow; *ovary* glabrous, 1- or occasionally 2-locular, sometimes developing into twin fruits; *style* filiform, 5–11 mm long, slightly longer than stamens or female flower with minute pistillode, glabrous; stigma capitate to sub-peltate. *Infructescence* 5–8 cm long, densely brown pubescent, few (4–10) fruits. **Fruits** stipitate, 5–8 mm long, young fruit green, dark purple to black when mature or ripe, ovoid, 8–10 cm long, 5–5.5 cm wide, apex acute to slightly obtuse; young and mature fruits glabrous; exocarp smooth, shallow ventral longitudinal groove; mesocarp fleshy, succulent, adnate to endocarp, dark purple; endocarp stone brown to light brown, ellipsoid to suborbicular, compressed, 1–25 mm long, 8–20 mm wide, and 10–14 mm deep, base round, asymmetric, apex acute to acuminate, surface pits sometimes present, deeply longitudinally and transversely furrowed; calyx deciduous; style absent or if present forming a peak or apiculum up to 1 mm long. **Seeds** oval to circular in cross-section, thin, with glabrous shallowly reticulate testa, endocarp glabrous inside.

Additional specimens examined.— **BHUTAN**. **Bumthang**: Tang Rudo La, 27°35'00.1" N, 90°53'60.0" E, alt. 3,200 m, 18 May 1948, fl., *F. Ludlow*, *G. Sherriff & J.H. Hicks 18883* (**BM**001052153!);– **Lhuentse**: Menbi Kulu Chu river, Lhuntse Dzong, 27°39'14.0" N, 91°12'37.1" E, alt. 3,000 m, 25 April 1949, fl., *F. Ludlow*, *G. Sherriff & J.H. Hicks 18756* (**BM**001052154!);– **Trongsa**: 27°31'00.0" N, 90°34'00.0" E, 30 April 1967, fl., *H. Hara*, *H. Kanai*, *G. Murata*, *H. Ohashi*, *I. Tanaka & T. Yamazaki 8284* (**BM**!);– **Yangtse**: Bumdeling, 27°52'00.0" N, 91°28'00.0" E, alt. 2,743 m, 23 May 1947, fl., *F. Ludlow*, *G. Sherriff & H.H. Elliot 12522* (**BM**001052155!). **CHINA, Tibet**, Southeast, alt. 3,330 m, June 1932, *Joseph F. Rock 22026* (**K**!);– **Xizang**: Bomi Xian, From Bomi to Ga Wa Long alpine lake., 29°49'22.8" N, 95°42'32.8" E, alt. 3,453 m, 22 June 2009, fr., *J.Wen*, *Z. Nie*, *L. Xie*, *Y. Niu*, *G. Li*, *F. Yang*, *S. Lutz & J. Van De Veire 2612* (**P**!, **US**01061632†);– **Yunnan**: Tengchong, Houqiao, 25°32'42" N, 98°13'9" E, alt. 2,600 m, 29 May 2006, fl., *L. Heng*, *D. Zhiling*, *J. Yunheng*, *J. Xiaohua*, *B. Bartholomew*, *L Zhou. & N. McCheyne 30758* (**BC**42873†). **INDIA**. **Sikkim**: May 1885, fr., *Robert Pantling, C.B. Clark 46514C* (**BM**001052163!, **K**!);– April *s.n.*, lvs., *J.D. Hooker & T. Thomson*, *s.n.* (**L**1902836;– Lachung, 27°41’20.6” N, 88°44’34.7” E, 4 May 1971, fr., *Simon Alexander Bowes-Lyon 6022* (**BM**001052156!). **MYANMAR**. **Upper Burma, Laktang**: Adung valley, Sikkim and Bhutan, alt. 3,000 m, 3 April 1931, fl., *F. Kingdon Ward 9340* (**E**!). **NEPAL**. **Gola**: 5 May 1962, fr., *K. Nishioka 224* (**KYO**!);– **Papung**: Mechi, Mewa Khola, 16 May 1965, fr., *John*

David Adam Stainton 310 (**BM**001052161!).;– **Taplejung**: 19 July 1978, fr., *H. Tabata*, *R. Keshab*, *Rajbhandari & Y. Shimizu 11698* (**KYO**!).

Distribution.— N. India, Tibet, Nepal, Bhutan, N. Myanmar, and W. China. (**Map 4.1.**)

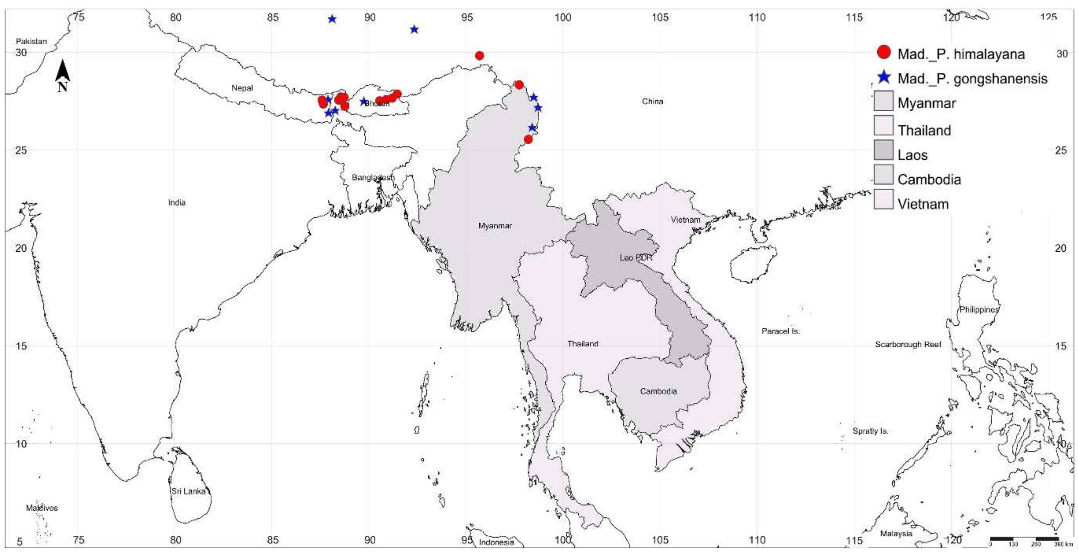
Vernacular name. **— China:** Himalaya chou ying. **Tibet**: Jyokun shin.

Ecology.**—** Edge of Lower Montane to Upper Montane forest, 2,000–3,400 m alt.

Phenology.**—** Flowering April–June, fruiting May–August.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 148,636.53 km^2; AOO = 76.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.1. Distribution of *Prunus himalayana* (Hook.f. & Thomson) J.Wen, and *P. gongshanensis* J.Wen, of subg. *Maddenia* in continental Southeast Asia and nearby.

2. ***Prunus gongshanensis*** **J.Wen,** in PhytoKeys. 11: 54–57 f. 4. 2012.

Typification**: CHINA,** Yunnan, Gongshan Xian, Gongshan, on the way from Qingnatong to Anwalong, 3,100 m, small tree 4 m tall, in the valley in shrublands, 31 May 1979, fl., flowers white, common, *Lujiang Expedition 790292* (holotype **KUN**†; isotype **KUN**, *non vidi*).

=*Maddenia himalaica* var. *glabrifolia* H.Hara, Journal of Japanese Botany. [Shokubutsu Kenkyu Zasshi]. Tokyo 51(1): 8. 1976.

Typification: **BUTAN**. **Rukubi**: Chendebi, 2600 m, 14 April 1967, *H. Kanai*, *G. Murata*, *H. Ohashi*, *O. Tanaka* & *T. Yamazaki 4191* (holotype **TI**†; isotype **BM**000622228!, **E**00010529!, **K**!, **KYO**4025!).

Description: Deciduous, shrub to small tree 4–8 m tall, understory, canopy shape oval, broad horizontally spreading. **Stem** erect or straggling; outer bark dark brown, smooth with large brown horizontal lenticels, spines absent; inner bark, strong almond smell. **Branchlets** moderate, greyish-brown with brown lenticels; young twigs reddish-purple, reddish-brown, usually sparsely hairy to pubescent, with many cataphylls at base; old twigs glabrescent. *Axillary winter bud* solitary, purplish-brown, ovoid, scales 4–23 mm long, 3–12 mm wide, broad to narrowly ovate, outside brown pubescent, glabrous inside; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral and alternate on annual twigs, oblong, elliptic to ovate, 5–13 cm long × 2–6 cm wide; *lamina apex* acuminate, angle acute; *margin* doubly serrate in the upper 2/3, glandularly serrulate in the lower 1/3, teeth at the margin sharp, teeth irregularly spaced, sinus angular, stipitate at base and apex glandular serrate, glabrous; *base* asymmetrical or slightly asymmetrical, subcordate to broadly cuneate; young leaves reddish-purple to pale green, light green to sub-glossy green adaxially, pale green abaxially, long pubescent along the veins, turning yellow before falling, chartaceous; young leaves densely to sparsely pubescent; old leaves densely to sparsely pubescent, sparsely hairy or pubescent along veins adaxially, glabrescent abaxially; leaf blade with stalk or capitate glands up to 2 mm long basally, margin glandularly serrulate in the lower 1/3, sometimes whole leaf, apex serrate with conspicuous tufts of pubescence on lateral vein axils; *2° venation* weakly brochidodromous, 12–20 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, impressed adaxially, prominent abaxially, narrow angle (< 45°); *3° venation* mixed alternate and opposite percurrent, impressed adaxially; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles*, 0.4–0.8 cm long, shallowly canaliculate in cross-section, densely brown hairy; *petiolar glands* absent. **Stipules** large, 12–25 mm long × 2–8 mm wide, lanceolate to broadly oblong, leaf-like, membranaceous, apex acuminate to acute, marginal teeth glandular, base rounded, pubescent abaxially, glabrescent adaxially, glandular teeth on the lower 1/3 - 1/2, or sparsely glandular on the stipule blade, caducous. **Inflorescences** compound, solitary raceme, dense-flowered. Flowering usually at the end of a new shoot, opening with young leaf blade, ovate to ovate-lanceolate, 5–10 cm long, 2–5 cm wide, apex acuminate to caudate, 4–6 cm long, 12–16 flowers, densely brown pubescent; *bracts* broadly lanceolate, narrowly ovate, 6–14 mm long × 2–5 mm wide, membranaceous, pubescent outside, glabrescent inside, margin with sparse glandular teeth, caducous. **Flowers** bisexual or female with stamens reduced to staminodes, opening at the same time as new leaves, whitish-brown; pedicels stout and short, 2.5–4 mm long, densely brown pubescent; *bracteoles* ovate to lanceolate, up to 4 mm long, greyish-green to brown, densely pilose, whitish-brown hairs outside, glabrescent to glabrous inside, margin ciliate, caducous after anthesis; *hypanthium* campanulate to broadly campanulate, 4–6 mm long, greenish-brown, densely brownish-pubescent; *perianth* petals slightly different from calyx lobes; *calyx* lobes 10, narrowly triangular, minute, 1.5–3.5 mm long × 0.7–1 mm wide, subequal, apex acute to sub-obtuse, margin entire, ciliate, base oblong, separate or valvate in bud, spreading when mature, deciduous, densely brown pubescent outside, glabrous inside; *corolla* perianth, spreading to upright, sepals and petals lobes equal or slightly different in shape & size, as long as calyx lobes, elliptic-oblong, shortly unguiculate, apex acute to obtuse, margin entire, ciliate, base truncate to oblong, alternate or opposite calyx lobes, sparsely pubescent outside, sparsely hairy inside; *stamens* 25–45 in 3 to many series, exserted; filament filiform, white, 5–7 mm long, glabrous; anthers oblong, 0.3–0.4 mm long, pale yellow; *ovary* glabrous, 1- or occasionally 2-locular, sometimes developing into twin fruits; *style* filiform, 7–9 mm long, as long as stamens or slightly shorter than stamens or female flower with minute pistillode, glabrous; stigma capitate to sub-peltate. *Infructescence* 4–6 cm long, densely brown pubescent, 4–8 fruits. **Fruits** stipitate, 5–8 mm long, young fruit green, dark purple to black when mature or ripe, ovoid, 8–9 cm long, 5–6.5 cm wide, apex acute to slightly obtuse; young and mature fruits glabrous; exocarp smooth, ventral shallow longitudinal groove; mesocarp fleshy, succulent, adnate to endocarp, dark purple; endocarp stone brown to light brown, ellipsoid to suborbicular, compressed, 13–25 mm long, 8–20 mm wide, and 10–14 mm deep, base round, asymmetric, apex acute to acuminate, surface pits sometimes present, deeply longitudinally and transversely furrowed; calyx deciduous; style absent or present forming a peak or apiculate up to 1 mm long. **Seeds** oval to circular in cross-section, thin, with glabrous shallowly reticulate testa, endocarp glabrous inside.

Additional specimens examined.— **BHUTAN**. **Eastern Himalaya**: 28 April 1967, fl., *H. Hara*, *H. Kanai*, *G. Murata*, *H. Ohashi*, *O. Tanaka & T. Yamaraki 10319* (**K**!). **BHUTAN**., 14 May 1967, fl., *H. Hara*, *H. Kanai*, *G. Murata*, *H. Ohashi*, *O. Tanaka & T. Yamaraki 21806* (**K**!);– Punakha, 27°30'5.6" N, 89°45'12.4" E, 19 April 1982, fl., *A.J.C. Grierson & D.G. Long 4481* (**K**(H2010101913_31)!). **CHINA**. Tchen Keou Tin, May 1897, fl., *R.P. Farges*, *s.n.* (**P**!);– **Tibet**: Xizang: Kenichunpo, May 1932, fl., *F. Rock Joseph 2206* (**BM**001052176!, **K**(H2010101913_19)**!**);– **Yunnan**: Shan, Dulong Jing valley, 27°42'28" N, 98°29'49.0" E, 15 July 2000, fl., *L. Heng*, *B. Bartholomew*, *P. Thomas*, *P. Fritsch*, *D. Zhi-ling*, *W. Zhong-lan & L. Rong 12626* (**CAS**0042875†, **K**!);– *ibid.*, Shibali, 27°11'06" N, 98°43'12.0" E, 8 May 2004, fl., *L. Heng*, *B. Bartholomew*, *P. Thomas*, *P. Fritsch*, *D. Zhi-ling*, *W. Zhong-lan & L. Rong 20474* (**CAS**0042874†, **K**!). **INDIA**. **Sikkim**: Dentam, 25 April 1966, fl., *John David Asam Stainton 5358* (**BM**001052151!);– *ibid.*, Ninhong, July 1900, fl., *P. Sammler*, *s.n.* (**U**†). **MYANMAR**. **Upper Burma, Laktang**: Adung valley, 26°10'00.0" N, 98°25'00.0" E, 3 April 1931, fl., *F. Kingdon-Ward 9340* (**E**00419971!);– *ibid.*, Advance base, Sengkhu, 1 June 1926, fl., *F. Kingdon-Ward 6811* (**K**(H2010101912_12)!);– **NEPAL**. **East Bengal**: Ilam, Mechi, 26°54'22.0" N, 87°56'02.0" E, 4 May 1891, fl., *John David Asam Stainton 8264* (**BM**001052160!).

Distribution.— N. India, Bhutan, Nepal, N. Myanmar, and W. China.

Vernacular name. **—** Not known.

Ecology.**—** Shady valleys of Lower Montane to Upper Montane Forest, alt. 1,600–3,500 m.

Phenology.**—** Flowering March–July, fruiting April–August.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 255,883.22 km^2; AOO = 52.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

4.3.2. Subgenus *Amygdalus* Linnaeus, Species Plantalum. 1: 676–677. 1753; Koehne, Deutsche Dendrol.: 302. 1893; Lingdi in Lu et al. Flora of China. 9: 394. 2003; Yazbek (2010). Systematics of *Prunus* Subgenus *Amygdalus* Monograph and Phylogeny. 2010. – genus *Amygdalus*, *pro parte,* Tourn., Institutiones Rei Herbariae.: 627. 1700. – genus *Persica, pro parte,* Tourn., *ibid*.,:624. 1700.

Description: Trees or shrubs, deciduous. Branches unarmed or spiny. Axillary winter buds (2 or 3), lateral one(s) flower buds, central one a leaf bud; terminal winter buds present. Stipules present. Leaves simple, alternate, sometimes fascicled in short branchlets, conduplicate when young; petiole usually with 2 nectaries or sometimes nectaries at the base of leaf blade margin; leaf blade margin usually serrate. Inflorescences born on short axillary branches, 1(or 2)-flowered. Flowers are bisexual, regular, opening before or rarely with leaves. Pedicel nearly sessile or short, rarely longer. Sepals 5, imbricate. Petals 5, pink or white, inserted in the rim of hypanthium, imbricate. Stamens 15 to many, inserted with petals; filaments filiform, free. Ovary superior, usually hairy, 1-loculed; ovules 2, collateral, pendulous. Style terminal, elongated. Fruit a drupe, hairy, glabrous in some cultivated, *Amygdalus persica,* with a conspicuous longitudinal groove; mesocarp fleshy and not splitting when dry, or splitting when ripe; endocarp hard, 2-valvate, globose or ellipsoid, usually laterally compressed, surface furrowed, pitted, rugose, or smooth.

3. ***Prunus persica* (L.) Batsch**, Beytrage und Entwurfe zur Pragmatischen Geschicte der Drey Naturreiche Nach Iihren Verwandtschaften. 30. 1801; Kurz, Forest Flora of British-Burma 1: 433. 1877; Hook.f., The Flora of British-India, London. 2 (5): 313. 1878; Cardot, in Flore Générale de L'Indo-Chine: 629. 1920; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 534. 1933; Merr., Brittonia; a Series of Botanical Papers. 4: 89. 1941; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 165–168, pl. xxii, 10. 1968; *Ibid.*, in Flora of Thailand 2 (1): 67–68. 1970; Tirvenggadum, in F.R. Fosberg. A Revised Handbook of the Flora of Ceylon. 3: 373. 1981; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 349. 1993.

≡ *Amygdalus persica* L., Species Plantarum. 1: 472. 1753.

Typification: Sweden, Uppsala, sterile specimen, Pehr Kalm, *Herb. Linn. No. 639.2* (lectotype **LINN-HL**639-2†), designated by Balanca & Diaz de la Guardia in Cafferty & Jarvis, Taxon. 51: 541. 2002.

– *Prunus persica* (L.) Stokes, A Botanical Materia Medica. 3: 100. 1812.

– *Prunus persica* (L.) Siebold & Zucc., Historiae Naturalis in Japonia Statu. 122. 1845.

≡ *Persica vulgaris* Mill., Gardeners Dictionary, Edition 8. n. 1: 1. 1768.

Typification: Common Peach tree with double flowers. Tournefort Inft. *R.H. 625*.

–*Prunus persica* subsp. *vulgaris* (Mill.) Dippel, Handbuch der Laubholzkunde. Berlin 3: 605. 1893, include–var. *alba* (Lindl.) Holub bis in Vedecke Prace Ovocnarske. 6: 310. 1977;– var. *albaplena* (C.K.Schneid.) Holub bis *ibid.* 6: 310. 1977;– var. *atropurpurea* (C.K.Schneid.) Holub bis *ibid.* 6: 309. 1977;– subsp. *atropurpurea* (C.K.Schneid.) Zaiats, Ukrayins'kyi Botanicnyi Zhurnal. Kiev. (The Ukrainian Botanical Journal). 57(1): 54. 2000;– var. *camelliiflora* (Dippel) Holub bis *ibid.* 6: 311. 1977;– var. *densa* (Makino) Holub bis *ibid.* 6: 308. 1977;– var. *dianthiflora* (Van Houtte) Holub bis *ibid.* 6: 311. 1977;– var. *duplex* (Weston) Holub bis *ibid.* 6: 311. 1977, nom.;– var. *magnifica* (Bean) Holub bis *ibid.* 6: 311. 1977;– var. *pendula* (Dippel) Holub bis *ibid.* 6: 312. 1977;– var. *pyramidalis* (Dippel) Holub bis *ibid.* 6: 312. 1977.

≡ *Amygdalus communis* var. *persica* (Batsch) Risso, Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes Maritimes. 2: 327. 1826.

= *Amygdalus persica* var. *nucipersica* L., Species Plantarum. 1: 472. 1753.

–*Amygdalus persica* L. var. *nectarina* Aiton, Hortus Kewensis, or A catalogue of the plants cultivated in the Royal Botanic Garden at Kew. 2: 161. 1789. – *Persica nucipersica* (L.) Borkh., Versuch einer Forstbotanischen Beschreibung der in den Hessen-Darmstadtschen. 205. 1790. –*Amygdalus nucipersica* (L.) Rchb., Flora Germanica Excursoria. 647. 1832. –*Prunus persica* subsp. *nucipersica* (L.) Dippel, Handbuch der Laubholzkunde. 3: 606. 1893. –*Prunus persica* var. *nucipersica* (Suckow) C.K.Schneid., Illustriertes Handbuch der Laubholzkunde (C.K.Schneider). 1(5): 594. 1906. –*Persica vulgaris* var. *nectarina* (Aiton) Holub bis in Vedecke Prace Ovocnarske. 6: 305. 1977. –*Persica vulgaris* convar. *nucipersica* (L.) Holub, in Folia Geobotanica et Phytotaxonomica. 28: 107. 1993.

Type, *non vidi*.

=*Persica amygdalus* Mill., Gardeners Dictionary, Edition 8. n. 3: 1. 1768. Dwarf almond with a single flower, *nom. inval.* Type, *non vidi*.

=*Amygdalus persica* L. var. *plena* Aiton, Hortus Kewensis, or A catalogue of the plants cultivated in the Royal Botanic Garden at Kew. 2: 161. 1789. Double-flower's Peach tree. Natural Culture. 1562. I have not seen the located type specimen of the variety. Type, *non vidi*.

= *Persica laevis* DC. in DC. & Lamarck Flore Francaise. Edition 3: 4. 487. 1805. – *Amygdalus laevis* (DC.) D. Dietr., Synopsis Plantarum seu enumeratio systematica plantarum. 3: 42. 1843. Type, *non vidi*.

= *Persica domestica* Risso, Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes Maritimes. 2: 104. 1826. – *Prunus persica* (L.) Batsch subsp. *domestica* (Risso) D. Rivera, Obón, S. Ríos, Selma, F. Méndez, Las

Variedades Tradicionales de Frutales de la Cuenca del río Segura: Catálogo Etnobotánico. Murcia. 1: 293. 1997. Type, *non vidi*.

= *Persica vulgaris* var. *compressa* Zaiats in Loudon Arboretum et Fruticetum Britannicum. 2: 680. 1838;– *Prunus persica* var. *compressa* (Loudon) Bean, Trees and Shrubs Hardy in the British-Isles. 2: 248. 1914. Type, *non vidi*.

=*Amygdalus persica* var. *stellata* Siebold & de Vriese in Annales d'Horticulture et de Botanique ou Flore des Jardins du Royaume des Pays-Bas. Leiden. 2: 65. 1859. – *Amygdalus persica* f. *stellata* (Siebold & de Vriese) H.Ohba & S.Akiyama, in Journal of Japanese Botany. (Shokubutsu Kenkyu Zasshi). Tokyo. 89(5): 287. 2014. Type, *non vidi*.

= *Persica pendula* Siebold, Catalogue raisonné et prix-courant des plantes et graines du Japon et de la Chine. 36. 1863, *nom. nud.*

– *Amygdalus persica* f. *pendula* (Siebold) H.Ohba & S.Akiyama, in Journal of Japanese Botany. 89(5): 290. 2014. *nom. nud.*

– *Amygdalus persica* f. *versicolor* (Siebold) H.Ohba & S.Akiyama, in Journal of Japanese Botany 89(5): 290. 2014.

Typification**: JAPAN,** *P.F. von Siebold*, *s.n.* (**L**0102984†), designated by Hideaki Ohba & Shinobu Akiyama, 2014.

= *Persica platycarpa* Decne., Le Jardin Fruiter du Muséum. 7: 42. 1875.

– *Prunus persica* var. *platycarp*a (Decne.) L. H. Bailey, Cyclopedia of American horticulture, comprising suggestions for cultivating horticultural plants. 3(2): 1457. 1902. Type, *non vidi*

= *Prunus daemonnifuga* H.Lév. & Vaniot, Bulletin de la Société Botanique de France. 55: 58. 1908.

Typification**: CHINA, Kiang-sou**: Tao-chou, Tao-tze-chou, *Rev. Pere C. d' Argy*, *plate no. 1843* (holotype **E**00011265!, isotype, **A**00032043†).

= *Prunus persica* Sieb. et Zucc. var. *longistyla* H.Lév. & Vaniot, Bulletin de la Société Botanique de France. 55: 58. 1908.

Typification: Unknown Country, *s. coll.*, *plate no. 1845* (lectotype **A**00032138†), designated by H.Lév. & Vaniot, 1908.

= *Prunus persica* f. *aganonucipersica* (Schübl. & G.Martens) Rehder, Journal of the Arnold Arboretum. 3(1): 25. 1922. Type, *non vidi*

– *Amygdalus persica* var. *aganonucipersica* (Schübl. & G.Martens) *T.T. Yu* & *L.T. Lu* in Flora Reipublicae Popularis Sinicae. 38: 18. 1986, including – var. *compressa* (Loudon) *T.T. Yu* & *L.T. Lu*, *ibid.* 38: 19. 1986;– var. *scleronucipersica* (Schübl. & G.Martens) *T.T. Yu* & *L.T. Lu*, *ibid.* 38: 19. 1986;– var. *scleropersica* (Rchb.) *T.T. Yu* & *L.T. Lu*, *ibid.* 38: 19. 1986.

=*Persica fergenensis* Kostina & Riab. In Bulletin of Applied Botany, of Genetics and Plant Breeding-Fruits and Small Fruits, Leningrad., Ser. 8(no.4): 75. 1935, *comb. nomen*. *inval*. Without synonym. Invalid publication. Type, *non vidi*

–*Prunus persica* subsp. *ferganensis* Kostina & Rjabov in Trudy Prikl. Trudy po prikladnoj botanike, genetike i selekcii. Serija A. Socialisticeskoe rastenievodstva. Bulletin of applied botany, genetics, and plant-breeding. Ser. 8, Plodovye Yagodnye Kul't. 1: 323. 1932.

= *Prunus persica* var. *aposarca* Burkart, in Darwiniana. 17: 451. 1972.

Typification: Argentina, Cordoba. Cruz Chica cerca de La Cumbre, 1,500 m, 26 February 1957, *A. Burkart 20440* (holotype **SI**003170†).

= *Prunus persica* subsp. *floriplena* Burkart, in Darwiniana 17: 447. 1972. Type, *non vidi*

–*Amygdalus ferganensis* (Kost. & Rjab.) T.T. Yu & *L.T. Lu* in Flora Reipublicae Popularis Sinicae. 38: 20. 1986.

–*Prunus ferganensis* (Kostina & Rjabov) Y.Y.Yao ex Y.H.Tong & N.H.Xia in Biodiversity Science. 24: 715. 2016.

= *Persica vulgaris* subsp. *erythrocarpa* V.A.Zaiats in Ukrayins'kyi Botanicnyi Zhurnal. 57(1): 55. 2000. Type, *non vidi*.

= *Persica vulgaris* var. *pendula* V.A.Zaiats in Ukrayins'kyi Botanicnyi Zhurnal. 57(1): 54. 2000. Type, *non vidi*.

Description: Deciduous, understory, shrub to small tree 3–8(10) m tall, canopy shape oval, horizontally spreading. **Stem** erect or straggling; outer bark brown, dark brown to black, smooth with large brown horizontal lenticels, scabrous and squamose with age, spines absent; *inner bark* strong almond smell. **Branchlets** moderate, greyish-brown with many small greyish-brown lenticels; young twigs brownish-green, usually glabrous to sparsely hairy, with many cataphylls at base; old twigs brown, glabrous, short shoots present. *Axillary winter bud* often 2–3 in a bundle, conical, pubescent, apex obtuse; scale 3–6 mm long, pubescent, margin entire, apex rounded; *terminal winter bud* present. **Leaves** conduplicate in bud, usually extended after anthesis, fascicled on short shoots, spiral and alternate on annual twigs, elliptic-oblong, oblong-lanceolate, elliptic lanceolate or obovate-oblanceolate, 6.5–15 cm long × 1.5–3.5 cm wide; *lamina apex* acute; *margin* finely to coarsely serrate, teeth regular to slightly irregular spacing, sinus angular, apex glandular serrate, glabrous; *base* symmetrical or slightly asymmetrical, attenuate, broadly cuneate to rounded, with 2(–4) basal glands, larger and darker than upper teeth, not different from the petiolar glands, sometimes carried on the petiole; young leaves dull dark green adaxially, pale green abaxially, turning reddish-brown via yellow before falling, chartaceous; glabrescent to sparsely hairy; old leaves glabrous to sparsely hairy adaxially, glabrescent to pubescent abaxially; *basal glands* (0–) 2 (–4), up to 2 mm long, globose, ovate to oblong, on the petilole and basal leaf margin, serrate teeth apex; *2° venation* weakly brochidodromous, 8–16 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles*, 0.5–2 cm long, grooved to shallowly canaliculate in cross-section, glabrous to sparsely hairy; *petiolar glands* present, (0–)2–4 glands. **Stipules** medium, 5–12 mm long × 0.8–1.5 mm wide, linear, subulate, glandular, apex acuminate, margin apex glandular serrate, base oblong, glabrous to sparsely hairy, margin toothed glandular, early caducous. **Inflorescences** solitary flower, sparse-flowered, axillary, on fallen leaves branch or opening before leaves, sessile to very short, grey villose; *involucral bracts* 5–10, different sizes and shapes, up to 5 mm long, concave orbicular, greyish-brown, pubescent outside, apex rounded to obtuse, margin yellowish-grey ciliate, usually persistent at anthesis. **Flowers** bisexual, opening before new leaves, red to pink, sometimes white, 20–35 flowers; pedicels stout and short, 5–10 mm long, pubescent; *bracteoles* ovoid to subglobose, concave, up to 5 mm long, greyish-green to brown, densely pilose, whitish-brown hairs outside, glabrescent to glabrous inside, margin ciliate, caducous after anthesis; *hypanthium* shortly campanulate to broadly campanulate, 4–6 mm long, green with a red tinge to red, pubescent to subglabrous, rarely glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, elliptic-ovate to ovate-oblong, medium, 4–6 mm long × 3–5 mm wide, subequal, apex obtuse or rounded, margin entire, ciliate or with broad band of pubescent along margin, base oblong, imbricate in bud, spreading when mature, deciduous, densely hairy outside, sparsely hairy to glabrescent inside; *petals* white, pink to deep reddish-pink, spreading to upright, margin concave or recurved, 5(–25), medium to large, 10–20 mm long × 5–15 mm wide, subequal or unequal, 3–4 times as long as sepals, elliptic-oblong to broadly ovate, shortly unguiculate, apex round with a notched, margin glabrous, entire to sparsely hairy, or erose, base sessile to shortly unguiculate, alternate or opposite calyx lobes, glabrous to sparse hairy outside, glabrescent inside; *stamens* 25–35(–75, cultivated) in 3 to many series, exserted; filament filiform, white, 5–10 mm long, glabrous; anthers subglobose, 0.4–0.7 mm long, purplish-red to brown; *ovary* tomentose, 1 locular; *style* filiform, up to 5 mm long, as long as stamens to slightly longer than stamens, villose abaxially, glabrous adaxially; stigma peltate, yellowish-green. *Infructescence* sessile to 0.1–0.3 cm long, densely hairy, 1 fruited. **Fruits** stipitate, 2–5(–10) mm long, young fruit green, greenish-white to orange-yellow, usually with a red tinge on the exposed side when mature or ripe, ovoid, broad ellipsoid, or subglobose, compressed or slightly so, (3–)5–7(–12) cm long, (3–)5–8 cm wide, apex acute, acuminate to slightly obtuse; young fruits pubescent, glabrescent or glabrous; mature fruits pubescent, glabrescent or glabrous; exocarp smooth, conspicuous longitudinal with ventral groove; mesocarp fleshy, succulent, adnate to endocarp, white, greenish-white, yellow, orangish-yellow, or red, succulent, not splitting at maturity; endocarp stone brown to light brown, ellipsoid to suborbicular, compressed, 13–25 mm long, 8–20 mm wide, and 10–14 mm deep, base round, asymmetric, apex acute to acuminate, surface pits sometimes present, deeply longitudinally and transversely furrowed; calyx deciduous; style absent or present forming a peak or apiculate up to 1 mm long. **Seeds** slightly or laterally compressed on both surfaces, thick, with glabrous shallowly reticulate testa, endocarp glabrous inside (**Figure 4.1**).

Additional specimens examined.— **CHINA**. **Guangdong**: 23°06'00.3" N, 112°59'18.2" E, alt. 718 m, 1 June 1938, fr., *T.W Taam 869* (**BKF**049736!). **JAPAN**., 27 March 1987, fl., *S. Tsugaru*, *s.n.* (**KYO**!);– **Yamanashi**: Oshino-mure, 35°27'53.5" N, 138°51'10.1" E, alt. 800 m, 26 August 1984, fr., *M. Togashi*, *s.n.* (**KYO**!);– **Kyoto**: April 1908, fl., *G. Koidzumi*, *s.n.* (**KYO**!);– **N**. **Honshu**: 38°21'18.4" N, 140°53'25.1" E, 30 April 1973, fl., *H. Ohba*, *s.n.* (**KYO**!);– **Okayama**: 34°47'23.2" N, 133°53'49.5" E, alt. 300 m, 25 April 1976, fl., *G. Murata 1807* (**BKF**049686!). **LAOS**. **Northern, Houaphanh**: Sam Neua, 19 September 1920, lvs., *E. Poilane 1929* (**E**01020028!, **K**!, **MUS**†, **P**03372591!);– **Luang Prabang**: LAOS Tien, 17 September 1920, lvs., *A.J.B. Chevalier 2099* (P!);– *ibid.*, Ko Mak Khai, 2 November 1920, lvs., *A.J.B. Chevalier 2213* (**P**03372602!);– *ibid.*, 19 October 1920, lvs., *A.J.B. Chevalier 41088* (**P**03372584-5!);– **Oudomxay**: Baengkham, 20°18'31.2" N, 101°38'55.2" E, 22 March 2002, fr., *Kunsawanh K.*, *Vanavong B. & Saynhauing S. S197* (**L**4310336†);– **Phong Saly**: alt. 1,500 m, 7 May 1936, lvs., *E. Poilane 26001* (**L**1893425†, **P**03372601!);– *ibid.*, Lao Chan, Lao Phu Tai, alt. 1,500 m, 28 April 1936, fl., *E. Poilane 25939* (**P**03372584!);– *ibid.*, alt. 1,500 m, 28 April 1936, fl., *E. Poilane 25943* (**P**00509606!);– *ibid.*, alt. 1,500 m, 28 April 1936, lvs., *E. Poilane*, *s.n.* (**P**03372586!);– **Xiang Khouang**: 19°26'18.5" N, 103°40'25.4" E, December 1918, fl., *A.J.B. Knight & Leg. Mieville 9* (**K**!, **MUS**†, **P**00509607!);– *ibid.*, Brannisek, 7 November 1920, lvs., *E. Poilane 2298* (**L**1893426†);– *ibid.*, 10 November 1920, lvs., *E. Poilane: 41089* (**P**03372650!); *41090* (**P**03372643!); *41091* (**P**03372642!); *41092* (**P**03372637!); *41096* (**P**03372636!); *41098* (**P**03372634!); fl., *E. Poilane 41099* (**P**03372598!); fl., *E. Poilane 41100* (**P**03372594!);– *ibid.*, fl., *E. Poilane 41101* (**P**03372593!); *41102* (**P**03372609!); *41103* (**P**03372611!); *41104* (**P**03372612!); *41106* (**P**03372603!); *41107* (**P**03372603!); *41108* (**P**03372613!); fl., *41110* (**P**03372599!); fl., *41111* (**P**03372595!); fl., *41112* (**P**03372596!);– September 1921, lvs., *Miéville 63* (**E**01020027!, **K**!, **L**1893419†, **MUS**†, **P**03372651!);– *ibid.*, December 1921, lvs., *Miéville 23* (**P**03372648!);– *ibid.*, fl., *A.J.B. Chevalier & Miéville 45* (**P**00509602!). **MYANMAR**. Hpugukhu, 25°22'40.4" N, 97°23'49.2" E, December 1961, fl., *J. Keenan 3317* (**RAF**6257!).;– **Upper Burma, Kachin**: Ning W'Krok village, 26°40'N, 97°20'E, alt. 2,500 m, 18 January 1962, fl., *J. Keenan*, *U. Tun Aung & U. Tha Hla 3317* (**E**!00901046!);– *ibid.*, Sumprabum Kanang village, 26°40'N, 97°20'E, alt. 2,333 m, 27 December 1961, fr., *J. Keenan*, *U. Tun Aung & U. Tha Hla 3025* (**E**00901047!);– *ibid.*, Ning W'Krok village, 26°40'N, 97°20'E, alt. 2,333 m, 14 March 1962, lvs., *J. Keenan*, *U. Tun Aung & U. Tha Hla 3858* (**E**00901045!). **SRI LANKA**. **Ceylon**: Nuwarat Eliya, 5 December 1972, fl., *D.D. Tirvengadum & L.H. Cramer 81* (**L**1893421†, **P**03359449!). **THAILAND**. **Northern, Chiang Mai**: 19°54'29" N, 99°02'22" E, alt. 580 m, 26 February 1958, fl., *T. Smitinand 4378* (**BKF**049595!);– Fang, Mae Sun, 19°54'31" N, 99°02'24" E, alt. 1,396 m, 14 March 2019, fl. & fr., *S. Rueangruea*, *S. Kaithongsuk*, *A. Rueangruea*, *P. Uea-Ari & S. Chatrupamai SR195* (**BKF**221169!, **TCD**!);– *ibid.*, 19°54'35.8" N, 99°02'07.5" E, alt. 1,413 m, 11 December 2019, fr., *S. Rueangruea*, *T. Thananthaisong & P. Uea-Ari SR249* (**BKF**229831!, **TCD**!);– *ibid.*, 19°45'05" N, 99°01'22" E, alt. 1,266 m, 15 March 2019, fr., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR133* (**BKF**229753!, **TCD**!);– Chiang dao, Khun Hui Maekok, Doi Chiang Dao WS., 19°18'48.6" N, 98°42'35.9” E, alt. 1,600 m, 6 May 2001, fr., *T. Wongprasert 439* (**BKF!**);– *ibid.*, 19°23'14” N, 98°53'25” E, 16 October 1995, fl., *L. Williams 17128* (**BKF**049593!);– *ibid.*, 19°22'27” N, 98°50'50” E, alt. 1,600 m, 6 May 2001, fr., *T. Wongprasert 015-04* (**BKF**133284!);– Chom Thong, Mae Klang village, Doi Inthanon NP., 18°32'37.1” N, 98°31'05.0” E, alt. 1,300 m, 6 December 1984, fl., *H. Koyama*, *C. Phengklai 40020* (**BKF**121230!);– *ibid.*, 18°31'52.6" N, 98°31'35.9" E, alt. 1,300 m, 29 January 1993, fl., *J.F. Maxwell 93-103* (**BKF**188679!, **CMUB**01206!);– *ibid.*, 18°32'24.8" N, 98°33'28.8" E, alt. 326 m, 6 May 2010, fr., *P. Georgiadis 326* (**CMUB**33529!);– *ibid.*, Ang Kha Noi village, 1 June 1979, fr., *J.E.Vidal, Vidal Y. & C. Niyomdham 6274 B* (**P**03372659!);– Mueang, Doi Suthep-Pui NP., 18°47'28” N, 98°55'58” E, alt. 1,250 m, 29 October 1988, fl., *J.F. Maxwell 88-1253* (**BKF**049592!);– Mae Taeng, Hui Nam Dung, 19°18'15.2” N, 98°35'56.6” E, alt. 1,670 m, 18 January 1983, fr., *H. Koyama*, *H. Terao & T. Wongprasert 32694* (**BKF**116751!);– Mae Rim, Mae Sa Mai village, 18°51'13.2” N, 98°51'40.1” E, alt. 1,325 m, 14 June 2001, fr., *J.F. Maxwell 01-300* (**BKF**143723!, **CMUB**18522!, **L**4194267†);– **Chiang Rai**: Mae Fang, 19°46'04.8” N, 99°22'26.9” E, 3 November 1928, fl., *Winit 1874* (**BKF**!, **K**!, **P**03372646!);– *ibid.*, Phu Lung Ka, 20°17'42” N, 99°48'47” E, alt. 600 m, 29 June 1954, lvs., *T. Smitinand*, *s.n.* (**BKF**049594!);– **Mae Hong Son**: Pang Mapha, Bor Krai village, 19°40'27.8” N, 98°15'27.8” E, 17 May 2011, lvs., *P. Georgiadis 578* (**P**00950228!);– *ibid.*, 18°18'48” N, 97°48'37” E, alt. 1,000 m, 29 March 1977, fr., *B. Nimanong 1716* (**BKF**213020, **BKF**210674!);– **Nan:** Doi Wao, 19°06'10.0” N, 100°43'05.1” E, alt. 1,330 m, 24 February 1912, fl., *A.F.G. Kerr 2450* (**BM**!, **K**!, **TCD**0016628!);– Chaloem Pra Kiat, Khun Nan, 19°30'20” N, 101°12'47” E, alt. 1,020 m, 24 March 2019, fr., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR151* (**BKF**229731!, **TCD**!);– *ibid.*, alt. 1,019 m, 24 March 2019, fr., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR149* (**BKF**229735!, **TCD**!);– *ibid.*, *SR150* (**BKF**229733!, **TCD**!);– Phitsanulok: Nakhon Thai, Noen Phoem, Phu Hin Rong Khla NP., 17°00'14” N, 100°59'39” E, alt. 1,000 m, 13 November 2004, fr., *O. Kudjabnak, D. Watanachaiyingcharoen 0086* (**BKF**152945!). **VIETNAM**. **Annam, Thanh Hoa**: Phong Y., Lang Oi, 12 July 1920, lvs., *E. Poilane 1624* (**BKF**182473!, **P**!);– Hoi Xuan, 18 August 1920, fr., *A.J.B. Chevalier 14269* (**E**01020024!, **K**! **MUS**†, **P**00509605!);– *ibid.*, 18 August 1920, lvs., *A.J.B. Chevalier 41266* (**E**01020025!, **L**1893424†);– Phu Quang, 26 July 1920, fr., *A.J.B. Chevalier 14265* (**E**01020026!, **K**!, **L**1893423†, **MUS**†);– Quan Hoa, Hoi xuan, 18 August 1920, fl., *A.J.B. Chevalier & E. Poilane 41269* (**E**01020024!, **P**00509605!);– **Cochinchine, Lam Dong**: July 1891, lvs., Pavie, *s.n.* (**P**03372645!);– **Phuc Nhac**: 13 January 1883, fl., *Bon H.*, *s.n.* (**P**03372694!);– **Tonkin, Cao Bang**: Khao Son, Pia Houac, November *s.n.*, fl., *E. Poilane 18970* (**P**00509604!);– *ibid.*, alt. 1,000 m, 15 February 1931, fl., *E. Poilane 18972* (**K!, L**1893349†**, MUS**†, **P**03372658!);– Piahouac, Binh Duong, alt. 1,000 m, 19 November 1921, lvs., *E. Poilane 19121* (**K**!, **MUS**†, **P**03372653!);– *ibid.*, alt. 1,000 m, 16 February 1931, fl., *E. Poilane 19045* (**K!, L**1893422†, **MUS**†, **P**03372660!);– **Tonkin, Sapa**: Bidoup Lamdong, 8 km to Lo-Qui village, 1 August 1926, fl., *E. Poilane 12760* (**K**!, **MUS**†, **P**03372656!, **VNM**00013192!);– **Chu-Cho**: Phu Pho, alt. 1,000 m, 25 April 1914, fr., *A.J.B. Chevalier 32279* (**K**!, **L**1893345†, **MUS**†, **P**03372692!);– **Hanoi**: 21°03'44.8” N, 105°21'38.5" E, 22 October 1902, fl., *D. Bois 420bis* (**K**! **MUS**†);– **Lai Chau**: San-Tan-ngai, 9 April 1936, fl., *E. Poilane 25654* (**P**03372654!);– **Lang Son**: Van Quan, Tran Ninh, December 1918, fl., *A.J.B. Chevalier 9* (**P**00509607!);– *ibid.*, Bam Laung village, 20 December 1913, lvs., *A.J.B. Chevalier 29738* (**P**03372655!);– **Phu-long Thung**: May 1917, lvs., *A.J.B. Chevalier 37316* (**P**03372693!);– **Phu-Tho**: Tam Nong, Hung Hao, December *s.n.*, fl., *P.A. Eberhardt 4428* (**P**00509603!).

Distribution.**—** Native to India (Assam, East Himalaya, East Bengal), China (Yunnan), and Myanmar; cultivated in orchards in temperate regions and on tropical mountains worldwide (Map 4.2).

English name.**—** Common Peach, Flowering Peach, Ornamental Peach, Peach.

Vernacular name.**— China**: Tao. **Thailand**: มักม่วน Mak muan, มักม่น Mak mon (Northern); ท้อ Tho (Central); มะฟุ้ง Ma-fung (Shan); หุงหม่น Hung khop, Hung mon (Chiang Mai).

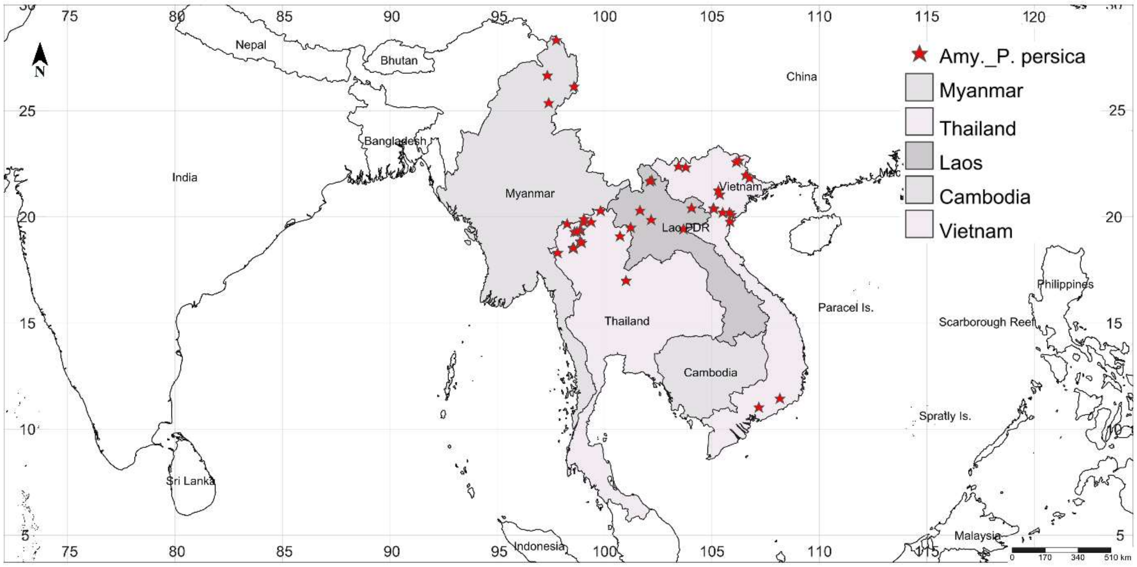
Ecology.**—** Cultivated in orchards or escaped from cultivation along roadsides, field borders, forest edges, grasslands, waste fields, and hills and mountainsides. Growing at elevations between (300–)1,000–3,000 m.

Phenology.**—** Flowering October–December, fruiting December–March.

Uses.— Cultivated, ornamental plants, fruits edible.

Conservation.— This species is known from many locations (> 10 locations): EOO = 197,115268.55 km^2; AOO = 1580.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Figure 4.1. *Prunus persica* (L.) Batsch, habit, vegetative and reproductive morphological characters; **A**, habit; **B**, outer bark, conspicuous horizontal lenticels; **C & D**, leaves; **C**, fascicled on short shoots; **D**, spiral and alternate on annual twigs; **E**, basal glands, 2, globose, on the petiole and basal leaf margin, stipule irregularly lobed with small glandular apex; **F–J**, solitary flower, very short pedicel, ramiflorus, variation of several petals in different cultivars; **K–O**, fruits; **K**, (ovary) young fruits with densely tomentose; **L**, young fruits; **M**, mature fruits; **N**, ripe fruits; **O**, endocarp laterally compressed, rugose testa. — Photos: A–G, L–O by S. Rueangruea; H–K by A. Sinbumroong. Scale bar = 1 cm.



Map 4.2. Distribution of *Prunus persica* (L.) Batsch of subg. *Amygdalus* (Amyg.) in continental Southeast Asia.

4.3.3. Subgenus *Prunus* Linnaeus, Species Plantarum. 1: 677. 1753. – genus *Prunus* Cuizhi & Bartholomew in Lu et al. Flora of China. 9: 404. 2003.

Description: Trees or shrubs, deciduous. Stipules membranous, soon caducous. Leaves simple, alternate, or spiral, convolute (or conduplicate) when young; petiolate or sessile; petiole apex or base of leaf blade margin with or without nectarial-glands; leaf blade margin variously crenate to coarsely serrate. Branchlets are sometimes spine-tipped. Axillary winter bud solitary, ovoid; terminal winter bud absent. Inflorescences are apparently axillary, solitary, or to 3-flowered in a fascicle; bracts small, soon caducous. Flowers open before or at the same times as leaves. Hypanthium campanulate. Sepals 5, imbricate. Stamens 20–30, in 2 whorls; filaments unequal. Ovary superior, carpel 1; 1-loculed, glabrous or rarely villous; ovules 2, collateral, pendulous. Style terminal, elongated. Fruit a drupe, glabrous, often glaucous, usually with a longitudinal groove; mesocarp fleshy, not splitting when ripe; endocarp laterally compressed, smooth, rarely grooved or rugose (Lu et al. 2003).

4. ***Prunus salicina* Lindl.**, Transactions of the Horticultural Society of London. 7: 239. 1830; Kurz, Forest Flora of British-Burma 1: 434. 1877; Hook.f., The Flora of British-India, London. 2 (5): 315. 1878; Koord., Flora of Java. 2: 337. 1912; Cardot, in Flore Générale de L'Indo-Chine: 628, fig. 59: 623. 1920; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 535. 1933; C.A. Backer and R.C. Bakhuizen van Den Brink, 1: 521. 1964; J.E.Vidal, Adansonia 4: 1436. 1964; *ibid.*, Flora du Cambodge, du Laos et du Vietnam 6: 159–161, pl. xxii, 1–4. 1968; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003. Type as for the basionym below.

≡ *Cerasus salicina* Don, Loudon's Hortus Britannicus. 480. 1830.

Typification**: CHINA,** Willow-leaved, 1822. Deciduous shrub, *non vidi*.

= *Prunus triflora* Roxb., Hortus Bengalensis, or a Catalogue of the Plants Growing in the Honourable East India Company's Botanical Garden at Calcutta. 38. 1814.

≡ *Cerasus triflora* (Roxb.) Wall. ex Steud., Nomenclator Botanicus, Edition 2. 1: 331. 1840. Western Szechuan: wild and cultivated around Tachien-LU alt. 2,300-3,000 m., 1908 (*No. 99*). Western Hupeh: Hsing-shan Hsien, alt. 1,300–2,000 m., May and August 1907 (*No. 169*); Hsing-shan Hsien, woodlands, alt. 1,300–1,600 m., April and August 1907 (*No. 17S*); Patung Hsien, thickets, alt. 1300 m., July 1907 (*No. 82*). Patung Hsien, thickets, alt. 1600 m., September 1907 (*No. 243*); Patung Hsien, April 1901 (*Veitch. Exped. No. 1781*); Ichang, March 30, 1900 (*Veitch. Exped. No. 124*, type of *P. ichangana* Schneider). Designated by E. Koehne, 1912.

= *Prunus tibetica* Franch. In Nouvelles archives du Muséum d'histoire naturelle. 2(8): 215–216. 1885.

Typification**: CHINA,** Tibet, Western Szechuan, Moupin, thickets, April 1869, *David*, *s.n.* (holotype **P**01819097!; isotype, *non vidi*).

= *Prunus gymnodonta* Koehne, in Sargent, Charles Sprague Plantae Wilsonianae. An Enumeration of the Woody Plants Collected in Western China for the Arnold Arboretum of Harvard University. 1(2): 279–280. 1912. Typification: cultivated in the Spath Arboretum near Berlin as "*Prunus trifloral*" from Mandshuria. Type, *non vidi*.

= *Prunus staminata* Hand.-Mazz., Symbolae Sinicae, Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Sudwest-China. 1914/1918. 7(3): 535. 1933.

Typification: **CHINA, North Yunnan**. Ad septentr. urbis Yünnanfu in convallis Hsiao-dsang trans flumen Pudo-ho, 25°40' lt., regione calide temperata in fruticetis, 1,750-1,900 m., 11 March 1914 *Handel-Mazzetti. H.R.E. von 548* (holotype W**U**0059422†; isotype *non vidi*).

= *Prunus botan* hort. ex Chow, Familiar Trees Hopei, Peiping. 211. 1934. *in. syn.*, Koehne, 1912. Type, *non vidi*.

= *Prunus salicina* var. *cordata* Y.He & J.Y.Zhang, Bulletin of Botanical Research. Harbin. 9(3): 71. 1989. Type, *non vidi*.

Description: Deciduous, understory, shrub to small tree 2–12 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown to brown, smooth with prominent lenticels or scales, spines absent; *inner bark* yellowish-brown; strong almond smell. **Branchlets** stout, greyish-brown with brown lenticels; young twigs reddish-brown with white lenticels, glabrous, with 3 to 6 cataphylls at the base; old twigs greyish-brown with brown lenticels. *Axillary winter bud* 2(–3), lateral ones forming flower buds, the central one a leaf bud, ovoid, broad to narrowly ovate, outside brown pubescent, glabrous inside; *terminal winter bud* present. **Leaves** plicate in bud, usually extended after anthesis, fascicled on short shoots, spiral and alternate on annual twigs, oblanceolate, oblong-obovate, narrowly elliptic or rarely oblong-ovate, 4–8(–12) cm long × 2–5 cm wide; *lamina apex* acute to short caudate, angle acute; *margin* teeth irregularly spaced, sinus angular, apex glandular serrate, usually glabrous or rarely hairy at scale margins; *base* asymmetric sometimes slightly so, attenuate with 2(–4) glands; young leaves pale green, glossy green adaxially, pale green abaxially, turning yellow before falling, chartaceous, glabrous; old leaves glabrous adaxially, glabrescent abaxially; *basal glands* (–0) 2 (–3), up to 1 mm long, ovate-oblong, short distinctly protruding, on upper or lateral surface of petiole or on the basal leaf, additional basal-marginal glandular-serrate; *2° venation* weakly brochidodromous, 6–8 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 1–2 cm long, shallowly canaliculate in cross-section, glabrous to sparsely hairy; *petiolar glands* present or absent, (0–)2(–4) glands, 0.8 mm long × 0.5 mm in diameter. **Stipules** small to medium, 6–10 mm long × 0.8–1 mm wide, linear, apex acuminate, margin glandular, base oblong, glabrous to sparsely hairy, and early caducous. **Inflorescences** compound, usually 2–3 in a bundle or solitary, dense-flowered, in axils of fallen leaves, opening before leaves, sessile to 0.5 mm long, 1–3, sparsely pubescent to glabrescent; bracts 5–12 bracts, brown, dry, persistent at anthesis. **Flowers** bisexual, opening before new leaves, white, pedicellate, slender, 0.8–15 mm long, glabrous; *bracteoles* oval, 1–3 mm long, greenish-brown, glabrescent, caducous; *hypanthium* campanulate, 2–4 mm long, glabrescent to glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, *c.* 5 mm long × 2–4 mm wide, subequal, apex obtuse to acute, margin entire, loosely glandular serrate, base truncate, separate or valvate in bud, spreading when mature, deciduous, glabrous outside, pubescent inside; *petals* white, spreading to decurved, 5, small, 4–6 mm long × 0.5–10 mm wide, subequal, 2–3 times as long as sepals, obovate to more or less orbicular, sessile to slightly unguiculate, apex rounded, margin usually entire, distinctly ciliate, base sessile to shortly unguiculate, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* 20–40 in 3 series, exserted; filament filiform, white, 5–10 mm long, glabrous; anthers globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, up to 10 mm long, as long as stamens to slightly shorter than stamens, glabrous; stigma globose. *Infructescence* 0.3–0.8 cm, glabrous, few, 1–3 fruited. **Fruits** young fruit green, yellow suffused with red when mature or ripe, globose, 2.5–3.5 cm long, 2.5–3.5 cm wide, apex obtuse to emarginate; young and mature fruits glabrous; exocarp smooth and shiny, with shallow longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp laterally compressed; calyx deciduous; style present, peaked or apiculate up to 1 mm long. **Seeds** lateral slightly compressed or laterally compressed on both surfaces, medium, with glabrous reticulate testa (**Figure 4.2**).

Additional specimens examined.— **CHINA**. Anhui, Jinzhai, 12 May 1984, fr., *K. Yao 8886* (**K**!);– Anhwei, 9 August 1925, fr., *Ren Chang Ching 3190* (**K**!);– **Hong Kong**: alt. 1,300 m, 16 February 2002, fl., *S.Y. Hu & P. But 23858* (**K**!);– *ibid.*, 15 February 1973, fl., *S.Y. Hu 12922* (**K**!);– *ibid.*, Tai Long To, 21 February 1969, fl., *S.Y. Hu 6616* (**K**!);– *ibid.*, Godu valley, 26 February 1993, fl., *S.Y. Hu*

& P. But 21984 (**L** L4207528†);– **Hupeh**: 4 July 1907, fl., *E.H. Wilson 175* (**K**!);– March 1889, fl., *A. Henry 1309* (**K**000737008!);– March 1889, fl., *A. Henry 7803* (**K**!);– **Nanking**: March *s.n.*, fl., *C.L. Tso 1412* (**K**!);– **Shantung**: June 1930, fl., *C.Y. Chiao 2547* (**K**!);– *Sichuan*: 2 April 1996, fl., *Lui Zheng Yu 15480* (**K**000809289!);– **Tibet**: Fu Kiang river, March 1925, fl., *J.F. Rock 12035* (**K**!);– *ibid.*, May 1925, fl., *J.F. Rock 12121* (**K**!);– Tse-Kou, March 1912, fl., *Abbe Monbeig 1653* (**P**03359157!).;– **Yunnan**: May 1921, fl., *s.coll. 20144* (**K**!). **INDIA**. **Assam**: Sadiya, 25 March 1894, fl., *G.A. Gammie 268* (**P**03359197!). **JAPAN**., 18 May 1888, fl., *Akita 2088* (**P**02974473!);– **Fukien**: 25 May 1923, fr., *H.H. Chang 1669* (**K**!);– **Honshu**: **Kyoto**, alt. 600 m, March *s.n.*, fl., *K. Ueda, E. Kinoshita*, *Manabe & Hamada 502* (**KYO**!). **LAOS**. Northern, **Luang Prabang**: Laos Tien, Ko Manh, 26 September 1920, lvs., *E. Poilane 1982* (**L**1894127†, **P**03359194!);– **Xiang Khouang**: August *s.n.*, lvs., *Miéville 39 pp.* (**P**03359195!);– **Southern, Champasak**: Pak Song, March 1917, fl., *Spire 1453* (**P**03359196!). **MYANMAR**. **Central Burma**, **Shan**: Mandalay, 10 February 1990, fl., *Yin Yin Ky 1233* (**RAF**979/90!);– *ibid.*, 20 May 1972, fl., *Kyi Kyi Win 13033* (**RAF** 9790/1!);– **North Eastern Burma, Shan**: Muang Len, Keng Tung territory, 29 January 1922, fl., *Rock 2177* (**NY**02649986†);– **Upper Burma, Kang-fang**: 14 January 1939, fl., *F. Kingdon-Ward 212* (**NY**02649986†);– *ibid.*, 23 March 1939, fl., *F. Kingdon-Ward 442* (**NY**02649986†). **THAILAND**. **Northern, Chiang Mai**: Fang, Mae Sun, 19°54'33” N, 99°02'06” E, alt. 1,427 m, 15 March 2019, fr., *S. Rueangruea*, *S. Kaithongsuk*, *A. Rueangruea*, *P. Uea-Ari & S. Chatrupamai SR131* (**BKF**229836-7!, **TCD**!);– *ibid.*, Mae Rim, QSBG, 18°53'14” N, 98°51'36” E, 27 February 2018, fr., *T. Pingyot 172* (**QBG**105711!);– *ibid.*, Chom Thong, Royal Project, 19°06'25.0” N, 98°46'17.5” E, alt. 1,325 m, 16 February 2001, fl., *J.F. Maxwell 01-127* (**CMUB**17753!, **L**4183697†). **VIETNAM**. **Annam, Nghe-an:** 14 May 1914, lvs., *A.J.B. Chevalier 32502* (**L**1894125†, **P**03359205!);– **Nghi-Ohr**: 14 May 1914, lvs., *F. Fleury 1453* (**P**03359199!);– **Thanh Hoa**: Annam, Thanh Hoa, Lang Van, alt. 355 m, 26 January 1931, fl., *E. Poilane 18944* (**K**!, **MUS**†, **P**03359201!);– **Vinh**: Con Cuong, 26 January 1932, fr., *E. Poilane 19948* (**L**1894126†);– **Tonkin**, December 1918, fl., *Miéville 10* (**K**!, **L**1894129-30†, **MUS**†, **P**03359209!);– August *s.n.*, lvs., *M. Bon*, *s.n.* (**P**03359156!);– **Cao Bang**: Binh Duong, alt. 1,000 m, 18 February 1931, fr., *E. Poilane 19048* (**K**!, **L**1894130†, **MUS**†, **P**03359217–9!);– **Sapa**: 5 August 1926, lvs., *E. Poilane 12838* (**L**1894131†, P03359218!);– **Lao Cai**: Yao San, 10 December 1937, lvs., *E. Poilane 26801* (**P**03359216!);– **Ninh Binh**: October 1923, fl., *P.A. Pételot 1159* (**P**03359213!, **VNM**!);– Tam Dao, 30 January 1882, fl., *R.P. Bon 1259* (**P**03359211!);– **Phuc Nhac**: 24 January 1882, fl., **H**. **Bon** *1256* (**P**03359206!);– **Phu-Cho**: 5 April 1914, fl., *F. Fleury 32294* (**P**03359214!);– **Phu-Tho**: Hung Hao, March *s.n.*, fl., *s.coll. 4426* (**P**!);– **Thanh Hoa**: Lang Oi, 12 July 1920, lvs., *E. Poilane 1623* (**BKF**182492!, **P**!);– **Tonkin, Hanoi:** 22 October 1902, fl., *D. Bois 416* (**P**03359212!).

Distribution.— Native to S. Russian Far East to China, Vietnam, Taiwan, and Japan. Introduced (cultivated) into Myanmar, Thailand, Laos, Korea, New South Wales, Tadzhikistan, Turkmenistan, and Uzbekistan**.**

English name.**—** Chinese plum, Japanese plum.

Vernacular name.**— China**: Li. **Thailand**: ลูกไหน Luk nai

Ecology.**—** Along forest edges or in forest openings, along mountain trails, streamsides in valleys, also cultivated, alt. (300–) 800–2,600 m (especially adaxially 800 m).

Phenology.**—** Flowering specimens were collected from January to May, fruiting from April to August.

Uses.— Cultivated, ornamental plants, fruits edible.

Conservation.— This species is known from many locations (> 10 locations): EOO = 5,231,107.35 km^2; AOO = 140.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

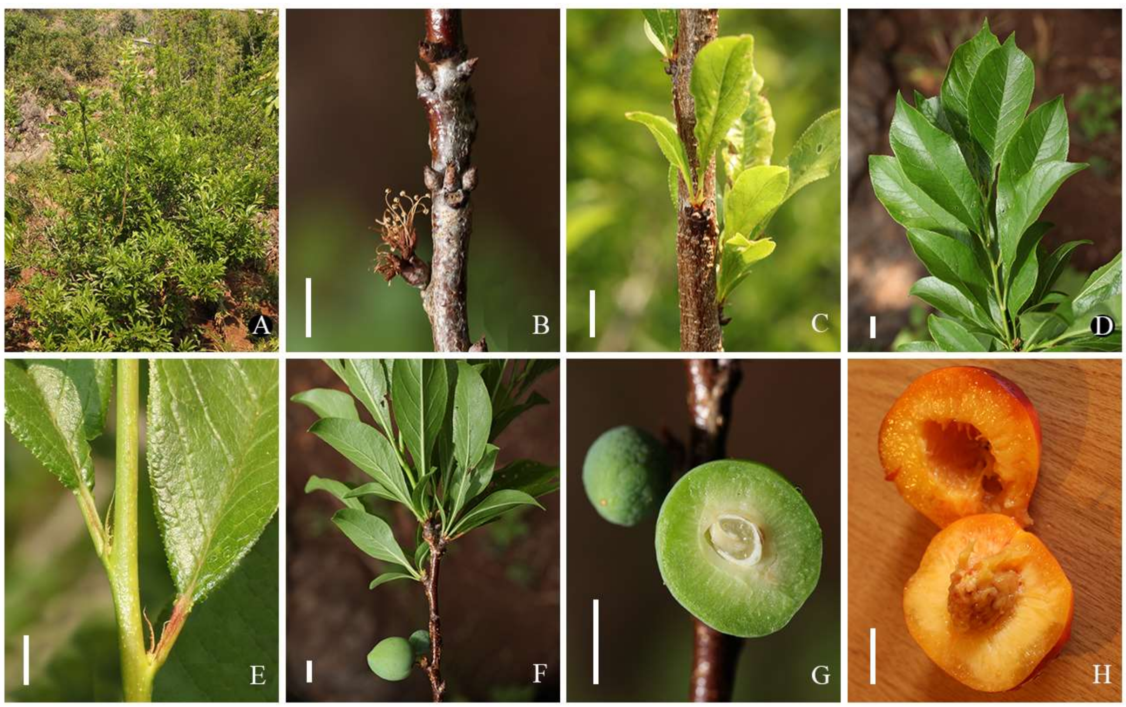
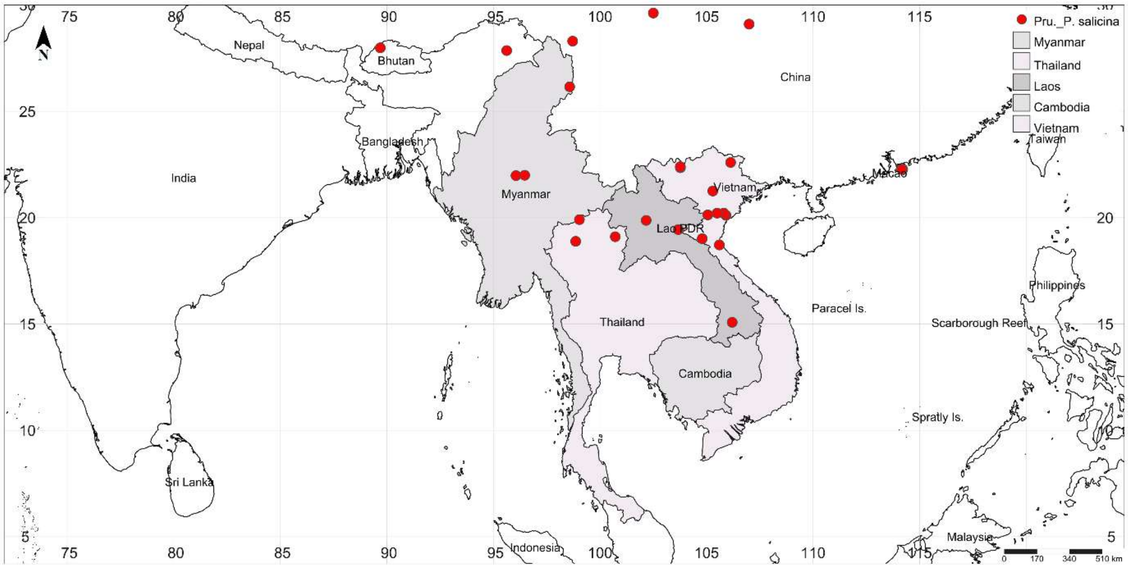


Figure 4.2. *Prunus salicina* Lindl., habit, vegetative and reproductive morphological characters; **A**, habit, shrub; **B**, axillary winter bud 2(–3), lateral one's flower buds, the central one a leaf bud; **C**–**E,** leaves spiral or alternate; **C**, young leaves; **D**, mature leaves, obovate-lanceolate; **E**, basal glands, and linear glandular stipules; **F**–**G**, young fruits; **F**, fruits in the axil of fallen leaves branch; **G**, cross-section, endocarp and seedcoat glabrous; H, ripe fruits; **O**, endocarp laterally compressed, rugose testa. — Photos: all by S. Rueangruea. — Sources: **Thailand**, Chiang Mai, A**–**G from *S. Rueangruea et al. SR131*. Scale bar = 1 cm.



Map 4.3. Distribution of *Prunus salicina* Lindl. of subg. *Prunus* (Pru.) in continental Southeast Asia and nearby.

4.3.4. Subgenus *Armeniaca* Scopoli, Methodus Plantarum Nova. 15. 1754. – subg. *Prunophora* sect. *armeniaca*, Koehne, Deutsche Dendrol.: 315. 1893. – genus *Armeniaca* Lingdi & Bartholomew in Lu et al. Flora of China. 9: 399. 2003.

Description: Trees, rarely shrubs, deciduous. Branches unarmed, sometimes spine-tipped. Leaves are simple, alternate or spiral, convolute or involute when young; petioles usually have 2 nectaries; leaf blade margin singly or doubly serrate. Axillary winter bud solitary; terminal winter bud absent. Stipules present. Inflorescences axillary, 1–3-flowered. Flowers bisexual, regular, solitary, or to 3 in a fascicle, opening before leaves or rarely with leaves. Pedicels usually short to subsessile, rarely longer than 1 cm. Hypanthium caducous in fruit. Sepals 5, imbricate. Petals 5, inserted on the rim of hypanthium, imbricate. Statements 15–45, perigynous; filaments free, filiform. Carpel 1(or 2); ovary superior, hairy, 1-loculed; ovules 2, collateral, pendulous. Style terminal, elongated. Fruit a drupe, ± laterally compressed, hairy, rarely glabrous, with a conspicuous longitudinal groove; mesocarp succulent or fleshy, neither splitting nor rarely dry when ripe; endocarp hard, 2-valved, lateral compressed on both sides, surface smooth, scabrous, or reticulate, rarely pitted, separating from or adnate to mesocarp. Seeds bitter or sweet.

5. ***Prunus mume* (Siebold) Siebold & Zucc**. in Siebold, Philipp Franz von Flora Japonica; sive, Plantae Quas in Imperio Japonico Collegit, Descripsit, ex Parte in Ipsis Locis Pingendas Curavit. 1: 29. 1836; Franch., Plantae Delavayanae: 197. 1890; Cardot, in Flore Générale de L'Indo-Chine: 629. 1920; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 536. 1933; Merr., Brittonia; a Series of Botanical Papers. 4: 89.

1941; J.E.Vidal in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris 13: 294. 1949; *ibid.*, Flora du Cambodge, du Laos et du Vietnam 6: 161–164, pl. xxii, 5–9. 1968; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003. Type as for the basionym below.

≡ *Armeniaca mume* Siebold in Synopsis plantarum oeconomicarum universi regni japonica. 69. 1830. Typification: **JAPAN,** Japonia, *Siebold P.F. von*, *s.n.* (lectotype **L**0329140†; isolectotype **P**00781065!), designated by Hideaki Ohba & Shinobu Akiyama, 2013.

≡ *Armeniaca mume* (Siebold) K.Koch, Hortus Dendrologicus. 7: 140. 1853.

≡ *Armeniaca mume* de Vriese, Tuinbouw-flora van Nederland en Zijne Overzeesche Bezittingen. 1: 1t. 1. 1855.

≡ *Prunopsis mume* (Siebold) André in M.L. Bourguignon Revue Horticole. 68: 209. 1890.

= *Prunus mume* var. *pendula* Siebold, Jaarboek van de Koninklijke Nederlandsche Maatschappij tot Aanmoediging van den Tuinbouw. 1848: 47. 1848. Type, *non vidi*.

– *Armeniaca mume* f. *pendula* (Siebold) H.Ohba & S.Akiyama, Journal of Japanese Botany. 89(5): 292. 2014.

= *Prunus mume* (Siebold) Siebold & Zuccarini var. *pallens* Franchet, Plantae Delavayanae. 197. 1890. Typification: **CHINA, Yunnan**, adaxially Pine Trees, 20 January 1887. *J.M. Delavay 2775* (lectotype **P**01819107!, designated by J.E.Vidal, 1963; isotypes **K**000737004!, **L**1893706†, **P**01819108–9!).

= *Prunus mume* (Siebold) Siebold & Zuccarini var. *cernua* Franchet, Pl. Delavay. 198. 1890.

Typification: **CHINA, Yunnan**, adaxially Pine Trees, 11 June 1888. *J.M. Delavay 3536* (holotype **P**01819110!, designated by Franchet, 1890; isotypes **A**00032122†, **K**000737005!).

= *Prunus ichangana* C.K. Schneid., in Feddes Repertorium Specierum Novarum Regni Vegetabilis. 1: 50. 1905.

Typification: **CHINA,** Szetschwan, Hubei, West-Hupeh, between the towns Jachou, Ichang, 30 March 1900, *E.H. Wilson 124*, (holotype, *non vidi*; isotype **NY**00429946†).

= *Prunus anomala* Koehne, in Plantae Wilsonianae. 1(2): 280. 1912.

Typification: **CHINA, Kwang Tung**, a. 1885-86, (distributed as *P. japonica*) *E. Faber*, *s.n.* (holotype, *non vidi*). Koehne (1912), this species is remarkable because its solitary flowers are borne in the axils of full-grown leaves, which resemble those of *Prunus mume*.

= *Prunus makinoensis* H.Lév., Catalogue des plantes de Yun-nan. 233. 1917. Typification. *non vidi*

= *Prunus mume* (Siebold) Siebold & Zucc. var. *tonsa* Rehder, Journal of the Arnold Arboretum. 3: 19. 1921. Sargent, Charles Sprague Plantae Wilsonianae. An Enumeration of the Woody Plants Collected in Western China for the Arnold Arboretum of Harvard University. 1(2): 279-280. 1912, *non* Sieb. & Zucc.

Typification: **CHINA**. **Western Szechuan**: west and near Wen-Chuan Hsien, thickets, alt. 1,300–2,500 m., September 1908, *E.H. Wilson 1018* (holotype **A**00032124†; isotype

HBG511123†); paratypes, same locality, alt. 1,600–2,000 m., October 1910, *E.H. Wilson 4146*, *non vidi*; Western Hupeh: Ichang, wild and cultivated, alt. 3,00–1,000 m., March and September 1907, *E.H. Wilson 75*, *non vidi*.

= *Armeniaca mume* var. *pubicaulina* C.Z.Qiao & H.M. Shen, Bulletin of Botanical Research. Harbin. 14: 150. 1994.

Typification. China, Yunnan, W. Yunnan, Mountains, alt., *c.* 2,500 m. branchlets and petioles densely incanus. Type, *non vidi*.

Description: Deciduous, shrub to small tree 4–10 m tall, understory, canopy shape oval or globose. **Stem** erect, straggling, or many stems; outer bark greyish-brown, smooth, or with scales; *inner bark* yellowish-brown; strong almond smell. **Branchlets** moderate, greyish-brown with light brown lenticels; young twigs first-year branchlets green, terminal spine-like, glabrous, glabrescent or densely incanous, with 3 to 6 cataphylls at the base; old twigs greyish-brown with sparse brown lenticels. **Axillary winter buds** are usually 1–3, covered by purplish-brown scales, 3.5–6 mm long, ovoid, glabrescent, apex acute; *terminal winter bud* present. **Leaves** convolute in bud or recurved when young, fascicled on short shoots, spiral or slightly alternate on annual twigs, ovate, ovate-elliptic, elliptic, obovate, or obovate-oblanceolate, 4–8 cm long × 2.5–5 cm wide; *lamina apex* acute, acuminate to caudate to 2 cm long, angle acute; *margin* usually acutely double serrate or crenate, teeth irregularly spaced, sinus angular, apex glandular serrate, glabrous; *base* asymmetric sometimes slightly so, broadly cuneate to rounded; young leaves reddish-green, dull green adaxially, pale green abaxially, turning yellow before falling, texture thin, chartaceous, glabrescent to glabrous; old leaves glabrescent to glabrous, gradually glabrescent or only pubescent in vein axils; *basal glands* (–0) 2 (–4), up to 0.5 mm long, ovate-oblong, usually distinctly stalked, on upper or lateral surface of petiole or on the basal leaf, basal teeth glandular-serrate; *2° venation* weakly brochidodromous, 4–6 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, narrow angle (< 45°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles*, 1–2 cm long, grooved to shallowly canaliculate in cross-section, pubescent, red to green; *petiolar glands* present, (0–)2(–3) glands, 0.6 × 0.3 mm in diameter. **Stipules** small to medium, 6–10 mm long × 0.5–1 mm wide, linear, apex acuminate, margin slightly glandular serrate, base oblong, glabrous to sparsely hairy, early caducous. **Inflorescences** simple or up to 3- flowers in a bundle, solitary or flowers in pairs, lax-flowered, in axils of fallen leaves, opening before or at the same time as new leaves, sessile or pedicellate to 0.5 mm long, 1(–2) flowers, sparsely hairy; bracts 6–10, different sizes, brown, margin yellowish-grey, dry, persistent at anthesis. **Flowers** bisexual, white, 2–2.5 cm in diameter, strongly fragrant; pedicels stout to slender, 1–10 mm long, glabrous; *bracteoles* oval, 5–10 mm long, brown to yellowish-brown, glabrescent, margin ciliate, caducous after anthesis; *hypanthium* cup-shape to broadly campanulate, usually maroon, reddish-brown but green to greenish-purple in some cultivated varieties, 2.5–4 mm long, usually glabrous to glabrescent or sometimes pubescent; corolla distinctly different from calyx lobes; *calyx* lobes 5, oblong, ovate to suborbicular, moderate, reddish to green, 3–5 mm long × 1.5–3 mm wide, unequal to subequal, apex acute to slightly obtuse, margin entire, ciliate, base truncate, separate, basally imbricate in bud, spreading when mature, deciduous, glabrous to glabrescent outside, pubescent inside; *petals* white, spreading to decurved, 5 (6) or many (cultivated), medium, 8–15 mm long × 8–12 mm wide, subequal, 2–3 times as long as sepals, more or less orbicular to obovate, slightly unguiculate, 1–3 mm long, apex rounded, margin usually entire, distinctly ciliate, base usually shortly unguiculate, alternate with calyx lobes, glabrous outside, glabrous inside, petal lobes 5, or sometimes with one additional long unguicalate (up to 1 cm long) petal or many for some cultivated varieties; *stamens* 35–48, more than 3 series (cultivated), exserted; filament filiform, white, 3–5 mm long, glabrous; anthers globose, 0.4–0.6 mm long, filaments shorter to slightly longer than petals; *ovary* densely pubescent, 1 locular; *style* filiform, up to 5 mm long, shorter to slightly longer than stamens, upper half glabrous, densely hairy at base; stigma globose. *Infructescence* 0.1–0.2 cm long, glabrous, few, 1–2 fruited. **Fruits** stipitate, 3–10 mm long, young fruit yellow to greenish-white, yellowish-green to reddish-yellow when mature or ripe, subglobose to ovoid, 2–3 cm long, 2–3 cm wide, apex acute to obtuse; young fruits pubescent; mature fruits with dense short hairs; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, sour, adnate to endocarp, yellowish-white; endocarp ellipsoid to subglobose; calyx deciduous; style present, peaked or apiculate up to 1 mm long. **Seeds** laterally compressed on both surfaces, medium, ventral suture somewhat obtuse, longitudinally furrowed on ventral and dorsal sides, and surface pitted, base cuneate, obtuse, or rounded, apex obtuse and abruptly mucronulate, glabrous (**Figure 4.3**).

Additional specimens examined.— **CHINA**. **Kwangtung**: October 1925, fl., *F.A. McClure 1661* (**L**†);– *ibid.*, Mkan Chi Shan, Huann-Kiangsi-Kwangt border, April 1936, fr., *W.T. Tsang 26195* (**L**4207516†);– *ibid.*, 31 March 1938, fr., *W.T. Tsang 28644* (**L**4183515-6†, **P**03373367!);– **Yunnan**: 20 January 1887, fl., *Delavay 2775* (**L**1893706†**, P**01819107-9!);– **Hong Kong**: Taipo-kau, 31 January 1992, fl., *Hu & But 20022* (**L**4183789†). **JAPAN**. **Honshu**: Matsuodairi-cho, Nishikyo-ku, 34°59'30.4” N, 135°41'29.9” E, alt. 270 m, 18 March 2002, fl., *G. Murata 79931* (**KYO**!);– *ibid.*, 11 June 2002, fl., *G. Murata 95027* (**KYO**!);– **Osaka**: Turu-dani, 34°41'05.4” N, 135°31'53.2” E, 18 June 1961, fr., *M. Rotta 6015* (**KYO**!);– **Kyoto**: Hiedano-cho, Honshu, Jinzoji, 35°10'06.4” N, 137°00'06.8” E, alt. 57 m, 12 May 1996, fr., *S. Tsugaru & T. Takahashi 23197* (**KYO**!);– Kameyama Botanic Garden, Kameoka-shi, 35°00'47.8” N, 135°34'45.4” E, 8 April 1978, fl., *S. Tsugaru 4466* (**KYO**!);– *ibid.*, Matsuodairi-cho, Nishikyo-ku, Kyoti-shi, 34°59'30.4” N, 135°41'29.9” E, alt. 270 m, 23 March 2003, fl., *G. Murata 80126* (**KYO**!);– **Ishikawa**: Kanazawa, Kintani valley, 36°28'13.8” N, 136°43'22.2” E, 25 May 1982, fl., *M. Suzuki 152c* (**KYO**!);– Japonia, January *s.n.*, fl., *P.F. von Siebold*, *s.n.* (**P**00781065!);– **Nagasaki**: January 1863, fl., *C.J. Maximowicz*, *s.n.* (**L**†). **LAOS**. **Northern, Luang Namtha**: Boudinxay, Dornsaart village, alt. 1,002 m, 23 March 2002, fr., *K. Kunsawanhh LAOS373* (**L**4310337†);– *ibid.*, January 1921, fl., *Miéville 8* (**K**!, **L**1893701†, P03372624-5!, P03372631!). **MYANMAR**. **North Eastern Burma**, June 1931, fl., *G. Forrest 29774* (**RAF**1795!);– **Upper Burma, Kachin**: March 1931, fl., *G. Forrest 29348* (**U**1551833†);– *ibid.*, Hpimaw hill, 10 May 1919, fl., *R. Farrer*, *s.n.* (**E**00072295!). **THAILAND**. **Northern, Chiang Mai**: Chom Thong, Khun Wang, Doi Inthanon NP., 19°22'27" N, 98°50'50" E, alt. 1,500 m, 20 January 2009, fl., *P. Sisanga & P. Suksathan 3262* (QSBG38329!);– Fang, 19°53'53.8" N, 99°02'21.0" E, alt. 1,385 m, 11 December 2019, fl., *S. Rueangruea*, *T. Thananthaisong & P. Uea-Ari SR247* (**BKF**229828!, **TCD**!);– *ibid.*, *SR248* (**BKF**229830!, **TCD**!);– **Nan**: Chaloem Pra Kiat, Khun Nan, 19°30'21" N, 101°12'45" E, alt. 1,014 m, 24 March 2019, fr., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR147* (**BKF**229737!, **TCD**!);– **Pha-Yao**: Mueang, Doi Laung NP., 19°23'13.0" N, 100°27'18.1" E, alt. 1,050 m, 17 March 1998, fl., *P. Sidisunthorn & S. Gardner 26530* (**CMUB**!). **VIETNAM**. **Tonkin**: January, fl., *Delavay 3536* (**K**!, **L**1893703†, **P**01819110!);– January 1888, fl., *Delavay*, *s.n.* (**L**1893705†, **K**!, **P**03372395!);– **Bin Duong**: Pia Houac, 16 February 1931, fl. & fr., *E. Poilane 19051* (**K**!, **L**1893700†, **P**03372623!);– **Lai Chau**: 14 January 1938, fl., *E. Poilane 27134* (**K**!, **L**1893702†, **P**03372632!);– **Lang Son**: Van Quan, Lang Son, October 1921, fl., *M.A. Chevalier 8* (**P**03372624!);– **Phobo**: 8 September 1926, lvs., *E. Poilane 13222* (**P**03372635!).

Distribution.— Native to China South-Central. Introduced into China (North-Central, Southeast, Hainan, Mongolia, Japan, Korea, Manchuria, Taiwan, Tibet, Xinjiang), Myanmar, Thailand, Laos, Vietnam, and Japan (**Map 4.4**).

English name.— Chinese plum, Japanese plum, and Japanese apricot.

Vernacular name.— **China:** Mei. **Thailand:** บ๊วย Buai. **Vietnam**: Plum blossom

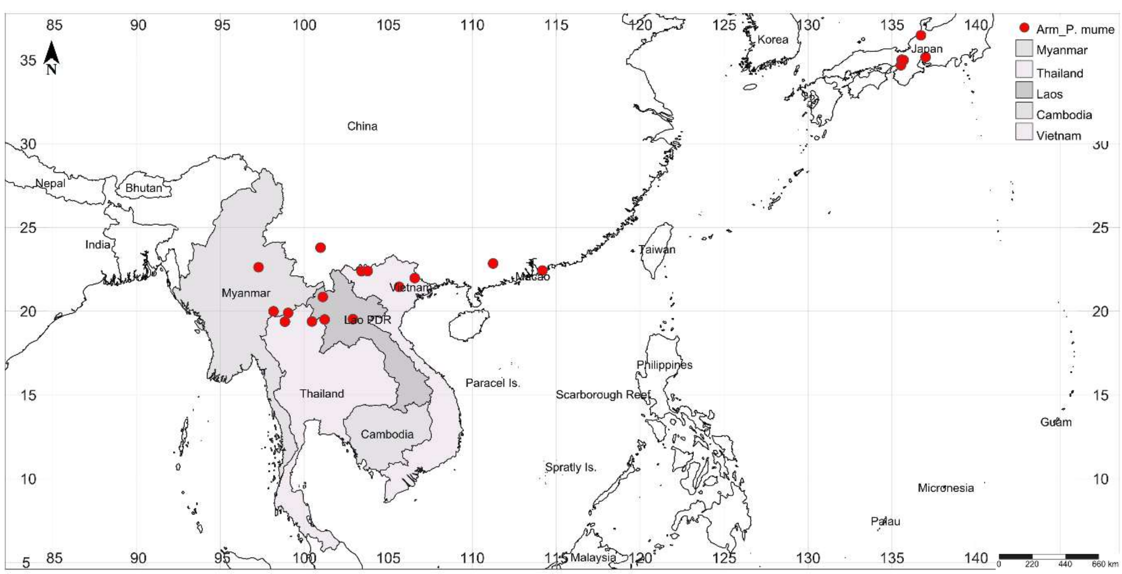
Ecology.— Forest slopes, in open areas, streamsides. Slopes along trails and mountains, also commonly cultivated, alt. (100–)1,000–3,200 m.

Phenology.— Flowering winter to spring, specimens were collected from October to March (or July to August in N. China), fruiting from February to May.

Uses.— Cultivated, ornamental plants, fruits edible.

Conservation.— This species is known from many locations (> 10 locations): EOO = 2,295,792.76 km^2; AOO = 80.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Figure 4.3. *Prunus mume* (Siebold) Siebold & Zucc., vegetative and reproductive morphological characters; **A**, habit, shrub to small tree; **B**–**D**, leaves; B, young shoot; **C**–**D,** variation of mature leaves; **E–F**, flower simple, ramiflorus; **E**, flower buds and flower, the twig apex reduced to spine-like, and the frontal view of flower with petaloid stamen; **F**, postal view flower show a short pedicel; **G**, mature fruits; **H**, nut, stone, endocarp laterally compressed, rugose testa. — Photos: A, C, D, G, and H by S. Rueangruea from Nan; B, E, and F by A. Sinbumroong. — Sources: all from **Thailand**; Nan, *S. Rueangruea, et al.*; A, C, D, G, and H from *SR147*; Chiang Mai, B, E, and F from *SR247*. Scale bar = 1 cm.



Map 4.4 Distribution *Prunus mume* (Siebold) Siebold & Zucc. of subg. *Armeniaca* (Arm.) in continental Southeast Asia and nearby.

4.3.5. Subgenus *Cerasus* Miller, The Gardeners Dictionary, Abridged. ed. 4: 300. 1754; Koehne, Deutsche Dendrol.: 302. 1893. – genus *Cerasus* Tourn., Institutiones Rei Herbariae.: 625. 1700; Chaoluan & Bartholomew in Lu et al. Flora of China. 9: 407. 2003.

Description: Trees or shrubs, deciduous. Branches unarmed. Axillary winter buds 1 or 3, lateral ones are flower buds; central ones are leaf buds; terminal winter buds are present. Stipules soon caducous, margin serrulate, and teeth are often gland-tipped. Leaves simple, alternate, or fascicled on short branchlets, conduplicate when young; petiole usually with 2 apical nectaries or nectaries sometimes at the base of leaf blade margin; leaf blade margin singly or doubly serrate, rarely serrulate. Inflorescences axillary. Fasiculate-corymbose or 1-or 2-flowered base, often with an involucre formed by floral bud scales. Flowers opening before or at the same time as leaves, pedicellate, with persistent scales or conspicuous bracts. Hypanthium campanulate or tubular, caducous in fruit. Sepals 5, reflexed or erect. Petals are usually 5 or numerous in cultivar, white or pink. Stamens 15–50. Inserted on or near the rim of hypanthium. Ovary superior. Carpel 1, 1-loculed, hairy or glabrous; ovules 2, collateral, pendulous. Style terminal, elongated, hairy, or glabrous; stigma emarginate. Fruit a drupe, glabrous, not glaucous, without a longitudinal groove. Mesocarp succulent, not splitting when ripe; endocarp globose to ovoid, smooth or ± rugose, glabrous inside.

6. ***Prunus pseudocerasus* Lindl**., Transactions of the Horticultural Society of London. 6: 90–91. 1825; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification: Cambridge Botanic Garden, 15 February 1925, *s. coll.*, *t9129* (lectotype **K**000737385! designated here; isolectotype **K**000737383–4!, **K**000737386–8!).

≡ *Cerasus pseudocerasus* (Lindl.) Anon. in A catalogue of the fruits cultivated in the garden of the Horticultural Society of London. 28. 1826.

≡ *Cerasus pseudocerasus* (Lindl.) Loudon, Loudon's Hortus Britannicus. 200. 1830.

≡ *Padus pseudocerasus* (Lindl.) S.Ya.Sokolov in Trees & Shrubs USSR. 3: 763. 1954.

≡ *Prunus cantabrigiensis* Stapf in Curtis, William Botanical Magazine: 152 t. 9129. 1928.

– *Cerasus cantabrigiensis* (Stapf) Ohle in R. Mansfeld, Verz. Landwirtsch. Gartn. Kulturpfl. 1: 419. 1986.

= *Prunus pauciflora* Bunge, Enumeratio Plantarum, quas in China Boreali Collegit: 23. 1833.

Typification**: CHINA,** *A.A. Bunge*, *s.n.* (holotype, *non vidi*; isotype **A**00032136†, with photograph).

= *Prunus involucrata* Koehne in Sarg. Plantae Wilsonianae. 1(2): 206. 1912.

Typification**: CHINA,** Western Hupeh, cultivated around Ichang, up to 1000 m. alt., tree 3–5 m tall, March and May 1907, *E.H. Wilson 1* (holotype **A**00435618†; isotype **E**00011285!, **K**000737034!).

= *Prunus saltuum* Koehne in Sarg. Plantae Wilsonianae. 1(2): 213. 1912.

Typification**: CHINA,** Western Hupeh: Patung Hsien, swords, alt. 1,300 m., April 1907, *E.H. Wilson 2824* (holotype **K**000737121!; isotype **A**00032192!).

= *Prunus scopulorum* Koehne in Sarg. Plantae Wilsonianae. 1(2): 241. 1912.

– *Cerasus scopulorum* (Koehne) T.T.Yu & C.L.Li, Flora Reipublicae Popularis Sinicae. 38: 61. 1986.

Typification**: CHINA,** Hubei, Western Hupeh; Ichang, cliffs, March 16, 1900, *E.H. Wilson 146* (holotype **K**000737035!; isotypes **A**00032193†, **NY**00429950†).

Description: Deciduous, sub-canopy, small tree up to 10 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown to brown, smooth with prominent brown horizontal lenticels, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** stout, greyish-brown with prominent brown lenticels; young twigs pale green to brownish-green, glabrescent to glabrous, with many cataphylls at base; old twigs sparsely hairy to glabrous with prominent whitish-brown lenticels. *Axillary winter bud* solitary, 5–8 mm long, ovoid to long elliptic, glabrous to subglabrous; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral and alternate on annual twigs, ovate, ovate-oblong to long elliptic, 5–12 cm long × 3–6 cm wide; *lamina apex* abruply acute to acuminate, angle acute; *margin* acute double-serrate or incised serrate, teeth irregular spaced, sinus angular, tif of apex minutely glandular, otherwise glabrous; *base* asymmetrical or symmetrical, obtuse, slightly cordate to broadly cuneate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous, glabrescent to glabrous; old leaves glabrescent to glabrous adaxially, glabrescent abaxially; *basal glands* usually 2, (0–) 4, up to 2 mm long, flattened, concave to swollen adaxially, sometimes stalk-like, on the petiole and contracted leaf–base and conspicuous to small glands on the apex of serrate margin; *2° venation* weaky brochidodromous, 8–12 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.5–1.5 cm long, canaliculate in cross-section, glabrous; *petiolar glands* present, 2 (–4) glands, 1 × 0.5 mm in diameter, stalked glands up to 1 mm long. **Stipules** large, conspicuous, 8–12 mm long × 4–8 mm wide, laciniate, subulate, 1-side lobed or branched, side lobed shorter than 1/2 of the main lobe length, apex acuminate, margin lobed, with numerous glands, base oblong, glabrous, not early caducous. **Inflorescences** compound, racemes short solitary, usually extended raceme subtended by conspicuous large leaf-like semi-persistent bracteoles, rarely fascicles by contraction of the main axis or umbellate, dense-flowered, from lateral buds on twigs with falling leaves, basal part of shoots appearing before or the flush of new leaves, 0.5–1 cm long, (2–7 flower) often 2 or 3-flowered, glabrous; *involucral bracts* 6–10, 3–5 mm long, brown color, size and shape variable, obovate-elliptic, apex acute or obtuse, margin without or with sparse stalked glands, soon caducous. **Flowers** bisexual, usually opening before or at the same time as new leaves, white, pedicellate, slender, 5–25 mm long, glabrous to sparsely hairy, pedicel elongate at anthesis; *bracteoles* obovate-oblong to leaf-like, with longitudinal nerves, entire or with long glandular fimbriate-serrate margin, 2.5–5 mm long, pale green, glabrous, caducous after anthesis; *hypanthium* campanulate, 3–6 mm long, glabrous to sparsely hairy; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular-ovate to ovate-oblong, moderate, greenish, extended at anthesis, 0.5–4 times as long as hypanthium, 0.5–1.2 mm long × 2.5–6 mm wide, subequal, apex usually acute or obtuse, margin entire or glandular serrate in the lower half, base truncate, separate or valvate in bud, spreading when mature, deciduous, glabrous to sparsely hairy outside, glabrescent inside; *petals* white, spreading to upright, 5, medium to large, 7–12 mm long × 5–1.2 mm wide, unequal in shape & size, petals 1–3 times of calyx lobes length, obcordate to orbicular-obcordate, 3–6 nerves, shortly unguiculate or sessile, apex retuse or deeply emarginate to 2-lobed, margin entire, base acute or rounded with short stalk or sessile, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* 30–35(–55 cultivated varieties) exserted, equal or shorter to petal length; filament filiform, white, 3.5–6 mm long, glabrous; anthers oblong to globose, 0.3–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 3–4.5 mm long, shorter to nearly as long as stamens, glabrous; stigma gland not divided, globose, green. *Infructescence* 0.5–1 cm long, glabrescent to glabrous, 2–5 fruited. **Fruits** stipitate, 30–45 mm long, young fruit green, turning red to dark red when mature or ripe, subglobose to ovoid, 0.9–1.5 cm long, 0.8–1.2 cm wide, apex obtuse, rounded; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, dark red; endocarp stone bony, with shallow net-foveolate and longitudinal or ridged, canaliculate; calyx deciduous. **Seeds** slightly laterally compressed on both surfaces, thin, with glabrous testa, shallowly rugose or sculptured, glabrous.

Additional specimens examined.— **CHINA**. **Hubei: Shiyan**, 32°35'01.8” N, 110°42'06.5” E, April 1989, fl., T.T. Yu & C.L. Li, *s.n.* (**HIB**†);– **Hupeh**: 31°03'45.1” N, 111°10'34.5” E, alt. 1,500 m, July 1909, fl. & fr., *E.H. Wilson 1* (**E**00011285!);– *Shandong Sheng*: Yantasi, 37°28'11.5” N, 121°27'15.9” E, October 2011, fl., *H. Jinghong*, *s.n.* (**PlutoF**†);– **Shantung**: 36°13'37.7” N, 117°10'57.7” E, 26 July 1936, lvs., *T.Y. Cheo & L. Yen 216* (**P**!);– **Sichuan**: Nanchuan, 20 March 1996, fr., *Liu Zheng-yu 15392* (**P**!);– *ibid.*, 29°01'N, 107°E, alt. 650 m, 3 March 1996, fl., *Liu Zheng-yu 15256* (**KYO**!). **JAPAN**. **Musashi**: Hanno, 35°55'17.7” N, 139°12'32.5” E, 24 May 1910, fl., *s.coll.*, *s.n.* (**US**14285818†);– **Shizuoka**: Shimoda, 34°42'10.6” N, 138°57'09.1” E, April 1853, fl., *C. Wright*, *s.n.* (**NY**1104442†);– **Tokyo**: Federal city, 35°48'29.8” N, 139°08'36.9” E, April 1887, fl., *s.coll. 138* (**US**14290244†). **THAILAND**. **Northern, Chiang Mai**: Fang, 19°45'39.3” N, 99°00'39.2” E, alt. 1,116 m, 11 December 2019, fl., *S. Rueangruea*, *S. Kaithongsuk & P. Uea-Ari SR196* (**BKF**221171!, **TCD**!).;– *ibid.*, (same tree as *SR196*), 11 December 2019, fl., *S. Rueangruea*, *T. Thananthaisong, & P. Uea-Ari SR250* (**BKF**229834!, **TCD**!).

Distribution.**—** Native to China (North-Central, China South-Central, China Southeast, Manchuria), Thailand (cultivated), and Japan (**Maps 4.5 & Map 4.6**).

English name.**—** Chinese sour cherry, False cherry.

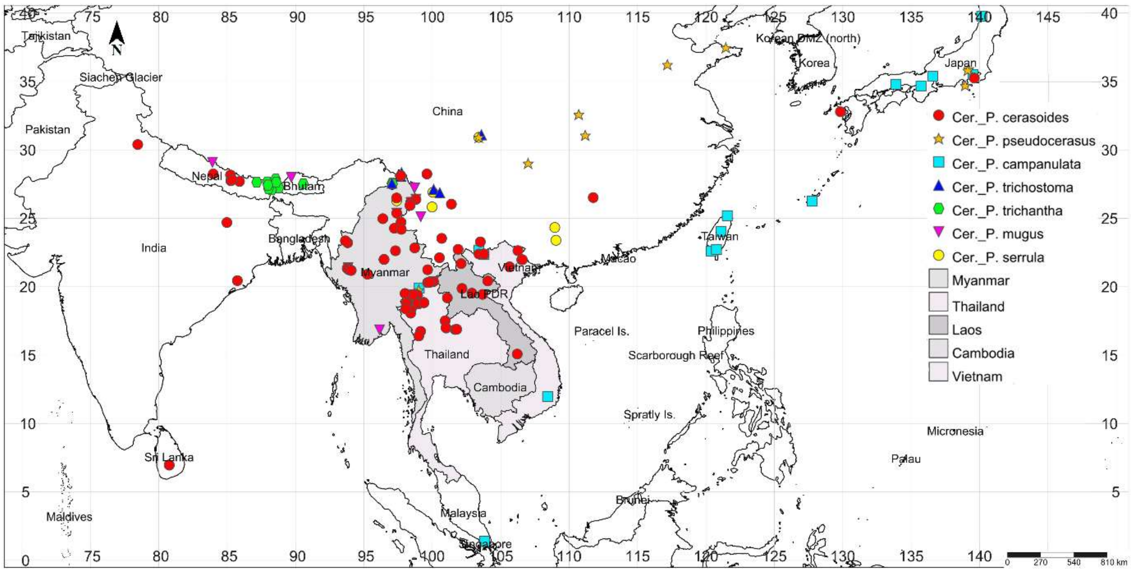
Vernacular name. — **China**: Ying tao.

Ecology.— Sunny mountain slopes, sides of ravines, usually cultivated; alt. 300–1,200 m.

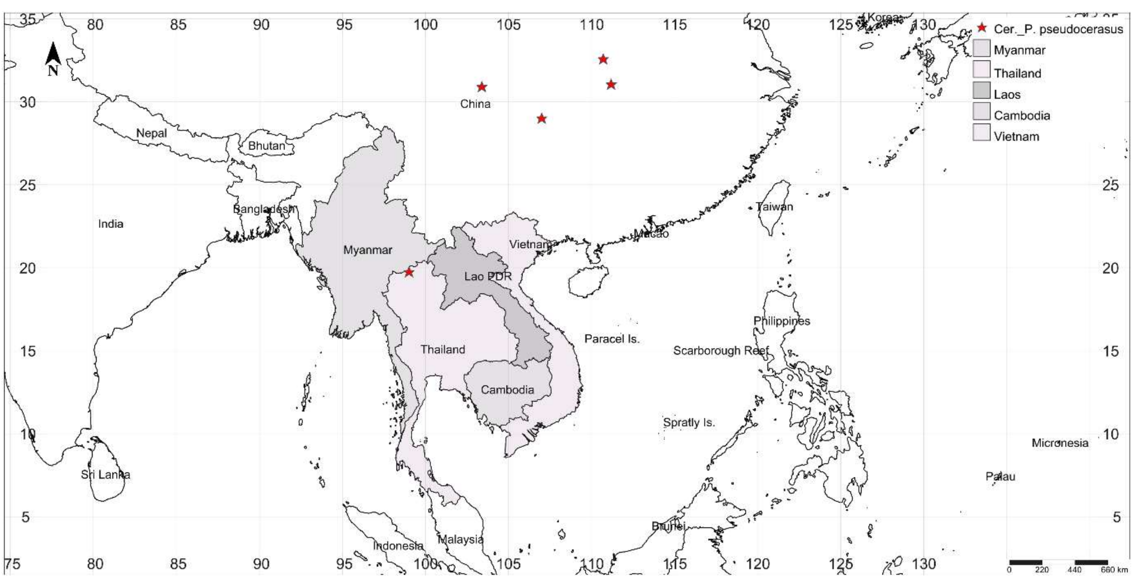
Phenology.— Flowering: March–May. Fruiting: May–July.

Uses.— Usually cultivated in gardens or ornamental plants along the roadside, fruits are edible.

Conservation.— This species is known from many locations (> 10 locations): EOO = 2,543,885.26 km^2; AOO = 40.00 km^2.. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.5. Distribution of *Prunus cerasoides*, *P. pseudocerasus*, *P. campanulata*, *P. trichostoma*, *P. trichantha*, *P. mugus,* and *P. serrula,* of subg. *Cerasus* in continental Southeast Asia and nearby.



Map 4.6. Distribution of *Prunus pseudocerasus* of subg. *Cerasus* in continental Southeast Asia and nearby.

7. ***Prunus cerasoides* Buch.-Ham. ex D.Don**, Prodromus Florae Nepalensis.: 239. 1825; Hook.f., The Flora of British-India, London. 2 (5): 318. 1878; Cardot, in Flore Générale de L'Indo-Chine: 626–627. 1920; Merr., Brittonia; a Series of Botanical Papers 4: 89. 1941, J.E.Vidal, Adansonia 4: 142–1433. 1964; *ibid.*, Flora du Cambodge, du Laos et du Vietnam 6: 169–171, pl. xxii, 11–12. 1968; *ibid.*, in Flora of Thailand 2 (1): 68. 1970; Tirvenggadum, in F.R. Fosberg. A Revised Handbook of the Flora of Ceylon. 3: 373–374. 1981; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification: **NEPAL,** Narianhetty, *F. Buchanan-Hamilton*, *s.n.* (holotype **BM**000522036!; isotype **CAL**0000011604†).

≡ *Cerasus phoshia* Buch.-Ham. ex D.Don, Prodromus Florae Nepalensis.: 239. 1825.

≡ *Cerasus cerasoides* (Buch.-Ham. ex D.Don) S.Ya.Sokolov, Trees, and Shrubs of the USSR. 3: 736. 1954.

≡ *Cerasus ceramides* (Buch.-Ham. ex D.Don) Tsitsv. & Matinyan, no. 38: 19. 1960.

= *Prunus hosseusii* Diels, Repertorium Specierum Novarum Regni Vegetabilis. 4: 289. 1907. Typification**: THAILAND, Chiang Mai**, Doi Suthep National Park, 1,650 m alt., 14 December 1904, *C.C. Hosseus 260* (holotype **M**0168970†; isotype **BKF**!, **BM**!, **K**000737333!, **L**0019567†, **L**350610†, **P**00851146!, **P**01818995!, **W**1905-0006285†).

= *Prunus cerasoides* D.Don var. *rubea* C.Ingram, in The Gardeners' Chronicle: a weekly illustrated journal of horticulture and allied subjects. Ser. 3(122): 162. 1947.

— *Cerasus cerasoides* var. *rubea* (C.Ingram) T.T.Yu & C.L.Li in Flora Reipublicae Popularis Sinicae. 38: 79. 1986.

Typification: **MYANMAR**, **Adung Valley**, 21 March 1931, *Kingdon-Ward F. 314* (holotype **BM**000622023!).

= *Cerasus puddum* Roxb. ex Ser., Prodromus Systematis Naturalis Regni Vegetabilis [A. P. de Candolle] 2: 537. 1825.

= *Cerasus puddum* Wall., Plantae Asiaticae Rariores. 2: 143. 1831.

Typification**: NEPAL,** 1821, *Wallich 714a* (lectotype **E**00317633! designated here; isolectotypes **E**00010499!, **M**0214802†; lectoparatypes *714* **K**000737218!, **E**00317634!, **K**000737219!, **K**000737216!, **TCD**!); *714d* (**M**0214801†, **M**0214803†).

≡ *Prunus pudendum* Roxb. ex Wall., Plantae Asiaticae Rariores. 2: 143. 1831. *nom. nud.*

= *Maddenia pedicellata* Hook.f., Flora of British-India. 2(5): 318. 1878.

Typification: Butan, *W. Griffith*, *s.n.* (holotype **K**000396854!; isotype, *non vidi*).

Note. – The specimen sheet is a mixed gathering with *Prunus gongshanensis* J.Wen.

= *Prunus cerasoides* var. *majestica* (Koehne) Ingram, in The Gardeners' Chronicle: a weekly illustrated journal of horticulture and allied subjects. Ser. 3(122): 162. 1947. Type as for the basionym below.

≡ *Prunus majestica* Koehne, in Sarg. Plantae Wilsonianae. 1(2): 252. 1912.

Typification**: CHINA, Yunnan**, Chu-yuan, Mengtze, woods, alt. 1,500-1,600 m., Tree 15–25 m tall, pink flower, 20 December 1898, *A. Henry* (*9411*, *9411 A* (lectotype **K**000395900! designated here on the same sheet as *9411B*, **K**000395901!; isolectotypes *9411* **A**00032112!, **K**000395899!; *9411A*, **A**00032113†, **K**000395365!, **US**00516875†, **US**00107969†; *9411B*, **A**00032114†, **K**000395901! and *A. Henry 11469* **A**00032115†, **E**00011297!, **K**000395898!).

≡ *Cerasus majestica* (Koehne) H.Ohba in H. Ohba et al. Flowering cherries of Japan: 253. 2007.

= *Prunus puddum sensu auct*. Franch., Plantae delavayanae: 197. 1889 (non Roxburgh), *pro parte*, *quoad J. M. Delavay s.n.*, China, Yunnan, wood below the hill of Hia-lo-pin, towards the north, below the Lan-Kong, 2,500 m alt, (Koehne, 1912).

= *Prunus carmesina* H.Hara, The Journal of Japanese Botany. 43(2): 46–47. 1968.

Typification: **MYANMAR,** Adung Valley, alt. 2,000 m, 21 March 1931, *Kingdon-Ward F. 9314* (holotype **BM**000622023!; isotype, *non. vidi*.).

Description: Deciduous, sub-canopy, tree up to 20 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh 10–80 cm in diameter; outer bark brown, smooth with prominent brown horizontal lenticels, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** stout, greyish-brown with prominent brown lenticels; young twigs green or reddish-purple or grey, glabrescent, with many cataphylls at base; old twigs glabrous with prominent whitish-brown lenticels. *Axillary winter bud* solitary, 5–8 mm long, ovoid; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled or spiral on short shoots, alternate on annual twigs, ovate, elliptic-oblong, 5–12 cm long × 3–5 cm wide; *lamina apex* acuminate or acute, angle acute; *margin* sharply double serrate, teeth spacing regular to slightly irregular, sinus angular, apex glandular serrate, glabrous; *base* asymmetrical or symmetrical, obtuse, slightly cordate to broad-cuneate; young leaves reddish-purple, brownish-red to light green, dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous, sparsely hairy; old leaves glabrescent to glabrous adaxially, sparsely hairy abaxially; *basal glands* usually 2, (0–) 6, up to 2 mm long, flattened, concave to swollen adaxially, sometimes stalk-like, on the petiole and contracted leaf–base and, conspicuous to small glands on the apex of serrate margin; *2° venation* brochidodromous, looped and anastomosing near the margin, 10–15 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–2 cm long, canaliculate in cross-section, glabrous to sparsely hairy; *petiolar glands* present, 0–2–4 glands, 1 × 0.5 mm in diameter, with stalked glands up to 2 mm long. **Stipules** large, conspicuous, 8–15 mm long × 4–8 mm wide, laciniate, subulate, lobed or branched, apex acuminate, margin shortly serrate with small glands at the tips of the teeth, base oblong, glabrous to sparsely hairy, not early caducous. **Inflorescences** compound, racemes short solitary, or extended raceme subtended by conspicuous large leaf-like semi-persistent bracteoles, lax-flowered, from lateral buds on twigs with fallen leaves, basal part of shoots appearing before or the flush of new leaves, 0.5–1 cm long, (2–5 flower) often 3-flowered, glabrous; *involucral bracts* 6–10, 0.5–2 mm long, size and shape variable, oblong, ovate to lobed, apex acute or obtuse, margin with stalked glands, caducous. **Flowers** bisexual, opening before or at the same time as new leaves, whitish-pink to reddish-pink, pedicellate, slender, 7–12 mm long, glabrous; *bracteoles* scale-like, 1–5 mm long, pale green, glabrous, caducous; *hypanthium* tubular or campanulate, 6–8 mm long, glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, lobes ovate, oblong to triangular, moderate, reddish to green, 2.5–4.5 mm long × 2–3.5 mm wide, subequal, apex usually acute or obtuse, margin entire to slightly serrate, base truncate, separate or valvate in bud, spreading when mature, deciduous, glabrous outside, sparsely hairy inside; *petals* whitish-pink to pink, sometimes purplish--veined, spreading to upright, 5, large, 8.5–14.5 mm long × 8–11.5 mm wide, equal or subequal, petals 4–6 times calyx lobes length, broadly ovate to orbicular, shortly unguiculate or sessile, apex retuse, margin entire, base acute or rounded with short stalk or sessile, alternate with calyx lobes, glabrous outside and inside; *stamens* 35–45 in 3 to many series, exserted or equal to petal length; filament filiform, reddish to pink, 7–10 mm long, glabrous; anthers oblong to globose, 0.3–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 11–20 mm long, longer than stamens, glabrous; stigma gland not divided, globose, green. *Infructescence* 0.5–1.5 cm long, glabrescent to glabrous, 2–5 fruited. **Fruits** stipitate, 12–17 mm long, young fruit green, turning red to dark purple when mature or ripe, ovoid to ellipsoid, 1.1–1.4 cm long, 0.7–0.9 cm wide, apex obtuse, rounded or acute; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, yellow to brown; endocarp stone bony, smooth with shallow longitudinal grove or ridged, canaliculate; calyx deciduous. **Seeds** lateral slightly compressed on both surfaces, thin, with glabrous testa, shallowly rugose (**Figure 4.4**).

Additional specimens examined.— **CHINA**. **Tibet**, 28°14'20.7" N, 99°36'12.1" E, January 1882, fl., *King*, *s.n.* (**P**03358333!);– **Xishuangbanna**: Menghai, 22°07'3.9" N, 100°31'7.9" E, alt. 1,700 m, 20 February 2011, fr., *P. Georgiadis 404* (**CMUB**34323!);– **Yunnan**: January *s.n.*, fl., *Delavay*, *s.n.* (**P**02974446!);– *ibid.*, Xiding, 26°02'16.8" N, 101°23'33.5" E, alt. 1,708 m, 14 November 2009, fl., *Yin Jiantao & Shi Xueqiang 1431* (**QBG**!);– *ibid.*, Jiangcheng, 22°43'49.1" N, 101°52'52.3" E, alt. 1,321 m, 24 March 2011, fl., *Z. Shishun 8408* (**QBG**74470!);– *ibid.*, Jinggu, 23°31'53.8" N, 100°40'49.7" E, alt. 950 m, 3 April 2010, fl., *Z. Shishun 6751* (**QBG**69360!). **INDIA**. **Himalaya**: Uttarakhand, Tihri Garhwal, November 1994, fl., *J.S. Gamble 15042* (**P**03358405!);– **Sikkim**: January *s.n.*, fl., *J.D. Hooker & T. Thomson 400* (**P**03358338!);– *ibid.*, Temp, January *s.n.*, fl., *J.D. Hooker & T. Thomson*, *s.n.* (**P**03358337!, **TCD**!);– *ibid.*, December 1879, fr., *J.S. Gamble 7614* (**P**03358346!);– **Odisha**: Mundali Cuttack, May 1923, fl., *Chandra Singh Chand 51* (**P**03358344!). **JAPAN**. **Osaka:** Nagasaki, January 1863, fl., *C.J. Maximowicz*, *s.n.* (**P**01818996!); **Yokoska**: January *s.n.*, fl.,. *Franchez A. 328* (**P**03342419!). **LAOS**. **Northern, Houaphanh**: Sam Neua, Ko Khas, Ko Khai Pa, 20°25'15.2" N, 104°02'56.2" E, 25 September 1920, fl., *E. Poilane 1975* (**E**01020044!, **K**!, **L**1892709†, **P**03358384!, **VNM**00023516!);– **Phong Saly**: 21°41'19.6" N, 102°06'27.9" E, alt. 1,500 m, 7 May 1936, fr., *E. Poilane 26000* (**K**!, **KYO**!, **L**1892763†, **P**03358386!);– **Xiang Khouang:** December 1963, fl., *D. Spire 1406* (**P**03358382!);– *ibid.*, 6 April 1952, fr., *J.E.Vidal 1546* (**P**03358377!);– *ibid.*, Tranninh, Brannisek, December 1917, fl., *Miéville 37083* (**P**03358381!);– *ibid.*, 19°31'37.0" N, 102°53'43.9" E, December 1918, fl., *Miéville 4* (**L**†, **K**! **MUS**†);– *ibid.*, 19°26'18.5" N, 103°40'25.4" E, December 1918, fr., *Miéville 5* (**E**01020049!, **K**!, **L**1892766†);– *ibid.*, Muong Soui, 19°31'37.0" N, 102°53'43.9" E, 8 February 1932, fr., *E. Poilane 20067* (**K**!, **P**03358364!);– *ibid.*, 1 January 1921, lvs., *Miéville 28* (**L**1892767†);– **Southern, Champasak, Pak Song**: March, fr., *Miéville 2* (**K**!, **P**03358365!);– *ibid.*, December 1963, fl., *D. Spire 1418* (**P**03358374!);– *ibid.*, December 1918, fl., *Miéville 4* (**K**!, **L**1892762†, **MUS**!, **P**03358358!). **MYANMAR**. alt. 1670 m, 29 March 1938, *F.G. Dickson 7235* (**L**1904406†);– alt. 2,667 m, 10 November 1962, fr., *U.M.G. Gale 9171* (**BKF**049702!, **E**00901040!);– alt. 1,830 m: 10 April 1912, fr., *J.H. Lace 5767* (**E**00901036!, **E**00901039!);– *ibid.*, 28 May 1924, fr., *R. E. Cooper 5972A* (**E**00901035!);– **Upper Burma, Chin**: 23°12'46.4" N, 93°48'30.2" E, alt. 1,924 m, 24 November 2019, fl. & fr., *N. Tanaka*, *S. Akiyama*, *Mu Mu Aung & S. Rueangruea MY5714* (**BKF**229780!, **RAF**!, **NMNS**!, **TNS**!);– *ibid.*, Lamzang, Natmataung NP., 23°21'21.8" N, 93°38'23.6" E, alt. 1,173 m, 22 November 2019, fl. & fr., *N. Tanaka*, *S. Akiyama, Mu Mu Aung & S. Rueangruea MY5626* (**BKF**221176!, **RAF**!, **NMNS**, **TNS**!);– *ibid.*, **Kachin**: between Tengyueh and Bhamo, alt. 2000 m, December 1922, fl., *J.F.C. Rock 1676* (**L**†**, NY**02649988 †);– **Central Burma, Mandalay, Mouymyo**: 21°59'38.5" N, 96°28'02.2" E, 13 May 1989, fr., *Yin Yin Ky 1154* (**RAF**925/86!);– *ibid.*, Payin Oo Lwin, Taung Pyo, 21°59'31.8" N, 96°28'05.1" E, alt. 1,600 m, 21 January 1997, fl., *Yin Yin Ky 2015* (**RAF**1545/97!);– *ibid.*, Kyaukpadamy, Popa Mountain Park, 20°54'42.7" N, 95°15'10.0" E, alt. 1,300 m, January 1988, fl., *Yin Yin Ky 658* (**RAF**625/88!);– *ibid.*, Popa Mountain Park, 20°54'42.7" N, 95°15'10.0" E, alt. 1,200 m, 21 January 1997, fl., *Yin Yin Ky 2016* (**RAF**1546/97!);– *ibid.*, Payin Oo Lwin, Botanical gardens, 21°59'31.8" N, 96°28'05.1" E, alt. 1,110 m: 26 March 1990, fr., *Yin Yin Ky 1202* (**RAF**969/90!);– *ibid.*, 25 January 1965, fr., *U.M.G. Gale 9838* (**RAF**7922/2!);– **Maymyo**: 21°59'38.5" N, 96°28'02.2" E, alt. 1,000 m, 13 January 1964, fl., *H. Kanai 6401131* (**KYO**!);– **North Eastern Burma, Shan**: Konglu, Konglangpii, 22°50'10.0" N, 98°42'37.6" E, alt. 2,000 m, 23 April 1920, fl., *R. Farrer & Purdom 1523* (**KYO**!);– Keng Tung, alt. 2,000 m, 30 January 1922, fl., *J.F.C. Rock 2195* (**E**00901033!, **P**03358403!);– **Upper Burma**: Near Kha-Nhan village, alt. 1,833 m, March 1909, fl., *G.E.S. Cubit 372* (**E**00901041!);– **Chin**: Kanpetlet, Makyauk Ar village, Natmataung NP., 21°11'22.9" N, 94°03'31.1" E, alt. 1,269 m, 3 January 2013, fl., *Ling Shein Mang 937* (**QBG**!);– *ibid.*, Mount Victoria, 21°13'59.7" N, 93°54'10.4" E, alt. 2,418 m, 14 November 2018, lvs., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Yunn Mi Mi Kyaw*, *Awng Khine Win MY3509* (**FU**!);– *ibid.*, Mindat Township, Natmataung NP, 21°23'41.70" N, 93°49'52.73" E, alt. 2,460 m, 3 March 2014, fr., *P. Srisanga*, *M. Norsaengsri*, *R.U.M. Rodda*, *E. Schuettpelz*, *T.T. Mu & L.S. Man 97497* (**E**00757882!, **QBG**!, **US**34871†);– *ibid.*, between Ohn and Lone Pan village, 21°20'12.22" N, 93°46'20.01" E, alt.

2,083 m, 6 March 2014, fr., *P. Srisanga*, *M. Norsaengsri*, *R.U.M. Rodda*, *E. Schuettpelz*, *T.T. Mu & L.S. Man 97609* (**E**00757881!, **QBG**!) *ibid.*, alt. 3300 m, April 1939, *F.G. Dickson 8597* (**E**00901072!, **L**1904405†);– **Kachin**: 1 March 1898, fr., *Shaik Mokim*, *s.n.*;– *ibid.*, May 1898, fr., *Shaik Mokim*, *s.n.* (**L**1893782†, **P**03358345!, **P**03358332!);– *ibid.*, The western flank of the Chimili, N'mai kha Salwin divide, 26°23'N, 98°48'E, alt. 3,000 m, August 1924, fr., *G. Forrest 24862* (**E**00072294!);– *ibid.*, Bhameo, Sialum Raba, alt. 2,000 m, 5 April 1912, fr., *J.H. Lace 5748* (**E**00901037!);– *ibid.*, Adung valley, 28°07'02.0" N, 97°41'56.3" E, alt. 2000 m, 21 March 1931, fl. & fr., *F. Kingdon-Ward 9314* (**BM**00062202!);– *ibid.*, Hpimaw, 22°37'39.2" N, 97°18'15.8" E, 4 April 1919, fl., *R. Farrer 836* (**E**00072296!);– *ibid.*, North Triangular (Hkinlum), alt. 1,667 m, 25 April 1953, fr., *F. Kingdon-Ward 20722* (**BM**!, **E**00901066!);– *ibid.*, The triangular, alt. 1,667 m, 30 March 1953, fl., *F. Kingdon-Ward 22085* (**BM**!, **E**00901068!);– *ibid.*, Ngawchang Valley, alt. 1,000 m, 27 February 1939, fl., *F. Kingdon-Ward 355* (**MO**†, **NY**†);– *ibid.*, Sumprabum, Eastern approaches from Sumprabum to Kumon Range, alt. 2,166 m, March 1962, fl., *J. Keenan*, *U. Tun Aung & U. Tha Hla 3953* (**E**00901070!);– *ibid.*, Htaw Gawt, Hpyepat, 25°56'17.9" N, 98°22'38.5" E, alt. 1,000 m, 27 November 1939, fl., *F. Kingdon-Ward 39* (**NY**02649982†);– *ibid.*, Mount Victoria, alt. 2,766 m, 16 April 1926, fr., *R. Anevan 3055* (**E**00901034!);– **West Central Burma, Chin**: Lungyang Pass, 21°11'52.3" N, 94°04'07.7" E, 2 April 1919, fl., *R. Anevan 804* (**E**00901031!);– *ibid.*, **Kanpetlet**: 21°11'26.8" N, 94°03'26.2" E, alt. 2,350 m, 30 October 1956, fl., *U.M.G. Gale 5925* (**RAF**3230!);– *ibid.*, 21°11'52.3" N, 94°04'07.7" E, alt. 2,000 m, April 1956, fr., *U.M.G. Gale 5379* (**RAF**5159!). **NEPAL**. 28°09'45.6" N, 85°14'36.9" E, April 1824, fl. & fr., *N. Wallich 714* (**K**!);– Mardi Khola, 28°14'37.3" N, 83°58'51.7" E, 4 November 1962, lvs., *J.L Creech & F. deVos 1231* (**WAG**†);– **Rasuwa**: Thare, 28°09'45.6" N, 85°14'36.9" E, 30 October 1976, fl., *H. Tabata, R. Keshab, K. Tsuchiya & Y. Konno 8611* (**KYO**!);– **Sindhu Palchok**: Bilaunepani and Sildhunga, 27°41'41.2" N, 85°54'03.4" E, alt. 1,690 m, 25 May 1978, fr., *H. Tabata, R. Keshab*, *Rajbhandari & Y. Shimizu 9932* (**KYO**!);– **Harain Letty**: December *s.n.*, fl., *F. Buchanan*, *s.n.* (**BM**!);– **Kathmandu**: Bagmati Zone, 27°44'43.2" N, 85°15'57.9" E, alt. 2,500 m, 23 November 1966, fl., *Nicolson H.D. 2779* (**BKF**16447!);– *ibid.*, Bagdwar, Sheopuri, North of Kathmandu., 27°48'43.6" N, 85°23'01.0" E, alt. 2,450 m, 26 March 1969, fr., *H. Kanai 11140* (**U**1551792†). **SRI LANKA**. **Ceylon**: 6°57'27.0" N, 80°45'59.5" E, alt. 700 m, January 1845, fl., *J.D. Hooker & T. Thomson 863* (**P**03358331!);– *ibid.*, Nuwara Eliya Park: Grand hotel, 6°57'27.0" N, 80°45'59.5" E, 26 January 1973, fl., *D.D. Tirvengadum & L.H. Cramer 292* (**K**!, **L**†);– *ibid.*, 14 December 1972, fl., *D.D. Tirvengadum & M. Jayasuriya 149* (**P**03358343!). **THAILAND**. **Northeastern, Loei**: Non-Yai, Phu Kradueng NP., 16°52'08" N, 101°40'00" E, alt. 1,100 m, 20 January 1970, fl., *C.F. Beusekom & C. Phengklai 3113* (**BKF**049603!, **E**01020045!, **KYO**!, **L**1892722†, **P**03358391!);– *ibid.*, Na Haeo, Phu Suan Sai NP., 17°30'15" N, 100°56'14" E, alt. 961 m, 16 January 2008, fr., *C. Maknoi 1912* (**BKF**!, **QBG**!);– **Chiang Mai**: 19°04'29" N, 98°18'24" E, alt. 1,400 m, 17 January 1988, fl., *T. Santisuk 6689* (**BKF**049584!);– *ibid.*, 18°04'N, 98°25'E, 20 January 1983, fl., *s.coll. 5457* (**BKF**!);– *ibid.*, 18°37'41" N, 98°30'24" E, alt. 1,300 m, 23 February 1958, lvs., *T. Smitinand 4323* (**BKF**049585!);– *ibid.*, Mae Chaem, Doi

Inthanon NP., 18°31'49” N, 98°29'43” E, alt. 1,500 m, 3 January 1975, fl., *R. Geesink*, *P. Hiepko & C. Phengklai 8033* (**BKF**049580!, **KYO**!, **L**1892721†, **P**03358423!);– *ibid.*, Doi Suthep-Pui NP., 18°45'N, 99°00'E, alt. 1,600 m, 19 December 1969, fl., *C.F. Beusekom 2629* (**BKF**049575!, **E**01020046, **L**1892723!, **P**03358421!);– *ibid.*, Wiang Haeng, Doi Sam Meun, 19°26'01.3” N, 98°34'19.5” E, alt. 1,530 m, 18 January 1983, fl., *H. Koyama*, *H. Terao & T. Wongprasert 32737* (**BKF**!, **KYO**!);– *ibid.*, Chiang Mai High Land, 18°48'21.7” N, 99°15'41.2” E, alt. 1,400 m, 3 March 2010, fl. & fr., *K. Jatupol 10-519* (**QBG**42693!);– *ibid.*, Mae Taeng, Doi Mae Ya, 19°12'30.7” N, 98°33'32.8” E, alt. 1,360 m, 19 January 1983, fr., *H. Koyama*, *H. Terao & T. Wongprasert 32776* (**BKF**116759!, **L**1892704†);– *ibid.*, Mae Chaem, 18°18'47” N, 98°26'15” E, 10 January 1988, fl., *R. Pooma*, *W. Werner 18* (**BKF**090186!);– *ibid.*, Chiang dao, Mae Taman, 22 March 1989, fr., *T. Santisuk 6956* (**BKF**049576!);– *ibid.*, Chiang Mai University campus, cultivated near the Biology greenhouse, alt. 1,100 m, 8 November 2003, fl., *J.Wen 7433* (**US**3515406 †);– *ibid.*, Chiang Dao, Doi Chiang Dao WS.: 19°23'54” N, 98°52'49” E, alt. 1,900 m, 31 December 1961, fl., *K. Bunchuai 104* (**BKF**049581!, **L**1892760†);– *ibid.*, 19°23'35” N, 98°55'31” E, alt. 1,900 m, 7 December 1965, fl., *E. Hennipman 3263* (**BKF**049564!**,** **K**!, **L**1892715†);– *ibid.*, alt. 1,900 m, 16 July 1958, fr., *T. Smitinand 4733* (**BKF**409582!);– *ibid.*, 19°23'47.1” N, 98°53'25.1” E, alt. 1,800 m, 2 December 1961, fl., *T. Smitinand & Jar Anduson 7244* (**BKF**049573!, **K**!);– *ibid.*, 19°23'35” N, 98°55'31” E, alt. 1,659 m, 27 January 2007, fr., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 2928* (**BKF**158194!);– *ibid.*, 19°22'26.4” N, 98°49'57.3” E, alt. 1,416 m, 27 January 2007, fr., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 2909* (**BKF**158222!);– *ibid.*, 31 December 1961, lvs., *K. Bunchuai 140* (**L**1892760†, **P**03358400!);– *ibid.*, alt. 304 m, 16 July 1958, lvs., *Th. Sorensen*, *K. Larsen & B. Hansen 4149* (**P**03358399!);– *ibid.*, Doi Laung valley, west of the summit, 19°22'27” N, 98°50'50” E, alt. 1,700 m, 31 January 1996, fr., *J.F. Maxwell 96-154* (**CMUB**!, **BKF**110944!, **L**4195889†);– *ibid.*, Chom Thong, Doi Inthanon NP.: 19°25’N, 98°25’E, alt. 1,750 m, 7 January 1975, fl., *R. Geesink*, *P. Hiepko & C. Phengklai 8129* (**BKF**049579!, **K**!, **L**1892720†, **P**03358422!);– *ibid.*, 18°31'49” N, 98°29'43” E, alt. 1,500 m, 17 December 1998, fl., *F. Konta*, *C. Phengklai, S. Khao-Iam 4695* (**BKF**140682!, **BKF**161024!);– *ibid.*, 18°31'32” N, 98°29'58” E, alt. 1,400 m, 7 February 1998, fl. & fr., *F. Konta 4048* (**BKF**122572!);– *ibid.*, 18°31'36” N, 98°29'53” E, 17 December 1993, fl., *C. Yonebayashi 93038* (**BKF**114218!);– *ibid.*, 18°31'32” N, 98°29'58” E, alt. 1,300 m, 3 February 1998, fl. & fr., *C. Phengklai & F. Konta 10805* (**BKF**136717!);– *ibid.*, 18°31’52.6” N, 98°31’35.9” E, alt. 1,300 m, 12 January 1997, fl., *M. Hara A728* (**CMUB**16460!);– *ibid.*, 18°31’52.6” N, 98°31’35.9” E, alt. 1,299 m, 25 March 2011, fr., *P. Georgiadis 438* (**CMUB**!, **L**2059078 †);– *ibid.*, 18°32'34” N, 98°30'59” E, alt. 1,250 m, 3 February 1998, fl. & fr., *F. Konta 3876* (**BKF**122622!);– *ibid.*, 18°32'10” N, 98°31'19” E, alt. 1,240 m, 8 March 2019, fr., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 5500* (**BKF**229766!, **TCD**!);– *ibid.*, 18°32’42.0” N, 98°32’8.79” E, alt. 1,020 m, 3 May 2010, fr., *P. Georgiadis 266* (**CMUB**33448!);– *ibid.*, Mae Wang, 16°53'17” N, 101°46'47” E, alt. 1,400 m, 10 February 1998, fl. & fr., *F. Konta 4156* (**BKF**122697!);– *ibid.*, Pha Mon, 18°33'53.7” N, 98°33'03.5” E, alt. 1,200 m, 20 January 1983, fr., *s.coll. 428* (**BKF**049574!);– *ibid.*, Pha Mon village: 2 October 1971, lvs., *J.E.Vidal 5269* (**P**03358394!);– *ibid.*, 31 May 197x, lvs., *J.E.Vidal*, *Y. Vidal & C. Niyomdham 6242* (**P**03358357!);– *ibid.*, Mae Chaem, Doi Inthanon NP: Doi Angka, 18°34'13.6” N, 98°29'03.6” E, alt. 1,380 m, 9 January 1935, fl., *H.B.G. Garrett 924* (**BKF**049572!, **E**01020038-9!, **K**!, **L**1892757†, **P**03358396!, **TCD**0016629!);– *ibid.*, 18°31'25” N, 98°29'13” E, alt. 1,000 m, 5 February 1998, fl. & fr., *F. Konta*, *s.n.* (**BKF**!);– *ibid.*, Hiu Luang fall, 18°31'32” N, 98°29'58” E, alt. 1,000 m, 5 February 1998, fl., *F. Konta 3977* (**BKF**122723!);– *ibid.*, Fang, Pong Nam Ron, Doi Phahompok NP., 16°44'23” N, 99°08'44” E, alt. 1,300 m, 25 February 1958, lvs., *Th. Sorensen*, *K. Larsen & B. Hansen 1633* (**BKF**049586!, **P**03358392!);– *ibid.*, Mueang, Doi Suthep-Pui NP.: 19°00'N, 98°30'E, alt. 1,700 m, 10 January 1969, fl., *H.P. Nooteboom*, *B. Tantisewie & C. Phengklai 708* (**BKF**049583!, **L**1892714†, **P**03358398!);– *ibid.*, 18°49'55.6” N, 98°53'10.0” E, alt. 1,650 m, 8 January 1959, fl., *Th. Sorensen*, *K. Larsen & B. Hansen 6587* (**K**!, **P**03358401!);– *ibid.*, 18°50’19.57” N, 98°53’45.99” E, alt. 1,323 m, 20 April 2018, fr., *T. Pilakul Kew023-S071* (**K**001293401!);– *ibid.*, 18°47'00.0” N, 98°55'00.0” E, 22 March 1994, fr., *J.F. Maxwell 94-367* (**L**4191915†);– *ibid.*, 20 March 1995, fr., *S. Kopachon S71 b1* (**L**4207842†);– *ibid.*, 18°50’19.57” N, 98°53’45.99” E, alt. 1,300 m, 9 April 1911, fr., *A.F.G. Kerr 1772* (**BKF**!, **BM**!, **K**!, **L**1893836†**,** **P**03358397!, **TCD**001627!);– *ibid.*, 18°48'17.6” N, 98°54'11.2” E, alt. 1,070 m, 23 January 1999, fl., *P. Navakitbumrung 30* (**CMUB**!);– *ibid.*, 18°47'28” N, 98°55'58” E, alt. 1,050 m, 8 January 1989, fl., *J.F. Maxwell 89-32* (**BKF**049566!, L1892705-6†);– *ibid.*, alt. 1680 m, fl., 9 January 1988, *J.F. Maxwell 88-33* (**L**1892707†);– *ibid.*, 18°48'17.6” N, 98°54'11.2"E: alt. 1,050 m, 27 May 1997, fr., *S. Zangkum S071b4* (**CMUB**12625!);– *ibid.*, 1,040 m, 20 March 1995, fr., *S. Kitiya S071b1* (**BM**!, **CMUB**07651!, **L**4207842†);– *ibid.*, Mae On, Huai Kaeo, Jae Son NP., 18°51'21” N, 99°22'02” E, alt. 1,422 m, 21 March 2019, fr., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR136* (**BKF**229751!, **TCD**!);– **Chiang Rai**: Mar Fa Laug;– *ibid.*, Mae Sai, Doi Tung summit, 20°19'28” N, 99°49'59” E, alt. 1,300 m, 29 November 1983, lvs., *E.F. Anderson 5288* (**BKF**099133!);– *ibid.*, Payapry Laoma village, 20°20'02.1” N, 99°48'44.1” E, alt. 1,075 m, 31 January 2006, fl., *J.F. Maxwell 06-84* (**CMUB**!, **L**4193510†);– **Lampang**: Mueang Pan, Jae Son NP., 18°49'42” N, 99°23'13” E, alt. 1,075 m, 9 January 1996, fl., *J.F. Maxwell 96-56* (**BKF**108537!, **CMUB**07902!, **L**4191509†);– **Mae Hong Son**: 18°22'44” N, 98°03'23” E, alt. 1,270 m, 26 January 1964, fl., *B. Hansen*, *G. Seidenfaden & T. Smitinand 10949* (**BKF**!, **E**01020040!, **L**1892754†, **P**03358390!);– *ibid.*, Khun Yuam to Mae Chang, 18°47’42” N, 98°05’40” E, 18 December 2007, fl., *N. Tanaka*, *H. Nagamasu*, *A. Naiki*, *Nishida S.*, *P. Srisanga & S. Watthana HN8609* (**KYO**!);– *ibid.*, Pang Mapha, Sop Pong, Doi Chiang Dao WS., 19°25'49” N, 98°18'24” E, alt. 1,420 m, 18 February 1968, fr., *Bartel Hansen & T. Smitinand 12649* (**BKF**049596!, **KYO**!, **L**1892755†, **P**03358402!);– *ibid.*, Mae He, Hoa Mae Muang, Doi Sam Meun, 6 April 1990, fr., *J.F. Maxwell 90-391* (**L**1892759†);– *ibid.*, Huai He, Namtok Pha Suea NP., 19°30'19.35” N, 98°00'4.2” E, 9 February 2013, fl., *M. Norsaengsri 10949* (**BKF**049577!, **L**1892754†);– *ibid.*, Nan: Pua, Doi Phu Kha NP., 19°11'00” N, 101°05'46” E, alt. 1,500 m, 11 January 1988, fl., *Y. Paisooksantivatan*, *J. Sadakor & P. Penchitra 2236-88* (**BK**213990!);– *ibid.*, **Phitsanulok**:

Nakhon Thai, Noen Phoem, Phu Hin Rong Khla NP., 16°58'51.6" N, 101°0'57.2" E, alt. 1,398 m, 13 November 2004, fl., *O. Kudjabnak & D. Watanachiang charoen BRT85* (**BKF**152878!).;– Western, Tak, Phob Phra, 16°23'51" N, 99°00'33" E, alt. 1,117 m, 5 March 2019, fl., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 5474* (**BKF**229775!, **TCD**!). **VIETNAM**. **Annam**: Cao Bang, Khao Son, Pia Houac, 22°38'08.4" N, 106°15'08.8" E, alt. 1,400 m, 15 February 1931, fl., *M. Norsaengsri 10259* (**BKF**218520!**,** **KYO**!);– *ibid.*, 15 February 1931, fl., *E. Poilane 19006* (**E**01020043!, **K**!, **KYO**!, **P**03358351!);– **Tonkin**, December 1918, lvs., *A.J.B. Chevalier 3* (**P**03358378!);– *ibid.*, July 1944, lvs., *J.E.Vidal 8A* (**P**03358353!);– *ibid.*, 19 October 1920, lvs., *E. Poilane 41086* (**P**03358368!);– *ibid.*, 22°21'04.3" N, 103°46'20.7" E, February 1929, fl., *P.A. Pételot 3376* (**P**03358354!, **US**1525916-7†);– *ibid.*, 22°21'04.3" N, 103°46'20.7" E, August 1925, fr., *P.A. Pételot*, *s.n.* (**P**03358354!);– *ibid.*, Bidoup Lamdong, 8 km to Lo-Qui village, 22°20'21.1" N, 103°46'34.4" E, 26 July 1926, lvs., *E. Poilane 12582* (**P**03358350!, **VNM**00013176!);– **Lai Chau**: Lai Chau, Pou Nhou, 22°23'16.4" N, 103°24'48.4" E, 31 December 1969, fl., *E. Poilane 26969* (**K**!, L1892711†);– **Lang Son**: Tam La, Tran Ninh, 21°58'14.5" N, 106°31'56.2" E, 19 October 1920, fl., *E. Poilane 2137* (**E**01020042!, **KYO**!, **L**1892710†, **P**03358375!);– *ibid.*, 120 October 1920, fl., *E. Poilane 2130* (**L**1892765†);– *ibid.*, Van Quan, Tran Ninh, 20 October 1920, lvs., *E. Poilane 2205* (**E**01020048!, **KYO**!, **L**1892713†);– *Lao Cai*: Fansipan, Hoang Lien NP., 22°20'21.1" N, 103°46'34.4" E, alt. 2,069 m, 2 May 2016, lvs., *T. Yahara*, *H. Toyama*, *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *V.N. Nguyên*, *T.B. Hoang & T.S. Hoang V5008* (**FU**!).

Distribution.— Temperate Himalaya (Nepal, type), Pakistan, Sri Lanka, India (Assam, Himalaya), S. Myanmar, China, Thailand, N. Laos, Cambodia, N. Vietnam, Taiwan, and Japan (**Maps 4.5 & 4.7**).

English name.**—** Wild Himalayan Cherry.

Vernacular name.**— China**: Gao peng ying tao. **Thailand**: ชมพูภูพิงค์ Chomphu phuphing, นางพญาเสือโคร่ง Nang phaya suea khrong (Northern); เส่คาแว่ Se-kha-wae, เส่แผ่ Se-phae, เส่ลาแหล่ Se-la-lae (Karen-Chiang Mai).

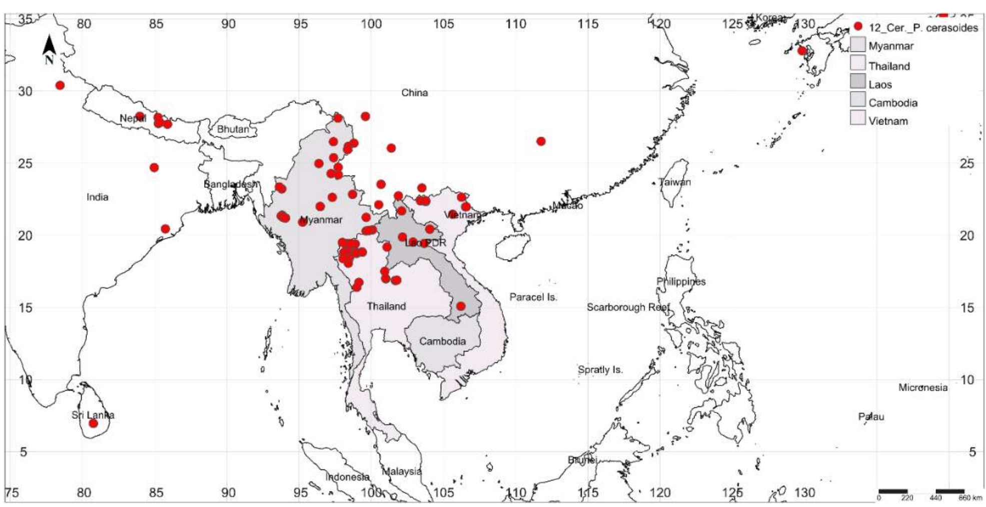
Ecology.**—** Subtropical forest, montane forests, alt. (300–) 800–2,000 (–3,000) m.

Phenology.**—** Flowering: December–February. Fruiting: February–May.

Uses.— Ornamental plants in gardens or along the road, fruits edible.

Conservation.— This species is known from many locations (> 10 locations): EOO = 10,698,373.98 km^2; AOO = 376.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Figure 4.4. *Prunus cerasoides* Buch.-Ham. ex D.Don., habit, vegetative and reproductive morphological characters; **A**, bark; **B**, leaves; **C,** stipules laciniate, lobed; **D,** 2-glands on the petiole; **E–H**, flowers, opening before or at the same time with new leaves; **E**, flowering tree; **F**, lateral view of the inflorescence, short raceme; **G**, extended raceme subtended by conspicuous large leaf-like semi-persistent bracteoles; **H**, flower parts from left to right, petals, sepals, and bracts with scale 1 cm; **I**, mature fruits with cross-section, endocarp, and seedcoat glabrous; **J**, ripe fruits. — Photos: A, B, D, E, G–I by S. Rueangruea; C & F by W. Keawbang; J by W. Kahambai. — Sources: **Myanmar**, Chin State, B & G from *N. Tanaka et al. MY5714*: **Thailand**; Chiang Mai, A, D, H & I from *S. Rueangruea et al. SR136*, and J; Tak, C & F from *S. Suddee et al. 5474*. Scale bars = 1 cm.



Map 4.7. Distribution of *Prunus cerasoides* Buch.-Ham. D. Don of subg. *Cerasus* in continental Southeast Asia and nearby.

8. ***Prunus campanulata* Maxim**., Bulletin de l'Académie Impériale des Sciences de Saint-Pétersbourg. 29: 103. 1883. Cardot, in Flore Générale de L'Indo-Chine: 627–628. 1920; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 531. 1933; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 420–421. 2003.

Typification: **CHINA,** Fokien Sinensium, 1861, Grijs, herb. *Hance 7046* (holotype, *non vidi*, isotype **K**000737115!); Japan, cultivated, Osaka, flowering January-March, *C.J. Maximowicz*, *s.n.* (paratype **P**01818996!).

≡ *Cerasus campanulata* (Maxim.) Masam. & S. Suzuki in Journal of the Taihoku Society of Agriculture and Forestry. 1: 316. 1936.

≡ *Cerasus campanulata* (Maxim.) A.N.Vassiljeva in Trudy Sukhumskogo Botanicheskogo Sada. 10: 119. 1957.

≡ *Cerasus campanulata* (Maxim.) T.T. Yu & C.L. Li in Flora Reipublicae Popularis Sinicae. 38: 78. 1986.

= *Prunus cerasoides* Koidz. in Page R D M. The Plant List with Literature. Institute of Biodiversity: 181. 1909. *nom. nud.*

= *Prunus cerasoides* var. *campanulata* (Maxim.) Koidz. in The Journal of the College of Science, Imperial University of Tokyo. 34(2): 264. 1910. Type, *non vidi*.

Description: Deciduous, understory, small tree up to 10 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth with brown lenticels, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** stout, greyish to purplish-brown; young twigs green, glabrous, with many cataphylls at base; old twigs glabrous with prominent whitish-brown lenticels. *Axillary winter bud* solitary, 5–8 mm long, ovoid; *terminal winter bud* present. **Leaves** plicate in the bud, usually extended after anthesis, fascicled or spiral on short shoots, spiral and alternate on annual twigs, ovate-elliptic to ovate-oblong, 4–7 cm long × 2–5.5 cm wide; *lamina apex* acuminate or acute, angle acute; *margin* sharply serrate, double serrate, teeth sometimes regular, usually somewhat irregular, sinus angular, small apex glandular serrate, glabrous; *base* asymmetrical, oblique or symmetrical, slightly cordate to rounded; young leaves reddish-purple to light green, dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous, glabrous; old leaves glabrous adaxially, glabrescent abaxially; *basal glands* usually 2, (–0), up to 2 mm long, flattened, concave to swollen adaxially with short stalk or sessile, beside or on the contracted leaf base, slightly on leaf blade margin or on the petiole, margin serrate with inconspicuous to small glands at the tips of the teeth; *2° venation* weaky brochidodromous or craspedrodomous, 8–12 alternate on other side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.5 cm long, canaliculate in cross-section, glabrous; *petiolar glands* present or absent, 0–2 glands, 1 × 0.5 mm in diameter, with stalk without stalked glands up to 2 mm long. **Stipules** large, conspicuous, 8–15 mm long × 4–8 mm wide, laciniate, lobed or branched, apex acuminate, margin filiform with small glands at the tips of the teeth, base oblong, glabrous, soon caducous. **Inflorescences** compound, racemes short solitary, usually extended raceme subtended by conspicuous large leaf-like semi-persistent bracteoles, rarely fascicles by contraction of the central axis or umbellate, dense-flowered, from lateral buds on twigs with fallen leaves, on the basal part of shoots and appearing before flushing of new leaves, 0.5–1 cm long, (2–4 flower) often 3-flowered, glabrous; *involucral bracts* 8–16, 3–4 mm long × 0.5 mm wide, rhomboid, flabellate, elliptic-ovate to oblong, apex deeply lobed serrate to acuminate, brown rarely greenish-brown, both surfaces adpressed villose, soon caducous. **Flowers** bisexual, usually opening at the same time as new leaves, pink to reddish-pink, pedicellate, slender, 10–13 mm long, glabrous; *bracteoles* oblong, obovate-oblong to lobed, with many longitudinal nerves, 2.5–8 mm long, pale green, glabrous, caducous; *hypanthium* campanulate, 3.5–6 mm long, glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, equal to longer than hypanthium tube, lobes ovate, ovate-oblong to oblanceolate, moderate, reddish to green, 6–9 mm long × 2–3 mm wide, usually longer than ½ of hypanthium length, unequal to subequal, apex acute, rarely obtuse, margin slightly serrate, or ciliate, base truncate, with 5 longitudinal nerves, reticulate, imbricate in bud, spreading when mature, deciduous, glabrous outside, and inside; *petals* pink, spreading to upright, 5, medium to large, 7–12 mm long × 5–8 mm wide, equal or subequal, petals 2.5–4 times calyx lobes length, broadly ovate to orbicular, shortly unguiculate or sessile, apex retuse to slightly lobed, margin entire, base acute or rounded with short stalk or sessile, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* (25–)30–45 in 3 to many series, exserted or equal to petal length; filament filiform, reddish to pink, 6.5–10 mm long, glabrous; anthers oblong to globose, 0.3–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 10–14 mm long, longer than or as long as stamens, glabrous; stigma gland not divided, globose, green. *Infructescence* 1–2 (–6) cm long, glabrous, 2–5 fruited. **Fruits** stipitate, 1–25 mm long, young fruit green, turning red to dark purple when mature or ripe, ovoid to ellipsoid, 1–1.2 cm long, 0.5–0.7 cm wide, apex obtuse, rounded or acute; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, yellow to brown; endocarp stone bony, smooth with shallow sculpture, with longitudinal grove or ridged, canaliculate with the margin of the channel raised; calyx deciduous. **Seeds** lateral slightly compressed on both surfaces, thin, with glabrous testa, shallowly rugose.

Additional specimens examined.— **JAPAN**. alt. 121 m, 16 March 1932, fl., *Kitamura S.*, *s.n.* (**BKF**!, KYO0055876!);– Kochima back to Uao, March 1882, fl., *G. Watt 6204* (**P**!);– **Karenko**: Batakan: 22 February 1942, fl., *Litamura S.*, *s.n.* (**BKF**!, **L**†);– *ibid.*, 16 March 1932, fr., *Kitamura S.*, *s.n.* (**KYO**!, **L**1892487†);– *Okinawa*: 34°47'23.2” N, 133°53'49.5” E, alt. 163 m, 18 January 1924, fl., *Z. Tashiro*, *s.n.* (**BKF**!);– *ibid.*, Ryukyu: 6 February 1974, fr., *M. Furuse 5015* (**P**!);– *ibid.*, 26°14'50.4” N, 127°45'50.4” E, 19 March 2006, fl., *Shinji Fujii 11598* (**KYO**!);– **Osaka**: March 1863, fl., *C.J. Maximowicz*, *s.n.* (**P**!);– Ura and Shinmura pass, Kagoshima, Amami-Ohsima, 27 January 1957, fl., *H. Noguchi 3522* (**L**1892844†);– **Yokohama**: 13 April 1904, lvs., *H. Hallier*, *s.n.* (**L**†). **PHILIPPINES**. **Musya**: 1 October 1929, fl., *T. Tamaka 346* (**L**1892848†, **P**03358406!). **TAIWAN**. 22°43'16.0” N, 120°46'07.6” E, 3 January 2020, fl., *Adam Duchac 37219793* (**L**†);– Linkin Islands, 22 February 1942, fl., *Bracelin N.F. 1921* (**L**1892850†);– Yang Min Shan, 25°11'38.6” N, 121°33'33.4” E, 22 March 1959, fr., *Chang & Chen*, *s.n.* (**L**†);– Nantou Hsien, Wushe, 23 March 1926, fr., *Saito S. 7737* (**L**4191566†). **THAILAND**. **Northern, Chiang Mai**: Fang, 19°54'36.7” N, 99°02'30.0” E, alt. 1,357 m, 11 December 2019, fr., *S. Rueangruea*, *T. Thananthaisong & P. Uea-Ari SR246* (**BKF**229827!, **TCD**!);– *ibid.*, Chom Thong, Siriphoom waterfall, Doi Inthanon NP., 19°22'27" N, 98°50'50” E, alt. 1,460 m, 6 January 1983, fl., *H. Koyama*, *H. Terao & T. Wongprasert T-32006* (**KYO**!, L1904407†). **VIETNAM**. **Annam, Lam Dong**: Suoi Vang to Cong Troi, 9 November 1994, fl., *Rushforth*, *K.D. 3241* (**E**00073486!);– **Tonkin**: 22°40'30.8” N, 103°24'08.8” E, alt. 800 m, March 1861, fl., *Hance 7046* (**K**000737115!);– *ibid.*, **Lao Cai**: Phong Yho, Yao San, 22°40'30.8” N, 103°24'08.8” E, alt. 1,600 m, 10 December 1937, fl., *E. Poilane 26806* (**E**01020047!, **K**!, **KYO**!, **L**1892764†, **P**03358352!);– *ibid.*, Sapa, San Sa Ho, Tram Ton Area. Forest margin, near the trail, Hoang Lien National Park, 22°20’45” N, 103°46’30” E, alt. 2,000 m, 22 February 2011, fl., *M.S. Nuraliev & D.D. Sokoloff 249* (**MW**0739603-4†).

Distribution.— Native to China (China Southeast, Hainan, Guangxi, Guangdong, Hainan, Hunan, Fujian, Zhejiang, Taiwan), Philippines, and Japan. Introduced into Thailand (cultivated), Vietnam, Alabama, Nansei-Shoto, and New Zealand. (**Maps 4.5 & 4.8**).

English name.**—** Taiwan cherry, Formosan cherry, Bell-flowered cherry.

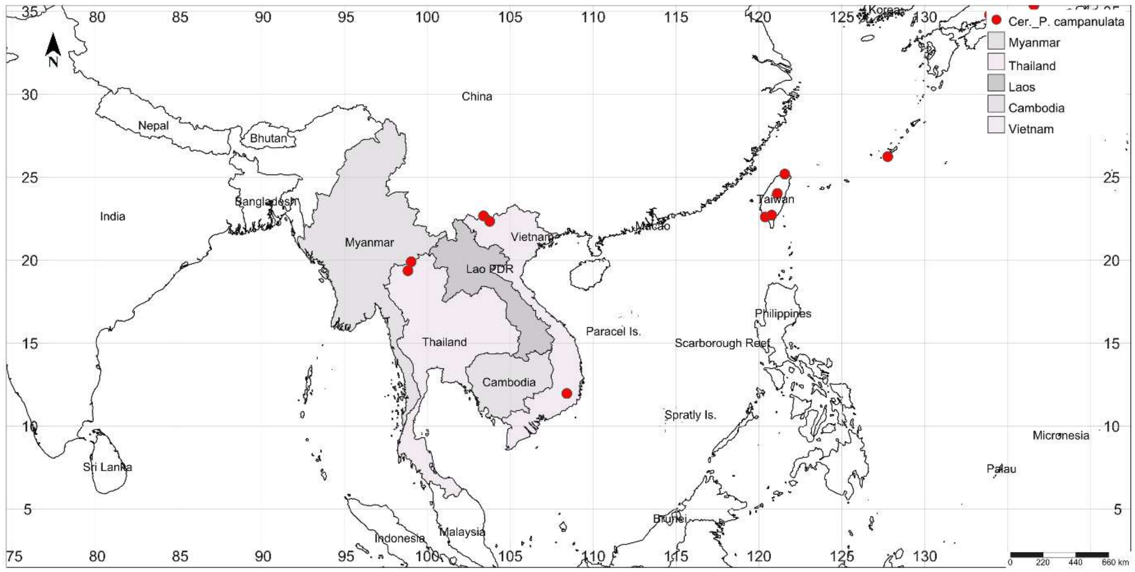
Vernacular name. **— China**: Zhong hua ying tao.

Ecology.**—** Lower Montane Forest, margins; alt. 800–1,500 m.

Phenology.**—** Flowering: (October–December) January–March. Fruiting: December–May.

Uses.— Ornamental plants along the roadside or in gardens.

Conservation.— This species is known from many locations (> 10 locations): EOO = 5,636,064.68 km^2; AOO = 64.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.8. Distribution of *Prunus campanulata* Max. of subg. *Cerasus* in continental Southeast Asia and nearby.

9. ***Prunus mugus* Hand.-Mazz.**, Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse. 9: 52. 1924; *ibid.*, Symbolae Sinicae, Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Sudwest-China. 7: 532. 1933; Merr., Brittonia; a Series of Botanical Papers. 4: 89. 1941; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification**: CHINA, Yunnan**: Prov. Yünnan bor.-occid.: Prope fines Tibeto-Birmanicas inter fluvios Lu-djiang (Salween) et Djiou-djiang (Irrawadi or. sup.), in Jugi Tschiangschel, alt. 3,700–3,950 m, 4 July 1914, *H.R.E. von Handel-Mazzetti 9289* (holotype **WU**0059423†; isotypes **A**00032121†, **E**00010475!, **K**000737183!).

≡ *Cerasus mugus* (Hand.-Mazz.) Hand.-Mazz., Vegetationsbilder. 17: 7-8t. 43B. 1927.

≡ *Cerasus mugus* (Hand.-Mazz.) T.T. Yu & C.L.Li in Flora Reipublicae Popularis Sinicae.: 71. 1986.

Description: Deciduous, understory, prostrate shrub up to 1 m tall, canopy shape oval or globose. **Stem** prostrate or straggling; outer bark greyish-brown, smooth with prominent brown lenticels, spines absent; faint almond smell. **Branchlets** stout, greyish to dark brown with prominent lenticels; young twigs brown to greyish-brown, densely adpressed villose, many cataphylls at base; old twigs glabrescent to densely hairy, and long cataphyll scales. *Axillary winter bud* solitary, *c.* 4 mm long, ovoid to ellipsoid, glabrescent, apex acuminate; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral and slightly alternate on annual twigs, obovate, obovate-elliptic to rounded, 1.5–3.5 cm long × 0.5–2.5 cm wide; *lamina apex* obtuse to acute, angle obtuse; *margin* mostly acutely serrate, incised serrate or double-serrate, teeth irregularly spaced, sinus angular, apex minute and glandular serrate, glabrous; *base* asymmetrical or symmetrical, cuneate to broadly cuneate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, herbaceous to subcoriacious; young leaves densely to sparsely hairy; old leaves densely to sparsely hairy, sparsely strigose on midrib, veins or leaf blade adaxially, densely along lateral veins, leaves glaucous abaxial; *basal glands* usually 0–2(–4), up to 0.5 mm long, subglobose or somtimes with stalk-like, basal leaf blade sometimes with marginal toothed apical glands, sometimes with additional glands on the basal leaf blade; *2° venation* weakly brochidodromous, 6–10 alternate on ether side of midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.3–0.6 cm long, shallowly canaliculate in cross-section, pilose; *petiolar glands* absent. **Stipules** medium to large, 5–12 mm long × 0.3–1 mm wide, linear, apex acuminate, margin entire to glandular serrate, base oblong, densely hairy, margin minutely glandular serrate, caducous. **Inflorescences** compound, racemes short solitary or corymbs, lax-flowered, terminal or in leaf axis near the end of a young shoot, and appearing with the flush of new leaves, 0.2–0.5 cm long, 1–2-flowered, densely pilose; *involucral bracts* 3–10, obovate to oblong, 6–8 × 2–3 mm., brown rarely greenish-brown, adaxially glabrescent to glabrous outside, sparsely hairy inside, pilose abaxially, margin ciliate or glandular serrate, persistent at anthesis. **Flowers** bisexual, opening at the same time as new leaves, white, pedicellate, slender, (6–)10–30 mm long, densely pilose; *bracteoles* linear to triangular, 2–3.5 mm long, brown to brownish-green, sparsely brown hairy, caducous after anthesis; *hypanthium* tubular or campanulate, 6–10 mm long, densely shortly hairy to glabrescent outside, glabrous inside; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular or deltoid, moderate, green, 2–3.5 mm long × 1.5–2.5 mm wide, subequal, apex usually acuminate to acute, margin ciliate, minutely glandular serrate, base truncate, valvate at base, spreading or upright when mature, deciduous, densely shortly hairy to glabrescent outside, glabrescent to glabrous inside; *petals* white or pale pink, extending to erect, 5, medium, 4–10 mm long × 2.5–4.5 mm wide, equal or subequal, petals 2.5–3 times calyx lobe length, broad-obovate, oblanceolate to suborbicular, 5–8 nerves, shortly unguiculate or sessile, apex obtuse or slightly erose, margin almost entire to shallowly serrate, base attenuate to acute with short stalk or sessile, alternate with calyx lobes, sparsely hairy outside, glabrous inside; *stamens* 30–45 in 3 to many series, exserted or equal to petal length; filament filiform, white, 2.5–4 mm long, glabrous; anthers oblong to globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 8–12 mm long, much longer than or up to 3 times as long as stamens, glabrous; stigma gland not divided, globose, green. *Infructescence* sessile or 0.3–0.5 cm long, glabrescent to glabrous, 1–2 fruited. **Fruits** oval, 0.8–1 cm long, 0.6–0.9 cm wide. **Seeds** swollen or lateral, slightly compressed on both surfaces, glabrous, endocarp shallowly reticulate, inner endocarp, and seedcoat glabrous.

Additional specimens examined.— **CHINA**. 27°12'03.0" N, 98°41'41" E, June *s.n.*, fl., *s.coll. 20238* (**P**!);– **Tibet**: 27°59'14.6" N, 89°41'26.5" E, June *s.n.*, fl., *s.coll. 21804* (**P**!);– **Yunnan**: Lumadeng Xiang, Fugong Xian, Gaoligong Shan, 27°12'37.0" N, 98°41'46" E, alt. 3,640 m, 5 August 2005, fl. & fr., *L. Heng*, *B. Bartholomew*, *P. Thomas*, *P. Fritsch*, *D. Zhi-ling*, *W. Zhong-lan & L. Rong 26427* (**CAS**319158†);– *ibid.*, alt. 4,150 m, May 1925, fr., *J.F. Rock 8819* (**US**1332928†);– *ibid.*, 25°22'40.4" N, 97°23'49.2" E, alt. 2,950 m, 4 July 1916, fl., *F.R.H. von Handel-Mazzetti 9289* (**A**†, **CAS**†, **WU**0059423!);– *ibid.*, 11 July 1916, fl., *F.R.H. von Handel-Mazzetti 9537* (**WU**059424†);– *ibid.*, Lumadeng Xiang, Fugong Xian, Gaoligong Shan, 27°12'03.0" N, 98°41'41" E, 24 August 2005, fr., *L. Heng*, *B. Bartholomew*, *P. Thomas*, *P. Fritsch*, *D. Zhi-ling*, *W. Zhong-lan & L. Rong 28025* (**CAS**319159†);– *ibid.*, Xizang, Kenyichunpo and Chanputong, Salwin-Irawadee, alt. 3,962 m, July 1923, fl., *J.F. Rock 10241* (**SU**14297175†);– *ibid.*, Wei-His, Ta-Pao-Shan Mount, alt. 4,150 m, July 1928, fr., *J.F. Rock 17114* (**US**14295957†);– *ibid.*, Tsarung, Western of Mekong on Kakerpo, 29°05'33.3" N, 83°55'26.5" E, alt. 4,333 m, May 1932, fl., *J.F. Rock 22937* (**UN**†). **MYANMAR**. **Lower Burma**, **Kaw Hkaik**: Htawara, June 1824, fl., *G. Forrest 24615* (**RAF**1886!);– **Kachin**: Myitkyina, Chawchi Pass., alt. 4,000 m, 3 July 1920, fl., *R. Farrer 1678* (**RAF**5636!);– *ibid.*, Putao, Khaunglanphu, 27°12'23.0" N, 98°41'43.7" E, alt. 3,714 m, 7 August 2005, fr., *s.coll. 26654* (**CAS**00032010†);– *ibid.*, Laktang, Jit Loi, 26°10'00.0" N, 98°26'00.0" E, 16 June 1925, fl., *G. Forrest 26861* **(K**!, **US**00672652, **US**1377986†);– *ibid.*, N. Maikha-Salwin divide, 26°24'00.0" N, 98°48'00.0" E, October 1925, fr., *G. Forrest 27285* (**NY**02649990†, **US**00672651†);– *ibid.*, N. Maikha-Salwin divide, 26°24'00.0" N, 98°48'00.0" E, 1925, fr., *G. Forrest 20238* (**NY**556†, **US**1378203†);– *ibid.*, N. Maikha-Salwin divide, 26°24'00.0" N, 98°48'00.0" E, 1925, fr., *G. Forrest 218104* (**NY**†, **US**1378203†);– *ibid.*, Adung valley, 21°23'40.19" N, 93°49'49.30" E, alt. 3,400 m, 7 June 1931, fl., *F. Kingdon-Ward 9589* (**K**!);– *ibid* Triangle (Hkinlun), alt. 1333 m, 27 May 1953, *F. Kingdon-Ward 20931* (**BM**!).

Distribution.**—** China, and N. Myanmar.

Distribution.— China (Yunnan, South–Central), Myanmar (**Maps 4.5 & 4.9**).

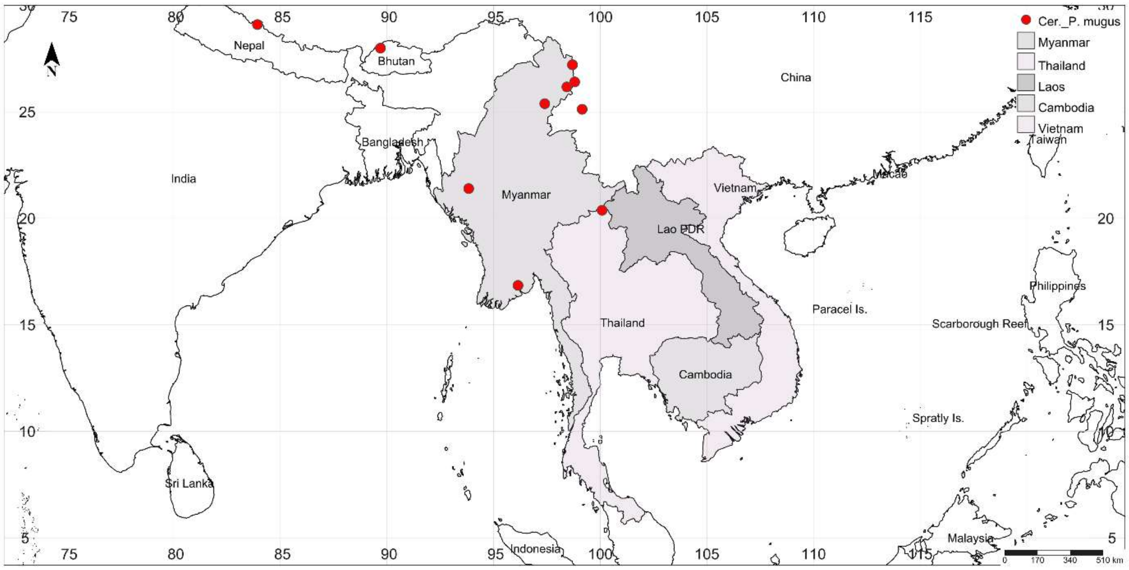
Vernacular name. **— China:** Yan ying tao.

Ecology.— Scattered in open areas, upper Montane to Subalpine forest, alt. 2,600–4,300.

Phenology.**—** Flowering: May–July. Fruiting: June–October.

Uses.— Not known.

Conservation.— This species is known from many locations, (> 10 locations): EOO = 607,139.39 km^2; AOO = 17,500.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.9. Distribution of *Prunus mugus* Hand.-Mazz. of subg. *Cerasus* in continental Southeast Asia and nearby.

10. ***Prunus serrula* Franch**., Plantae Delavayanae 196. 1890; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 531. 1933; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification**: CHINA, Yunnan**, in the forest Fang-yang-chang on Mosoyn alt. 3,000 m; fr. 17 July 1889. *Delavay 3773* (holotype **A**00032197†; isotype **A**00076760†, **A**00032199†, **GH**00032198†, **NY**00429952†).

≡ *Cerasus serrula* (Franch.) T.T. Yu & C.L.Li in Flora Reipublicae Popularis Sinicae.: 80. 1986.

= *Prunus odontocalyx* H.Lév. in H.Lév. Bulletin de Géographie Botanique. 25: 45. 1915.

Typification**: CHINA, Yunnan,** plateau de Ta-Hai-Tse, alt. 3,200 m., May 1912, *E. Maire*, *s.n.* (holotype **E**00011298!; isotype **A**00032132†).

Description: Deciduous, shrub to small tree up to 15 m tall, understory to sub-canopy, canopy shape oval or globose. **Stem** clear single bole to many stems from the ground; outer bark reddish-brown, papery, smooth with large brown lenticels, spines absent; *inner bark* yellowish-white; faint almond smell. **Branchlets** stout, reddish-brown with prominent lenticels; young twigs reddish-brown, glabrescent to densely adpressed tomentose, with 3–5 cataphylls at the base, various shapes and sizes, obovate-oblong, to 2 cm long, thin, margins glandular serrate, glabrescent to sparsely hairy at the base outside, sparsely hairy inside; old twigs glabrescent to densely hairy, with many cataphyll scales at base. *Axillary winter bud* solitary, acutely oblong-lanceolate, glabrous to sparsely adpressed brown pilose, shape various and up to 12 mm long; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral and slightly alternate on annual twigs, elliptic-lanceolate or oblong-lanceolate, 3.5–8.5 cm long × 1–2.5 cm wide; *lamina apex* acuminate, angle obtuse; *margin* mostly acutely serrate or slightly double-serrate, teeth irregularly spaced, sinus angular, with minute gland at the top of teeth, glabrous; *base* asymmetrical or symmetrical, rounded to broadly acute; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous; young leaves sparsely adpressed pilose to glabrous; old leaves sparsely adpressed pilose to glabrous, glabrescent adaxially, more densely hairy along lateral veins (domatia) abaxially; *basal glands* usually 0–2(–6), up to 0.8 mm long, subglobose or sometimes with very short stalk-like, margin of the basal leaf blade sometimes on the contracted petiole, additional with a minute marginal toothed apical gland; *2° venation* weaky brochidodromous, 12–18 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.6–1.2 cm long, shallowly canaliculate in cross-section, pilose, adaxially somtimes reddish-green when young; *petiolar glands* absent or 0.3–1 mm in diameter near the contraction of leaf blade. **Stipules** medium, 3–6.5 mm long × 0.3–1 mm wide, linear, apex acuminate, margin entire to serrate, base oblong, densely hairy, margin minutely glandular serrate, caducous. **Inflorescences** compound, racemes short solitary or corymbs, dense-flowered, terminal or in leaf axil near the end of young shoot, 0.2–0.6 cm long, 1–4-flowered (usually 2 or 3-flowered), densely pilose to glabrescent; *involucral bracts* 5–10, obovate to oblong, 1.5–5 × 1–2.5 mm., brown, adaxially glabrescent to glabrous, pilose, margin ciliate or pectinate glandular, usually with 2 bracts, leaf-like to ovate-oblong, glabrescent to sparsely adpressed hairy, margin serrate, teeth apical glands, soon caducous. **Flowers** bisexual, opening at the same time as new leaves, white, pedicellate, slender, 6–12(–35) mm long, densely to sparsely pilose; *bracteoles* ovate-oblong to leaf-like, with 5–8 nerves, margin serrate, teeth apex with minute gland, 6–10 mm long, pale green, sparsely pilose, caducous after anthesis; *hypanthium* tubular or campanulate, green to reddish-green, 5–7 mm long, densely to sparsely pilose; corolla distinctly different from calyx lobes; *calyx* lobes 5, lobes triangular, moderate, green to reddish-green, 2.5–3.5 mm long × 1.5–2 mm wide, subequal, apex usually acute, margin ciliate, minutely glandular serrate, base truncate, valvate at bud, spreading, deciduous, densely pilose to glabrescent outside, glabrous inside; *petals* white, spreading to upright, 5, medium, 5.5–7 mm long × 4–5.5 mm wide, equal or subequal, petals 2.5–3 times calyx lobes length, broadly ovate to ovate-elliptic, shortly unguiculate or sessile, apex acute, obtuse or slightly erose, margin almost entire, base attenuate to acute with short stalk or sessile, alternate with calyx lobes, sparsely hairy outside, glabrous inside; *stamens* 38–45 in 3 to many series, exserted or equal to petal length; filament filiform, white, 4.5–8.5 mm long, glabrous; anthers oblong to globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 10–12(–20) mm long, slightly longer than to 2 times as long as stamens, sparsely hairy; stigma gland not divided, globose, green. *Infructescence* 0.2–1 cm long, sparsely pilose, 1–3 fruited. **Fruits** fleshy, stipitate, 15–25 mm long, young fruit green, turning red when mature or ripe, ovoid to subglobose, 0.8–12 cm long, 0.6–0.8 cm wide, apex obtuse, rounded or apiculate-acute; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, yellowish-red, slightly sour and bitter; endocarp stone bony, with shallow surface net-foveolate and longitudinal furrowed or ridged, remarkedly furrowed along keel; calyx deciduous. **Seeds** are oval to circular in cross-section, thin, with glabrous testa, markedly sculptured, curved (**Figure 4.5**).

Additional specimens examined.— **CHINA**. **Sichuan**: alt. 1,100 m, 7 August 1908, fr., *E.H. Wilson 988* (**P**03372237!);– *ibid.*, Szechwan, Mitzuga, alt. 3,540 m, September 1929, fr., *J. Rock 181256* (**US**14293215†).;– Ta Tsien Lu, An Niang Pu et Jungalo, 25°49'48.0" N, 99°58'48.0" E, alt. 3,200 m, 16 May 1983, fl., *Kachkarov*, *s.n.* (**K**000737117!);– **Yunnan**: Li Jiang snow, Yangtze watershed, 26°54'10.6" N, 100°02'20.6" E, alt. 3,658 m, April 1923, fl., *J. Rock 8384* (**US**14296843†);– *ibid.*, Peimashan, Pungtzera, 25°49'48.0" N, 99°58'48.0" E, alt. 3,658 m, July 1923, fr., *J. Rock 9929* (**US**†);– *ibid.*, Yangbi Xiang, Dajiuping Mount, 25°49'48.0" N, 99°58'48.0" E, alt. 3,400 m, 30 June 1984, fr., *B. Bartholomew*, *D.E. Boufford*, *Li H.W.*, *C.G. Ma, D.H. Nicolso & S.W. Yu 624* (**US**14296891†);– *ibid.*, Fang Yang Tchang, Mosoyn, alt. 3,000 m, 17 July 1889, fr., *J.M. Delavay 3773* (**GH**†);– *ibid.*, Peimashan, Pungtzera, alt. 3,000 m, July 1923, fr., *J. Rock 9296* (**US**14295626†);– *ibid.*, Fang Yang Tchang, alt. 3,000 m, 9 May 1887, fl., *J.M. Delavay*, *s.n.* (**US**14299267†);– *ibid.*, Fang Yang Shan, Moioyn, alt. 3,000 m, April *s.n.*, fl., *s.coll*, *s.n.* (**K**!);– *ibid.*, Yangbi Xiang, Dapigzi, alt. 2,850 m, 17 June 1984, fr., *B. Bartholomew*, *D.E. Boufford*, *H.W. Li*, *C.G. Ma, D.H. Nicolso & S.W. Yu 187* (**US**3043137†). **MYANMAR**. Chimili Woods, alt. 3,048 m, 16 May 1919, fl., *R. Farrer 930* (**E**00072297!, **RAF**5501!);– **Upper Burma, Kachin**: Chimili woods, alt. 3,000 m, April *s.n.*, fl., *R. Farrer*, *s.n.* (**E**2398300!).

Distribution.— China (Tibet, Sichuan, Yunnan), Myanmar (Upper, Kachin) (**Maps 4.5 & 4.10**).

Vernacular name. **— China**: Xi chi ying tao. **English name**: Paperbark cherry, Birchbark cherry, Tibetan cherry.

Ecology.— Scattered in mountain slopes, forest margins, grassy mountain slopes, Lower Montane to Subalpine forest, alt. 1,100–4,000 m.

Phenology.**—** Flowering: April–June. Fruiting: June–September.

Uses.— Ornamental plants along roadsides or in gardens.

Conservation.— This species is known from many locations (> 10 locations): EOO = 517,670.91 km^2; AOO = 28.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

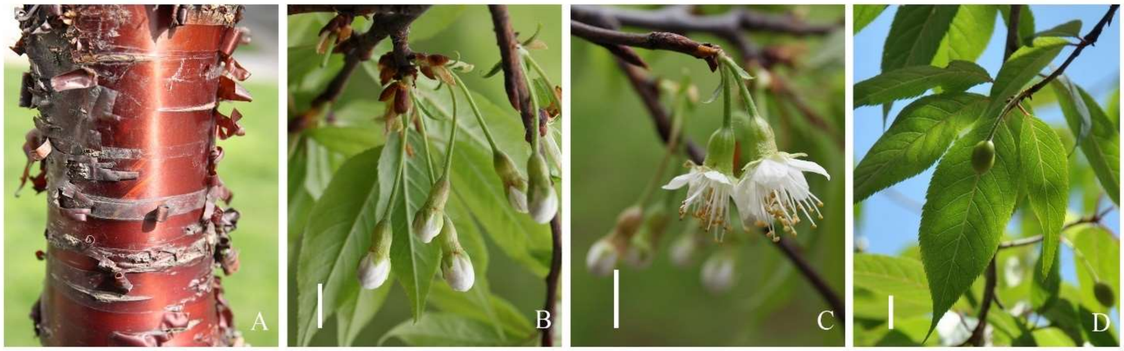
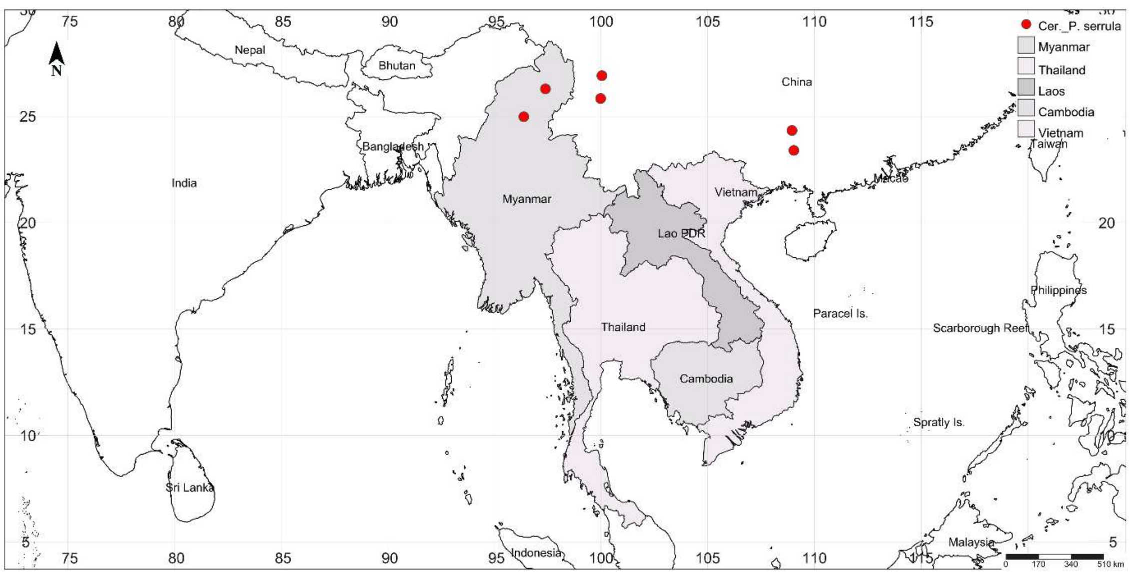


Figure 4.5. *Prunus serrula* Franch., vegetative and reproductive morphological characters; **A**, bark reddish-brown with prominent horizontal lenticels, papyraceous; **B–C**, inflorescence; **B**, flower bud, solitary to short raceme, 1–4 flowered, pendulous; **C**, lateral view of flowers, opening at the same time as new leaves; **D**, fruiting, young fruit green, turning red when mature or ripe, ovoid to subglobose. — Photos: all by S. Rueangruea. — Source: **Ireland**, Trinity College Dublin Scale bar = 1 cm.



Map 4.10. Distribution of subg. *Cerasus*, *Prunus serrula* Franch. in continental Southeast Asia and nearby.

11. ***Prunus trichantha* Koehne** in Sarg. Plantae Wilsonianae. 1(2): 254. 1912; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification**: NEPAL,** Eastern Himalayas, Sikkim, the Tonghoo alt. 3,000 m., 29 May 1862, *T. Anderson 466*, *non vidi*.

≡ *Cerasus rufa* var. *trichantha* (Koehne) T.T.Yu & C.L.Li in Flora Reipublicae Popularis Sinicae. 38: 81. 1986.

≡ *Cerasus trichantha* (Koehne) C.LLi. & S.Y.Jiang in C.Y.Wu & P.H.Raven Flora of China. 9: 413. 2003.

= *Prunus rufa* Wall. ex Hooker f., The Flora of British-India. 2. 314. 1878.

Typification: **NEPAL,** Napalia, Himalaya, the temperate region, alt. 10,000–12,000 ft., 1821. *Wallich, 721* (lectotype **M**0214863† designed here): syntypes, Sikkim, temperate region, alt. 3,000–4,000 m., *Hooker f. & Thomson*, *s.n.* (**P**03372764!, **U**1551811†).

≡ *Cersus rufa* Wall., A Numerical List of dried specimens of plants in the East India Company's Museum: collected under the superintendence of Dr. Wallich of the Company's botanic garden at Calcutta. London. n. 721. 1829, *nom. inval*., *nom. nud.*.

≡ *Cerasus rufa* (Hook.f.) T.T.Yu & C.L.Li, in Flora Reipublicae Popularis Sinicae. 38: 81. 1986.

Description: Deciduous, shrub to small tree 2–10 m tall, understory, canopy shape oval or globose. **Stem** erect or straggling, greyish, outer bark greyish to dark brown, smooth with prominent brown lenticels, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** stout, slightly ridged (not terete), greyish-brown with prominent lenticels; young twigs green or greyish-brown, densely greyish-brown hairy, with many cataphylls at base; old twigs soon glabrescent. *Axillary winter bud* solitary, *c.* 4 mm long, ovoid to long ovoid, glabrescent to sparsely hairy; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral and alternate on annual twigs, ovate-lanceolate to obovate-elliptic, (3–)5–12 cm long × 2.5–5 cm wide; *lamina apex* acuminate to caudate-acuminate, angle acute; *margin* mostly acutely incised to slightly double-serrate, teeth irregularly spaced, sinus angular, tooth apex usually non-glandular or with a minute apical gland at the base of leaf blade, glabrous; *base* asymmetrical or symmetrical, cuneate to slightly attenuate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous; young leaves densely brown hairy abaxially; old leaves densely brown hairy on whole leaf blade abaxially, pilose but soon glabrous adaxially, pilose along veins, densely to sparsely hairy abaxially; *basal glands* usually 0(–2), up to 0.5 mm long, first pair of teeth usually with stipitate apical glands; *2° venation* weaky brochidodromous, 9–12 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.5–1 cm long, canaliculate in cross-section, densely brown hairy to pilose; *petiolar glands* absent. **Stipules** medium to large, 8–15 mm long × 1–2 mm wide, linear to lanceolate, apex acuminate, margin serrate, the top teeth usually with gland, base oblong, densely pilose, caducous. **Inflorescences** compound, racemes short solitary or corymbs, lax-flowered, from lateral buds on twigs with fallen leaves, basal part of shoots appearing before or the flush of new leaves, 0.2–1 cm long, usually 2-flowered, glabrous; *involucral bracts* 3–5, 1–4 mm long, *c.* 1 mm wide, brown color, size, and shape variable, orbicular to spathulate, apex acute to rounded, margin glandular serrate, soon caducous. **Flowers** bisexual, opening at the same time as new leaves, white or pink, pedicellate, slender, 10–25 mm long, densely pubescent; *bracteoles* obovate-oblong, elliptic to leaf-like, with longitudinal nerves, margins serrate or toothed with minute apical glands, 2–5 mm long, pale green, glabrous to sparsely pubescent, caducous after anthesis; *hypanthium* tubular or campanulate, (8–)10–15 mm long, densely pilose; corolla distinctly different from calyx lobes; *calyx* lobes 5, lobes triangular to ovate, green, 2–3(–4) mm long × 1.5–2 mm wide, subequal, apex usually acute to obtuse, margin minute glandular serrate, base truncate, slightly imbricate at the basal part in the bud, spreading or reflexed when mature, deciduous, glabrescent to pilose outside, glabrescent or adpressed pilose inside; *petals* white or pale pink, spreading to upright, 5, medium, 5–6 mm long × 4–6 mm wide, equal or subequal, petals *c.* twice calyx lobes length, broadly ovate to orbicular, 5–8 nerves, shortly unguiculate or sessile, apex obtuse to slightly erose, margin entire, base acute with short stalk or sessile, alternate with calyx lobes, sparsely pilose to glabrescent outside, glabrous inside; *stamens c.* 45 in 3 to many series, exserted or equal to petal length; filament filiform, white, 3–5 mm long, glabrous; anthers oblong to globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 5–9 mm long, slightly longer than to 3 times as long as stamens, glabrescent to pilose at basal part; stigma gland not divided, globose, green. *Infructescence* sessile or 0.3–0.5 cm long, densely pubescent, 1–2 fruited. **Fruits** stipitate clavate-like, apex thickness 10–25 mm long, young fruit green, turning purplish-red when mature or ripe, ovoid to subglobose, 0.8–1.2 cm long, 0.7–0.8 cm wide, apex obtuse, rounded or acute; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, reddish-purple; endocarp stone bony, with surface shallow net-foveolate and with longitudinal furrow or ridge, remarkedly furrowed along keel; calyx deciduous. **Seeds** lateral slightly compressed on both surfaces, thin, with glabrous testa, shallowly rugose.

Additional specimens examined.— **BHUTAN**, alt. 2000 m, 19 May 1979, *A.J.C. Grierson & D.G. Long 1160* (**L**†d);– **Kohina**, alt. 3415 m, 15 May 1967, *H. Hara, H. Kanai, G. Murata, H Ohashi, O. Tanaka & T. Yamaraki s.n.* (**L**†d). **INDIA**, **Sikkim**, Temp, alt. 3300 m, 15 March 1901, *J.D. Hooker s.n.* (**K**!);– East Himalaya, alt. 1600 m, May s.n., *W. Griffith 2065* (**P**03372763!);– Kokchuurong, alt. 1600 m, June 1888, *King s.n.* (**P**03372762!). **MYANMAR**, **Thama Bum**, alt. 3300 m, 24 June 1953, *F. Kingdon Ward 21051* (**BM**!, **E**!). **NEPAL**, 27°38'17.3"N, 88°35'21.4"E, alt. 3350 m, 25 May 1992, *M. Suzuki, N. Acharya. S Akiyama, H. Koba, S. Noshiro & K.R. Rajbhandari 9240310* (**L**†d);– 27°38'17.3"N, 88°35'21.4"E, alt. 2350 m, 17 May 1992, *M. Suzuki, N. Acharya. S Akiyama, H. Koba,* *S. Noshiro & K.R. Rajbhandari 9263087* (**L**†d);– Ghunsa, 27°39'37.8"N, 87°56'04.3"E, alt. 1700 m, May s.n., *K. Nishioka 459* (**KYO**!);– Raman-Phalut, alt. 3000 m, May s.n., *s.coll. 6238* (**KYO**!);– Panchthar, Temple Jung, 27°25'42.6"N, 87°59'00.0"E, alt. 3410 m, 16 June 1992, *S. Nlshiro, S. Akiyama & N. Acharya 9240840* (**L**4194264!);– Sankhuwasabha, Burun Khola, alt. 3110 m, 9 February 1981, *Grey Wilson 4330* (**K**!).

Distribution.— India, Nepal, N. Myanmar, and China (**Maps 4.5 & 4.11**).

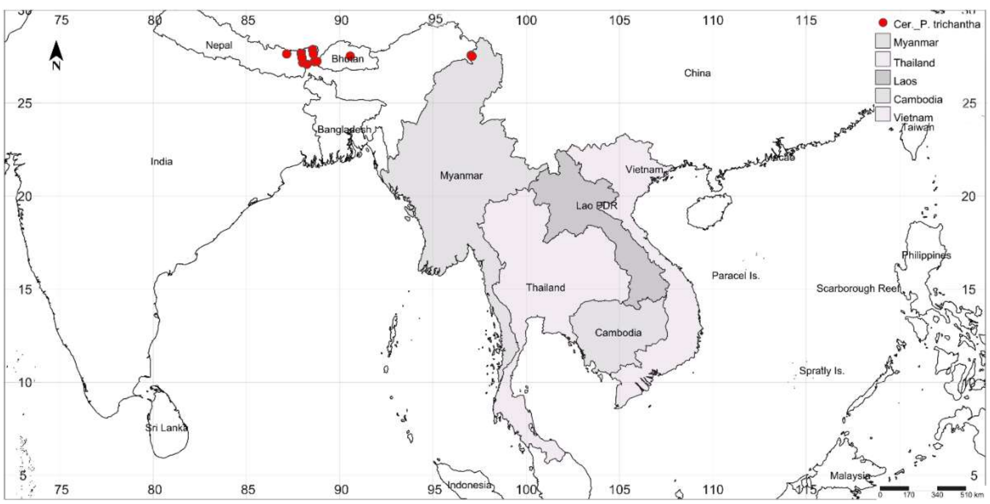
Vernacular name. — **China**: Mao ban zang ying.

Ecology.— Sparsely forested regions, forest margins, thickets, mountain slopes, alt. 2,800–3,900 m.

Phenology.— Flowering: March–June. Fruiting: June–July.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 332,240.31 km^2; AOO = 68.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.11. Distribution of *Prunus trichantha* Koehne of subg. *Cerasus* in continental Southeast Asia and nearby.

12. ***Prunus trichostoma*** **Koehne** in Sarg. Plantae Wilsonianae. 1(2): 216. 1912; Merr., Brittonia; a Series of Botanical Papers 4: 89. 1941; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification**: CHINA, Western Szechuan**: west of Kuan Hsien, woods, alt. 1,600–2,000 m., May 1907, *E.H. Wilson 2817* (lectotype **A**00032213† designated here); isosyntypes,–Western China, Omi Mountain, May 1904, *E.H. Wilson 4860* (**A**00076762†, **K**000737105!);– alt. 2,600–3,100 m., May 1904, small tree 15 ft tall, *E.H. Wilson 3524a* (**A**00076761†,

A00032214†, **K**000737106!);– Western China, woods, 1904, *E.H. Wilson 3527* (**A**00076763†, **K**000737107!).

≡ *Cerasus trichostoma* (Koehne) T.T. Yu & C.L.Li in Flora Reipublicae Popularis Sinicae.: 69. 1986.

= *Prunus latidentata* Koehne in Sarg. Plantae Wilsonianae. 1(2): 217. 1912.

Typification**: CHINA, Western Szechuan**: west of Kuan Hsien, woodlands, 2,000–3,000 m alt., June 1908, *E.H. Wilson 2820* (lectotype **A**00032083†, designated here; isolectotypes **E**00317754!, **HBG**511117†, **US**00107963†); isosyntypes;– Tachien-Iu, woodlands, August 1808, *E.H. Wilson 2819*, *non vidi*;– western China, ravines, 4,000 m alt., 11 June 1904, *E.H. Wilson 3524* (**A**00032085!);– woods, May 1904, *E.H. Wilson 3528* (**A**00032086†, **K**00737101!).

= *Prunus micromeloides* Koehne in Sarg. Plantae Wilsonianae. 1(2): 218. 1912.

Typification**: CHINA, Western Szechuan**: Wa-shan, thickets, 2,300–2,500 m alt., June 1908, fr., *E.H. Wilson 824* (lectotype **A**00032120† designated here; isolectotypes **K**000737099!, **E**00011302!).

= *Prunus oxydonta* Koehne in Sarg. Plantae Wilsonianae. 1(2): 218–219. 1912.

Typification**: CHINA, Western Szechuan**: Ta-Hsiang-Iing, Ching-chi Hsien, thickets, alt. 1,600–2,300 m., May 1908, *E.H. Wilson 2822* (lectotype *non vidi*; isolectotype **E**00011304!; the date for the branches with adult leaves not indicated); syntype;– Western China: Wa-shan, May 1904. *E.H. Wilson 3525*, *non vidi*.

= *Prunus glyptocarya* Koehne in Sarg. Plantae Wilsonianae. 1(2): 219–220. 1912.

Typification**: CHINA, Western Szechuan**: Wen-chuan Hsien, woods 2,000 m alt., September 1908, *E.H. Wilson 1026* (lectotype **A**00032063†, designated here; isolectotypes **A**00032064†, **K**000737096!); lectosyntype;– west of Kuan Hsien, woodlands 2,600–3,000 m alt., August 1910, *E.H. Wilson 4040* (**A**00032065†).

= *Prunus lobulata* Koehne in Sarg. Plantae Wilsonianae. 1(2): 220. 1912.

Typification**: CHINA, Western Szechuan**: west of Tachien-lu, alt. 3200 m., 24 July 1908 *E.H. Wilson 912* (lectotype **A**00032104! designated here; isolectotypes **E**00011303!, **K**000737092!); lectosyntypes;– Western Szechuan, Tachien-lu, woods, 2,300–3,000 m alt., September 1908, fr., *E.H. Wilson 978* (**E**00317752!, **K**000737093!); west and near Wen-chuan Hsien, alt. 2,000–2,800 m., August 1808, fr., *E.H. Wilson 810* (**A**00032106–7†, **E**00317753!, **K**000737094!, **US**00623850†).

= *Prunus pleuroptera* Koehne in Sarg. Plantae Wilsonianae. 1(2): 221. 1912.

Typification**: CHINA, Western Szechuan**: southeast of Tachien-lu, woods, 2,300–3,000 m alt., August 1908, *E.H. Wilson 981* (lectotype **K**000737089! designated here; isolectotype **E**00010483!, **HBG**511128†, **US**00107984†); syntype;– *ibid.* 2,300–3,000 m alt., September 1908, *E.H. Wilson 984* (**E**00317766!, **K**000737088!).

= *Prunus zappeyana* Koehne in Sarg. Plantae Wilsonianae. 1(2): 221–222. 1912.

Typification**: CHINA, Western Hupeh**: Fang Hsien, woods, alt. 1,300–2,000 m., June 1907, *E.H. Wilson 7*0 (lectotype **E**00011305! designated here); lectosyntype;– Patung Hsien, alt. 1,000–1,600 m., June 1907, *E.H. Wilson 45* (**A**00032250†).

=*Prunus zappeyana* var. *subsimplex* Koehne in Sarg. Plantae Wilsonianae. 1(2): 222–223. 1912.

Typification; **CHINA, Western Hupeh**: Changyang Hsien, cliffs, 1,300 m alt., June 1907, *E.H. Wilson 45a* (lectotype **A**00032252! designated here); lectosyntype;– Western China: Mountains, 2,800 m alt., May 1904, *E.H. Wilson 3526* (**A**00032251†, **K**000737060!).

= *Prunus podadenia* Koehne in Sarg. Plantae Wilsonianae. 1(2): 258. 1912.

Typification**: CHINA,** Western China: Mountains, alt. 3000 m., July 1903 *E. H*, *Wilson 3525a* (lectotype **A**00032152† designated here; isolectotype **A**00032151†, **K**000737095!).

= *Prunus kingdonwardii* Merr., Brittonia; a Series of Botanical Papers. 4: 90. 1941.

Typification**: MYANMAR, Upper Burma**, Kachin: Ta Su Htu, Adang Valley, 28°20'00.0” N, 97°45'00.0” E, alt. 2,700 m, 14 May 1931, fl., *F. Kingdon-Ward 9475* (holotype **A**00032419!; isotype **HUH**2684491†).

Description: Deciduous, understory, shrub to small tree (1.5–)2–10 m tall, canopy shape oval or globose. **Stem** erect or straggling; outer bark greyish to dark brown, smooth with large brown lenticels, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** stout, greyish-brown with prominent lenticels; young twigs green or greyish-brown, glabrescent, with many cataphylls at base; old twigs glabrescent to glabrous. *Axillary winter bud* solitary, 3–4 mm long, ovoid to long ovoid, glabrous; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral and alternate on annual twigs, ovate, obovate or elliptic-lanceolate, 1.5–7 cm long × 0.5–4 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* mostly coarsely incised double-serrate to lobed, teeth irregularly spaced, sinus angular, tooth apex at the base of leaf blade with a minute to conspicuous apical gland, glabrous to sparsely ciliate; *base* asymmetrical or symmetrical, cuneate, broadly cuneate or subrounded; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous; young leaves glabrescent to densely pilose, especially along lower part of midrib and lateral veins abaxial; old leaves sparsely hairy to densely hairy, especially along lower part of midrib and lateral veins abaxially, pilose to glabrescent adaxially, dense along lateral veins, and glabrescent on leaf blade, domatia present on lateral veins axil; *basal glands* usually 2(–4), up to 1 mm long, first pair of teeth with stipitate apical glands, slightly on leaf blade margins, serrate margin apex without or with minute glands; *2° venation* weaky brochidodromous, 6–10 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles*, 0.5–1 cm long, canaliculate in cross-section, pilose to glabrescent; *petiolar glands* absent. **Stipules** medium, 3–5 mm long × 1–2 mm wide, lanceolate to linear, apex acuminate, margin 2 or 3 serrate or lobed, teeth acute to acuminate, base oblong, glabrescent to glabrous, caducous. **Inflorescences** compound, racemes short solitary or corymbs, lax-flowered, from lateral buds on twigs with falling leaves, basal part of shoots appearing before or the flush of new leaves, 0.2–1 cm long, 1–3-flowered, glabrescent to pubescent; *involucral bracts* 3–5, elongate to 2 cm long, 1–3.5 mm wide, brown, size and shape variable, basal ones ovate orbicular, apex acute to rounded, margin serrate, toothed or ciliate, with sparse minute apical glands, soon caducous or persistent at anthesis. **Flowers** bisexual, opening at the same time as new leaves, white, pedicellate, slender, 10–30 mm long, glabrous to glabrescent; *bracteoles* obovate-oblong, elliptic to leaf-like, with longitudinal nerves, margins serrate or toothed with minute apical glands, 2–5 mm long, pale green, glabrous to sparsely pubescent, bracts and bracteols caducous after anthesis; *hypanthium* tubular or campanulate, 4–6 mm long, glabrescent to glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, lobes triangular to ovate, green, moderate size, 2–3.5 mm long × 1.5–2.5 mm wide, subequal, apex usually acute to obtuse, margin minute glandular serrate, ciliate, base truncate, separate or valvate in bud, spreading or reflexed when mature, deciduous, glabrescent to pilose outside, glabrous or adpressed pilose inside; *petals* white or pale pink, spreading to upright, 5, medium, 3–5 mm long × 2–3 mm wide, equal or subequal, petals 2–3.5 calyx lobes length, broadly ovate to orbicular, 5–8 nerves, shortly unguiculate or sessile, apex obtuse to slightly erose, margin entire, or slightly serrate, base acute with short stalk or sessile, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* (25–)30–44 in 3 to many series, exserted or equal to petal length; filament filiform, white, 3–6 mm long, glabrous; anthers oblong to globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, 6–13 mm long, slightly longer to 2–3 times as long as stamens, glabrescent to pilose at basal part; stigma gland not divided, globose, green. *Infructescence* sessile or 0.3–1.5 cm long, sparsely hairy to glabrescent, 1–3 fruited. **Fruits** stipitate clavate-like, apex thickness, 10–30 mm long, young fruit green, turning purplish-red when mature or ripe, ovoid to subglobose, 0.7–1.2 cm long, 0.7–0.8 cm wide, apex obtuse, rounded or acute; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, reddish-purple; endocarp stone bony, surface shallow net-foveolate and longitudinal or ridged, remarkedly furrowed along keel; calyx deciduous. **Seeds** lateral slightly compressed on both surfaces, thin, with glabrous testa, shallowly rugose, seedcoat glabrous.

Additional specimens examined.— **CHINA**. 27°06'41.6” N, 100°05'47.6” E, alt. 3,048 m, 21 April 1982, fl., *D.O. Wijnands 964* (G!);– **Sichuan**: Kuan Hsien, alt. 2,750 m, 20 June 1908, fl., *E.H. Wilson 2820* (**A**†);– *ibid.*, alt. 2,500 m, August 1908, fr., *E.H. Wilson 810* (**E**!);– *ibid.*, *978* (**K**!);– **Yunnan**: Yu Lung Shan, Satseto Mountain, alt. 3,180 m, June 1932, fl., *J.F. Rock 24819* (**US**†);– *ibid.*, Saba, Li Jiang, Yangtze watershed, alt. 3,348 m, 7 September 1922, fr., *J.F. Rock 6287* (**US**†);– *ibid.*, Kulu Mountain, alt. 4,000 m, June 1929, fl., *J.F. Rock 18009* (**US**†);– *ibid.*, Yu Lung Shan, 27°06'41.6” N, 100° 5'47.6” E, alt. 3,048 m, April 1932, fl., *J.F. Rock 24979* (**US**†). **MYANMAR**. **Upper Burma, Chin**: Moku Ji Pass, 27 May 1920, fl., *R. Farrer 1585* (**E**00901048–9!, **RAF**!);– Mount Victoria, alt.

2,855 m, 14 November 2018, lvs., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Yunn Mi Mi Kyaw*, *Awng Khine Win MY3423* (**FU**!);– *ibid.*, alt. 2,333 m, 14 November 2018, lvs., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Yunn Mi Mi Kyaw*, *Awng Khine Win MY3473* (**FU**!);– *ibid.*, Kanpetlet, alt. 3,000 m, 4 April 1956, fl., *F. Kingdon-Ward 21932* (**E**00901069!);– **Kachin**: Ta Su Htu, Adung valley, alt. 3,000 m, alt. 4,000 m, 7 June 1936, fr., *F. Kingdon-Ward 9604* (**HUH**†).

Distribution.— China (Western to Central Sichuan, Qinghai, Tibet, Yunnan) and Myanmar (Upper Burma: Chin, Kachin) (**Maps 4.5 & 4.12**).

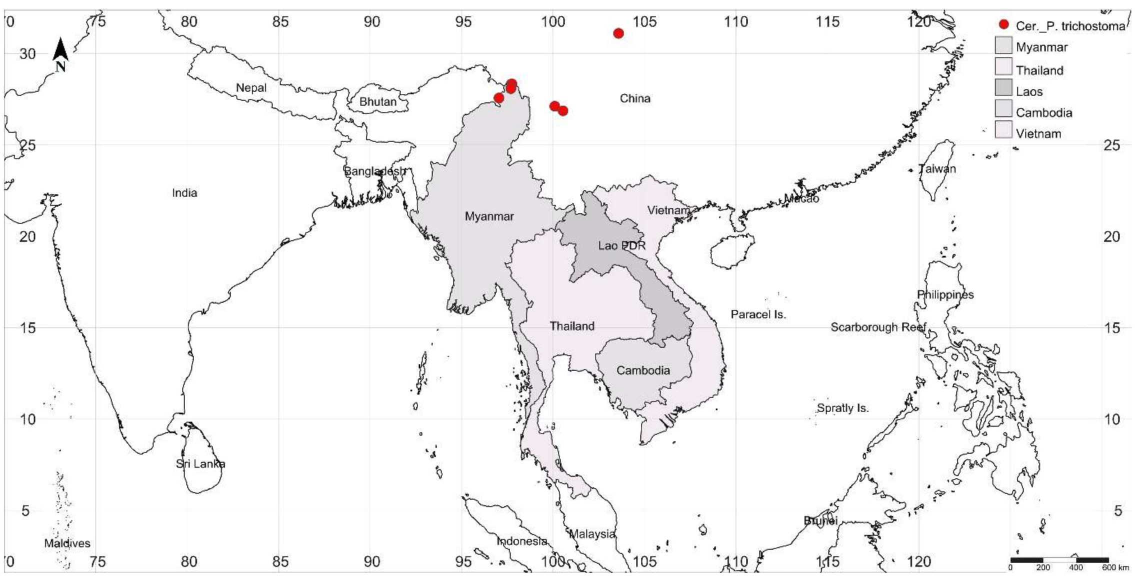
Vernacular name. **— China**: Chuan xi ying tao. **English name**: Ribbed cherry.

Ecology.**—** Upper Montane forest to Alpine forest, thickness on rocky slopes, alt. 2,200–4,000 m.

Phenology.**—** Flowering: April–June. Fruiting: June–September.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 27,631,902.68 km^2; AOO = 460. 00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.12. Distribution of *Prunus trichostoma* Koehne of subg. *Cerasus* in continental Southeast Asia and nearby.

4.3.6. Subgenus *Padus* Miller, The gardener's dictionary, Abridged. ed. 4: 999. 1754. – sect. *Eupadus* Koehne, Deutsche Dendrol.: 302. 1893; Koehnei in Sarg., Plantae Wilsonianae. 1: 59–75. 1912. – genus *Padus* Cuizhi & Bartholomew in Lu et al. Flora of China. 9: 423. 2003.

Description: Tree or shrubs, deciduous, many-branched. Branches unarmed. Axillary winter buds ovoid; terminal bus present. Stipules membranous, soon caducous. Leaves simple, alternate or spiral, conduplicate when young; petiole usually has 2 nectaries at the apex or base of leaf blade margin; leaf blade margin serrate, rarely entire. Inflorescences terminal or on current year's branchlet, racemose, many-flowered, base with a soon caducous involucre formed by floral bud scales; peduncle usually with leaves or sometimes leafless. Hypanthium campanulate to cup-shape, usually caducous or sometimes persistent in fruit. Sepals 5. Petals 5, white. Stamens 10 or more, inserted on the rim of hypanthium. Ovary superior, 1-loculed; ovules 2, collateral, pendulous. Style terminal, elongated; stigma flat or peltate. Fruit a drupe, glabrous, not glaucous, without a longitudinal groove; mesocarp succulent, not splitting when ripe; endocarp bony, usually smooth, glabrous inside.

13. ***Prunus* sp. "inthanonensis"** sterile specimens.

Description: Deciduous, sub-canopy, small tree up to 10 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown with horizontal prominent large brown lenticels, smooth, spines absent; faint almond smell. **Branchlets** medium with light brown lenticels; young twigs purplish-green to pale green; young twigs and branchlets with white pubescence, with many cataphylls at base; old twigs sparsely brown pubescent. *Axillary winter bud* solitary, ovoid, pubescent; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral or alternate on annual twigs, elliptic to oval-elliptic, 6–16 cm long × 4–8 cm wide; *lamina apex* acuminate, angle acute; *margin* serrate, teeth irregularly spaced, sinus angular, small apex glandular serrate, glabrous; *base* asymmetrical or symmetrical, broadly acute to rounded; young leaves pale green, pale green adaxially, glaucous abaxially, turning yellow before falling, chartaceous; sparsely tomentose; old leaves sparsely tomentose, glabrescent to glabrous adaxially, pubescent abaxially; *basal glands* 0–2, up to 1 mm long, circular, flat, on the lowest of basal leaf margin, or on the base of marginal surfaces of the teeth; *2° venation* weaky brochidodromous, 10–14 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles*, 1–1.3 cm long, slender, shallowly canaliculate in cross-section, densely grey hairs, sometimes reddish-purple adaxially when young; *petiolar glands* absent. **Stipules** medium, 6–10 mm long × 0.3–0.5 mm wide, linear, apex acuminate, margin entire, ciliate, sometimes sparsely serrate at the base, base sessile, densely tomentose, early caducous. **Inflorescences** have no information because all specimens are sterile (**Figure 4.6**).

Additional specimens examined.— **THAILAND**. **Northern, Chiang Mai**, Chom Thong, Doi Inthanon NP.: 18°31'39” N, 98°29'57” E, alt. 1,200 m, 8 March 2019, lvs., *S. Suddee*, *S. Rueangruea*, *S. Kaithongsuk*, *C. Hemrat*, *W. Kiewbang 5499* (**BKF**229768!, **TCD**!);– *ibid.*, 18°32'16” N, 98°29'37” E, alt. 1,746 m, 9 March 2019, lvs., *S. Suddee*, *S. Rueangruea*, *S. Kaithongsuk*, *C. Hemrat*, *W. Kiewbang 5503* (**BKF**229758!, **TCD**!);– *ibid.*, 18°31'25.89” N, 98°29'36.88” E, alt. 1,700 m, 11 December 1985, lvs., *H. Koyama*, *C. Phengklai, S.I. Mitsuta*, *T. Yahara & H. Nagamasu 39400* (**BKF**097783!, **KYO**!);–

ibid., 18°31'33” N, 98°24'59” E, alt. 1,650 m, 10 December 1989, lvs., *T. Yahara & H. Nagamasu T-50003* (**BKF049597**!, **KYO**!).

Distribution.— Endemic (known only from the specimens cited) (**Map 4.13 & 4.14**).

Vernacular name. **—** Not known.

Ecology.**—** Shaded or growing in open areas in Lower Montane Forest, alt. 1,200–1,800 m.

Phenology. **—** Not known.

Uses.— Not known.

Conservation.— DD (Data Deficient). More exploration is needed to gain information for a conservation assessment.

Note.— *Prunus* "inthanonensis" is similar to *P. cerasoides* in having a serrate leaf margin and a small or inconspicuous pair of glands at the leaf base margin. However, it is distinguished from *P. cerasoides* by its papyraceous leaves and glaucous abaxial surface (vs. herbaceous leaves and pale green abaxial surface), oblong-lanceolate stipules with an entire ciliate margin, (vs. stipule margins lobed with a long filiform glandular apex). I have not named this taxon yet because I have found only non-flowering specimens.

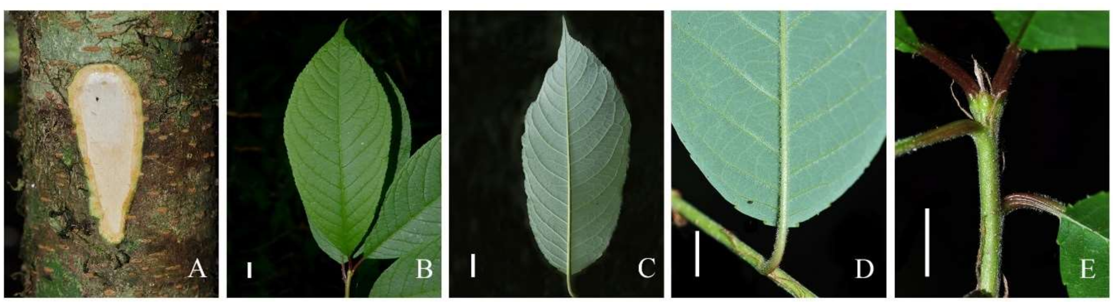
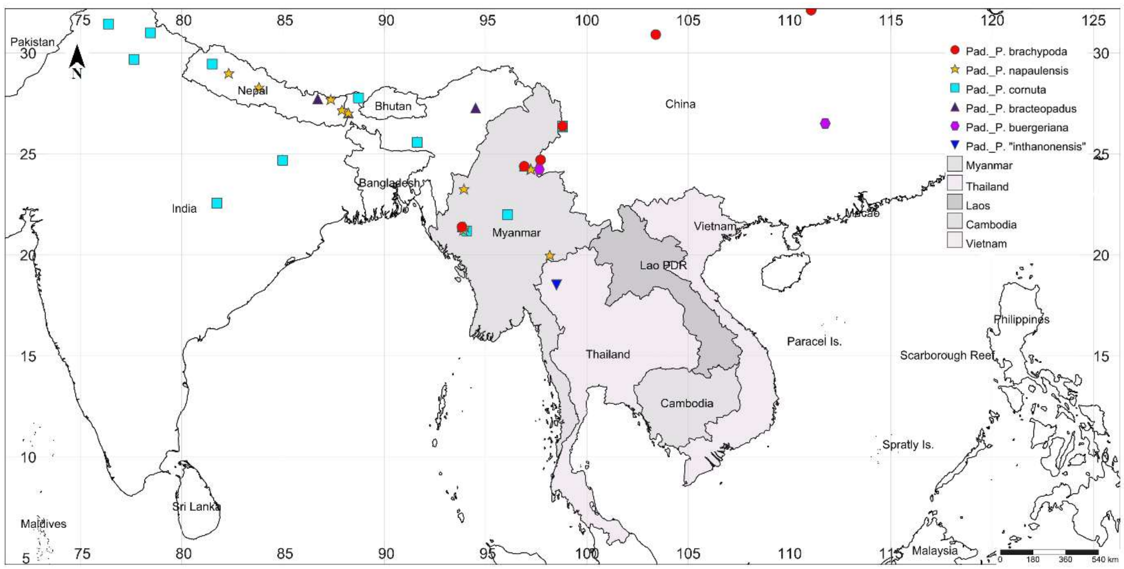
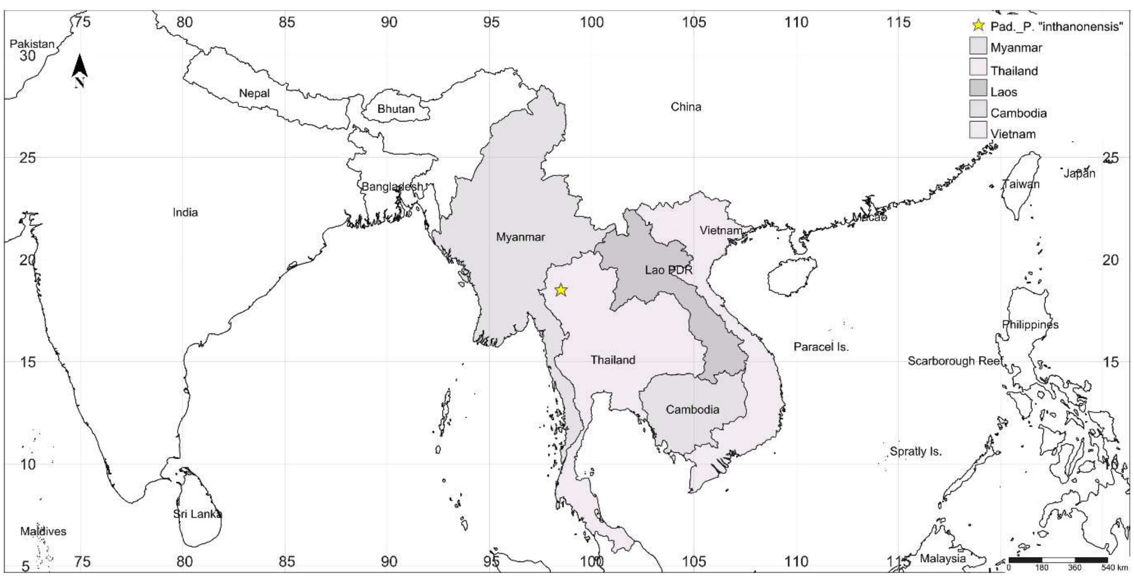


Figure 4.6. ***Prunus*** **sp. ‘inthanonensis’**, vegetative and reproductive morphological characters; **A**, bark; outer bark with conspicuous brown lenticels; **B–E**, leaves; **B**, adaxial; **C**, glaucous abaxial, margin serrate; **D**, basal obtuse, with 2-marginal glands; **E**, stipules filiform to linear. — Photos: all by S. Rueangruea. — Source: Thailand, Chiang Mai, *S. Suddee, et al. 5503*. Scale bars = 1 cm.



Map 4.13. Distribution of *Prunus brachypoda* Batalin, *P. napaulensis* (Ser.) Steud., *P. cornuta* (Wall. ex Royle) Steud., *P. bracteopadus* Koehne, *P. buergeriana* Koehne, and *P.* sp. "inthanonensis" of subg. *Padus* (Pad.) in continental Southeast Asia and nearby.



Map 4.14. Distribution of *Prunus* sp. "inthanonensis" of subg. *Padus* in continental Southeast Asia.

14. ***Prunus buergeriana* Miq.**, Annales Musei Botanici Lugduno-Batavi. 2: 92. 1865; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 284–285. 1915; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification: **JAPAN,** Japonia, *Nippo S.*, *s.n.* (lectotype **L**0329128!); *Unami Sakura*, *s.n. 76*0 (**L**0329130†), designated by Hideaki Ohba, 20 January 2004.

≡ *Laurocerasus buergeriana* (Miq.) C.K.Schneid., Illustriertes Handbuch der Laubholzkunde. 1: 646. 1906.

≡ *Padus buergeriana* (Miq.) *T.T. Yu* & T.C.Ku in Flora Reipublicae Popularis Sinicae. 38: 91. 1986.

= *Prunus capricida* Wall. ex D.Don, Prodromus Florae Nepalensis. 239. 1825. Basionym of

≡ *Cerasus capricida* Wall. ex D.Don in A General History of the Dichlamydeous Plants. 2: 515. 1832.

≡ *Cerasus capricida* Wall. in A Numerical List of Dried Specimens of Plants in the East India Company's Museum. *n. 718*. 1829.

≡ *Prunus adenophylla* Wall. in A Numerical List of Dried Specimens of Plants in the East India Company's Museum. *n. 718*. 1829.

≡ *Cerasus adenophylla* (Wall. ex Steud.) M.Roem., 81. 1847.

Typification**: NEPAL,** August 1831, *Wallich 718* (**GZU**000283027†, **K**001111701–2!, **M**0214839–43d!, **NY**00015938!; same locality, Nepal, 1829, Wallich, *s.n.* (**K**000737191–2, **K**000762727! Stored under *Cerasus capricida* Wall., *Prunus adenophylla* Wall.

= *Prunus venosa* Koehne in Sarg. Plantae Wilsonianae. 1(1): 60. 1911.

Typification: **CHINA, Western Hupeh**, Fang Hsien, Hubei, woodlands, alt. 1,500–1,800 m., May 1907, *E.H. Wilson 177* (holotype *non vidi*; isotypes **A**00032235!, **E**00010486!, **HBG**511148†, **K**000737175!, **K**000737176!); — North and South of Ichang, flowering branches; the fruiting branches belong to *P. stellipila*), alt. 900–1,500 m., May and July 1907, syntypes *E.H. Wilson 91* (**A**00032232†, **A**00032233†, **US**00623866†); — Patung Hsien, woods, May (not seen) and July 1907, *No. 91a* (**E**00313680!, **E**00313681!, **K**000737177!);— Chang-yang Hsien, woods, alt. 1,200 m., September 1907 *No.* 11*8* (**A**00032234†);— only a sterile branch seen); north and south of Ichang, woodlands, alt. 900–1,500 m., June 1907, *No. 2839* (**K**000737178!, **US**00623867†).

Description: Deciduous, small tree 6–15 m tall, sub-canopy, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth with sparse lenticels, spines absent; faint almond smell. **Branchlets** drooping, stout with light brown lenticels; young twigs greenish-brown and densely finely pubescent, many cataphylls at the base; old twigs sparsely hairy to glabrescent. *Axillary winter bud* solitary, 3–4 mm long, rounded to oval; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral or alternate on annual twigs, elliptic to elliptic-oblong or oblaceolate, 6–12 cm long × 2.5–4.5 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* serrate, teeth irregularly spaced, sinus angular, apex glandular serrate, glabrescent to glabrous; *base* asymmetrical or symmetrical, acute to attenuate, with basal marginal serrate glands; young leaves dull green adaxially, pale green abaxially, turning orange to yellow before falling, chartaceous to coriaceous; sparsely tomentose or glabrescent; old leaves sparsely tomentose, glabrescent, glabrous adaxially, glabrescent or sparsely hairy abaxially; *basal glands* 2, up to 1 mm long, circular to ovate, ± at junction of leaf blade and petiole, margin glandular serrate; *2° venation* weaky brochidodromous, 12–16 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent, inconspicuous abaxial; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.6 cm long, slender, shallowly canaliculate in cross-section, glabrous to sparsely hairy; *petiolar glands* absent. **Stipules** medium, 3–8 mm long × 0.4–0.6 mm wide, linear, apex acuminate, margin serrate or entire, margin glandular serrate, base sessile, sparsely pubescent to glabrescent, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, mainly on the lateral branchlets, 8–12 cm long, many-flowered, usually 20–30 flowers, lax, sparsely tomentose to subglabrous, peduncle erect basally leafless, base with involucre formed by floral bud scales, persistent at anthesis; *involucral bracts* 2–5, 0.5–1 mm long, size and shape variable, triangular to oblong, apex acute or obtuse, caducous. **Flowers** bisexual, opening before or at the same time as new leaves, white, pedicellate, slender, 2–10 mm long, densely to sparsely covered with short hairs; *bracteoles* linear, 0.7–1 mm long, pale green, sparsely hairy, early caducous; *hypanthium* campanulate, 0.8–1.5 mm long, densely to sparsely hairy; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, green, 0.6–1.5 mm long × 1–1.5 mm wide, subequal, apex acute, margin entire or glandular, base truncate, separate in bud, spreading when mature, calyx lobes persistent in fruit, densely to sparsely pubescent outside, glabrescent inside; *petals* white, spreading to upright, 5, medium, 1.5–2.5 mm long × 1.5–2.5 mm wide, subequal, 2–2.5 times calyx lobes length, broadly ovate to orbicular, sessile to slightly unguiculate, apex obtuse, margin entire, base rounded or broad ovate, alternate with calyx lobes, glabrescent outside, sparsely tomentose to glabrescent inside; *stamens c.* 10 in 1 to 3 series, exserted, slightly longer than petals; filament filiform, white, 2.5–3.5 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* glabrescent to glabrous, 1 locular; *style* filiform, slender, 1.5–2.5 mm long, shorter than stamens, 1/2 as long as stamens, glabrescent; stigma subpeltate. *Infructescence* 10–15 cm long, sparsely pubescent to glabrous, lenticels numerous, many-fruited. **Fruits** stipitate, 4–6 mm long, lenticellate, young fruit green, turning dark purple or black when mature or ripe, subglobose to ovoid, 0.5–0.7 cm long, 0.5–0.6 cm wide, apex acute to obtuse; young fruits glabrescent or glabrous; mature fruits glabrous; exocarp smooth and shiny, without longitudinal groove; mesocarp fleshy, thin, black; endocarp stone bony, smooth and shallowly longitudinal or ridged; calyx persistent in fruits; style absent or a minute at the end of the fruit. **Seeds** oval to circular in cross-section, thick, with glabrous testa, shallowly grooved.

Additional specimens examined.— **CHINA**. **Hupeh**, alt. 1800 m, 5 July 1907, *Wilson E.H. 91* (**A**00032231-3†, **HBG**511148†, **US**00623866†); **Su-Tchuen**, Tchen Keou Tin, alt. 1800 m, s.n., *Farges R.P. 768* (**P**03359061-2!). **INDIA, West Himalaya**, Kumaon, alt. 2,230 m, fr., *R. Strachery & J.E. Winterbottom 2* (**K**!);– *ibid.*, *R. Strachery & J.E. Winterbottom 6* (**K**!);– *ibid.*, alt. 2330 m, 5 August, fr., *J.F. Duthie 24672* (**K**!). **JAPAN**. alt. 960 m, July, fr., *B. 165* (**K**000737181!);– **Kagoshima**: 31°46'40.9" N, 130°36'10.9" E, alt. 163 m, 28 June 1919, fl., *Z. Tashiro*, *s.n.* (**BKF**049697!);– **Khasya hill**: s.d., fl., *W. Griffith s.n.* (**TCD**!);– **Kumamoto**: 32°48'47.4" N, 130°38'20.2" E, alt. 639 m, May *s.n.*, fl., *K. Mayebara 843* (**BKF**!);– **Yamanashi**: 35°24'N, 138°50'E: alt. 1,100 m, 29 May 1978, fl., *M. Togashi 436* (**BKF**!);– *ibid.*, alt. 960 m, 26 July 1980, fr., *M. Togashi 36* (**BKF**098076!, **P**03358770!). **MYANMAR**. **Upper Burma, Kachin**: Adung valley, alt. 1,800 m, 30 April 1931, fl., *F. Kingdon-Ward 9441* (*non vidi*);– **Khaiyang**, alt. 2,000 m, 20 May 1948, fl., *F. Kingdon Ward 17505* (**NY**02649980†). **TAIWAN**. **Hualien**: Xiulien, 14 June 2011, fr., *Chien-I Huang 131154* (**HAS**†).

Distribution.— India (Assam, West Himalaya), Nepal, Myanmar, China (Tibet, East Himalaya, Southeast to Central), China North-Central, China South-Central, China Southeast, East Himalaya, Japan, Korea (**Maps 4.13 & 4.15**).

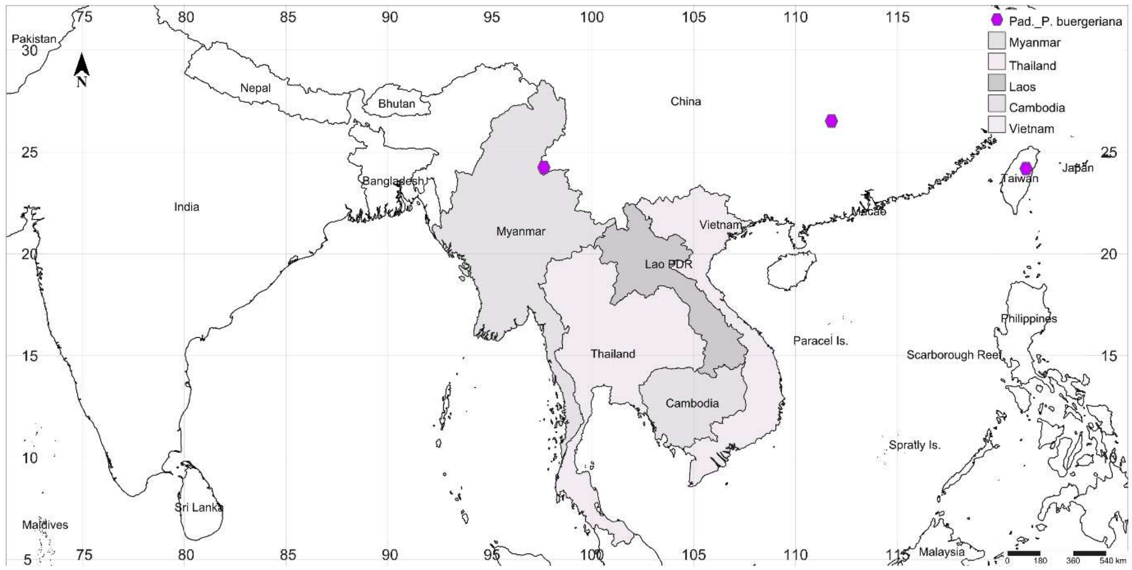
Vernacular name. — **China**: Lin mu. English name: Japanese bird cherry, Lin mu, Inuzakura.

Ecology.— Scattered on slopes in open areas of Lower Montane to Upper Montane forest, alt. 600–3,000 m.

Phenology.— Flowering: March–June. Fruiting: June–August.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 5,544,328.92 km^2; AOO = 2,164.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.15 Distribution of *Prunus buergeriana* Miq. of subg. *Padus* in continental Southeast Asia and nearby.

15. ***Prunus napaulensis* (Ser.) Steud.**, Nomenclator Botanicus. Editio secunda (Steudel), ed. 2. 2: 403 (1841). Type as for the basionym below.

Typification. **INDIA**, Temperate Himalaya, from Kumaon, 6,000 ft to Sikkim 7,000–10,000 ft., 1821, *Wallich, 717* (lectotype **K**001111694! designated here; isolectotypes **BM**000948648, **K**000737209, **K**000737210!; *717.2* **K**001111694!, **K**001111695!, **K**001111696! (part of two individuals, Mounted on the single herbarium sheet), **K**001111697!, **K**001111698!, **K**001111699!, **K**001111700!, **TCD**!; *717.3* **K**001111699!, **PH**00022370†; *717a* **M**0214879†, **M**0214880†, **M**0214881†; isosyntypes *717b* **E**00317637!, **GZU**000283028†, *117b* (erroneous) **M**0214882†, **M**0214880†).

≡ *Cerasus napaulensis* Ser. in A.P.de Candolle, Prodromus Systematis Naturalis Regni Vegetabilis. 2: 540. 1825.

≡ *Padus napaulensis* (Ser.) C.K.Schneid. in Repertorium Specierum Novarum Regni Vegetabilis. Centralblatt für Sammlung und Veroffentlichung von Einzeldiagnosen neuer Pflanzen. (Edited by Friedrich Fedde). Berlin. 1: 68. 1905.

≡ *Prunus napaulensis* (Ser.) K.Koch, Dendrologie. Bäume, Sträucher und Halbsträucher, welche in Mittel- und Nord-Europa im Freien kultivirt werden. Kritisch beleuchtet von Karl Koch. Erlangen Collation 1: 89. 1869.

≡ *Prunus glaucifolia* (Wall.) Koehne, Repertorium Novarum Specierum Regni Vegetabilis. Centralblatt für Sammlung und Veroffentlichung von Einzeldiagnosen neuer Pflanzen. [Edited by Friedrich Fedde]. Berlin, 9: 35–36. 1910. Merr., Brittonia; a Series of Botanical Papers. 4: 89. 1941.

≡ *Prunus padus* L. *sensu auct.* Hook.f., The Flora of British-India. 2: 315. 1878, *pro parte*, *quoad Wallich, 717, nom nud. Prunus nepalensis sensu auct.* Hook.f. *ibid.* 316, pro parte, quoad *Wallich, 717*, not *Prunus nepaulensis* Steud.

≡ *Cerasus glaucifolia* Wall., A Numerical List of dried specimens of plants in the East India Company's Museum: collected under the superintendence of Dr. Wallich of the Company's botanic garden at Calcutta. London, 1829, *n. 717. sub n. 1008* and *740, nom. nud.*

– *Prunus glaucifolia* Wall. ex Koehne in Repertorium Novarum Specierum Regni Vegetabilis. Centralblatt für Sammlung und Veroffentlichung von Einzeldiagnosen neuer Pflanzen. [Edited by Friedrich Fedde]. Berlin. 9: 35. 1910.

– *Padus glaucifolia* Wall. ex M.Roem., in Familiarum Naturalium Regni Vegetabilis Synopses Monographicae seu Enumeratio Omnium Plantarum hucusque Detectarum Secundum Ordines Naturales, Genera et Sepcies Digestarum, Additas Diagnosibus, Synonymis, Novarumque vel Minus Cognitarum Descriptionibus Curante M. J. Roemer. 3: 88. 1847.

= *Cerasus lindleyana* Wall., *opp. cit.*, *n.* 100*8*. 1829, *nom. nud.*

Typification**: INDIA,** Khasia Mts, 1,500–2,000 m alt., *Wallich, 1008* (**K**!).

Description: Deciduous, sub-canopy, small tree up to 15 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth with sparse lenticels, spines absent; faint almond smell. **Branchlets** drooping, stout with light brown lenticels; young twigs deep yellow in autumn, finely pubescent, with many cataphylls at the base; old twigs sparsely hairy to glabrescent. *Axillary winter bud* solitary, 3–4 mm long, rounded to oval, usually covered with hairs; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral or alternate on annual twigs, elliptic-oblong to oblong-lanceolate, 4–15 cm long × 1–6 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* serrate, teeth regular spacing, sinus angular, apex glandular serrate, glabrescent to glabrous; *base* asymmetrical or symmetrical, attenuate, acute to rounded; young leaves dull green adaxially, glaucescent pale green, midrib and lateral veins slightly dark purple abaxially, turning orange to yellow before falling, coriaceous; sparsely tomentose; old leaves glabrescent, glabrous adaxially, minutely puberulent abaxially, inconspicious to conspicuous domatia in lateral axial; *basal glands* 2(–4), up to 1 mm long, circular, flat, on lowest marginal surfaces of the teeth mounted near the end of petiole, margin glandular serrate; *2° venation* weaky brochidodromous, 12–22 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent, inconspicuous abaxial; *5° venation* regular polygonal reticulate; *petioles*, inflorescence leaves 0.8–1.6 cm and ordinary leaves 0.5–1 cm long, slender, shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent, sometimes with 2 glands. **Stipules** medium, 3–10 mm long × 0.4–0.6 mm wide, linear, apex acuminate, margin entire, sparsely ciliate to glabrescent, base sessile, sparsely pubescent to glabrescent, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, mainly on the end of current year's branchlets, 8–15 cm long, many-flowered, densely to sparsely tomentose, basally with 1–5 leaves, base with a soon caducous involucre formed by floral bud scales; *involucral bracts* 3–6, 0.5–1 mm long, size and shape variable, triangular to oblong, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, opening before or at the same time as new leaves, white, scented, somewhat resembling *Crataegus*, pedicellate, slender, 3–6(–10) mm long, densely to sparsely covered with short hairs; *bracteoles* linear, 0.7–1 mm long, pale green, sparsely hairy, early caducous; *hypanthium* campanulate, 2–3 mm long, sparsely hairy outside, glabrous with hairs around the base; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular-oblong, minute, green, 1.5–2 mm long × 0.5–0.8 mm wide, subequal, apex obtuse, somewhat glandular-fimbriate, margin ciliate, base truncate, separate in bud, spreading when mature, deciduous, glabrescent to glabrous outside, glabrescent inside; *petals* white, spreading to upright, 5, medium, broadly ovate to orbicular, 3–4.5 mm long × 2–3.5 mm wide, subequal, petals 2–3 times calyx lobes length, unguiculate, 0.5–0.7 mm long, apex obtuse or slightly erose, margin entire to shallowly glandular serrate, base narrowly cuneate and unguiculate, alternate with calyx lobes, glabrescent outside, sparsely tomentose to glabrescent inside; *stamens* 25–30 in 1 to 3 series, exserted, slightly longer than petals; filament filiform, white, various length, 2–4.5 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* glabrous, with sparse tomentose around the insertion, 1 locular; *style* filiform, slender, 2.5–4 mm long, shorter than stamens, glabrescent; stigma subpeltate, 1–1.5 mm in diameter. *Infructescence* 10–18 cm long, sparsely pubescent to glabrous, expanded when fruiting, to 3 mm thick, lenticels numerous, many-fruited. **Fruits** stipitate, extended when fruiting, 0.5–10 mm long, conspicuous lenticellate, young fruit green, turning dark purple or black when mature or ripe, ellipsoid to ovoid, globose, 1.2–2 cm long, 1–1.5 cm wide, apex obtuse or slightly retuse; young fruits glabrescent or glabrous; mature fruits glabrous; exocarp smooth and shiny, without longitudinal groove; mesocarp fleshy, thin, black; endocarp stone bony, smooth and shallowly longitudinal or ridged; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** oval to circular in cross-section, thick, with glabrous testa, shallowly grooved.

Additional specimens examined.— **INDIA**. **Assam**, Cherrapunjee, alt. 1200 m, 21 April 1952, fr., *Walter N. Koelz 33677* (**L**1893671†);– **East Himalaya**, 1861-2, *Griffith 2070* (**L**1893676†);– **Himalaya**, Chaur, Kamoon, alt. 2000 m, s.n., *R. Strachery & J.E. Winterbottom 3* (**K**!);– **Sikkim**, Numbong, July 1990, *Prain s.n.* (**L**1893675†);– *ibid.*, s.d., fl., *J.D. Hooker & Thomson s.n.* (**TCD**!). **West Bengal,** Darjeeling, alt. 2200 m, 6 May 1960, *H. Kanai, G. Murata, M. Togashi & T, Tuyama* 64 (**BM**!). **MYANMAR**. **North Eastern Burma**: October 1925, fr., *G. Forrest 27291* (**E**00901053!, **US**00672650†, **US**1378026!);– **Upper Burma, Kachin**: Bhameo, Lapyeka Sinlum Kaba, alt. 1,833 m, April 1912, fr., *J.H. Lace 5768* (**E**00901054!);– *ibid.*, Bhamo, 24°14'15.7" N, 97°14'12.2" E, 30 September 1908, fr., *J.H. Lace*, *s.n.* (**E**00901055!);– *ibid.*, Himalayan region to Yunnan, October 1925, fr., *G. Forrest 26956* (**E**!. **US**1378051†). **NEPAL**. **Bhotkhola**, Sibrung, Sankhuwasabha, 27°42'15.0"

N, 87°21'30.0" E, alt. 1820 m, 16 August 1998, fl., *S. Noschiro, N. Achrya, K. Kobayashi, Y. Omori, K, Shinozaki & H. Tsukaya 9840057* (**BM**!);– **Gandaki**, Parbat, Ulleri, Lumle Agricultural Centre, alt. 2285 m, 26 March 1976, fl., *G. Dawson 514* (**BM**!);– **Kamali**, Jajarkot, Barekot, alt. 2167 m, 6 April 1952, fl., *O. Pounin, W.R. Sykes & L.H.J Williams 1869* (BM!);– **Mechi**, Panchitar, Prangbung, alt. 2280 m, 25 June 1992, fr., *S. Noschiro, S. Akiyama & N. Achrya 9263249* (**BM**!).

Distribution.— India (Khasia), Nepal, Myanmar, Upper and West-central Burma (Kachin and Chin) (**Maps 4.13 & 4.16**).

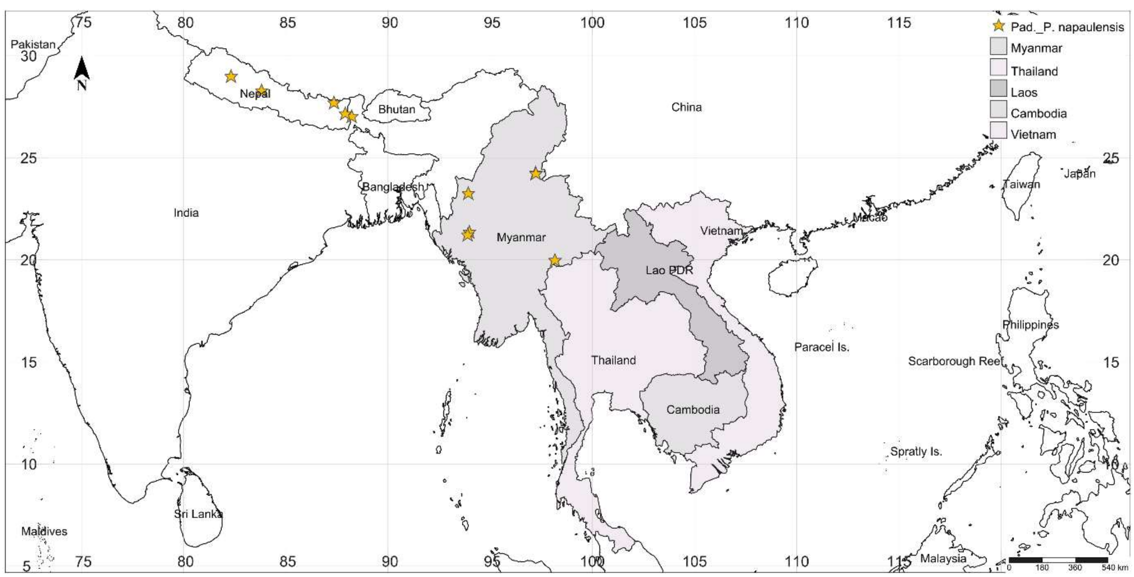
Vernacular name. **— China**: Cu geng chou li. **English name**: Khasia cherry, Nepal bird cherry.

Ecology.— Scattered in Montane forest and thickets on slopes, valleys, alt. 1,800–3,200 m.

Phenology.**—** Flowering: March–June. Fruiting: April–November.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 44,328.92 km^2; AOO = 64.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.16. Distribution of *Prunus napaulensis* (Ser.) Steud. of subg. *Padus* in continental Southeast Asia and nearby.

16. ***Prunus cornuta* (Wall. ex Royle) Steud.**, Nomenclator Botanicus. 2: 403. 1841; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 537. 1924; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003. Typification: as for the basionym and synonym below.

≡ *Cerasus cornuta* Wall. ex Royle, A numerical list of dried specimens of plants in the East India Company's Museum: collected under the superintendence of Dr. Wallich of the Company's botanic garden at Calcutta. *n. 716*. 1829. *nom. nud.* Illustrations of the botany and other branches of the natural history of the Himalayan Mountains. 1: 207. 1835.

Typification**: INDIA, Orientalis**, 1829, *Wallich 716* (Lectotype **K**001111693! designated here); – *Cerasus glaucifolia* Wall., **Wapalis** & **Kamaon**, 1829, fr., on the same sheet with *Wallich, H.T.717* (**K**000395447!);– *ibid*., 1832, *Wallich*, **K**000395448!, **M**0214789†, **M**0214880†, **M**0214881†, **M**0214883†).

≡ *Padus cornuta* (Wall. ex Royle) Carrière, Revue Horticole; résumé de tout ce qui parait d'intéressant en jardinage. 41: 275. f. 64. 1869.

≡ *Prunus cornuta* var. *villosa* H.Hara, Journal of Japanese Botany. 37(4): 98. 1841.

– *Padus cornuta* (Wall. ex Royle) Carrière, Indian Forester. 100(8): 498. 1974.

= *Prunus cornuta* var. *villosa* H.Hara, Journal of Japanese Botany. 37(4): 98. 1962; H.Hara, Flora of Eastern Himalaya, The results of the Botanical Expedition to Eastern Himalaya organized by the University of Tokyo 1960 and 1963. Tokyo. Ed.2: 54. 1971.

≡ *Padus cornuta* var. *villosa* (H.Hara) G.Singh, Indian Forester. 100(8): 498. 1974.

Typification: **INDIA**, West Bengal, Himalaya orient, inter Phalut et Sandakphu, Singalila Mountain, alt, ca. 3500 m, 6 June 1960. *H.K.M.T. & T. 678* (holotype **TI**, *non vidi*).

= *Prunus cornuta* var. *integrifolia* Ghora & Panigrahi, Journal of Economic and Taxonomic Botany. Jodpur. 7(1): 228. 1985.

≡ *Padus cornuta* var. *integrifolia* (Ghora & Panigrahi) A.A.Ansari, Indian Journal of Forestry; Quarterly Journal of Forestry, Agriculture, Horticulture, Natural History, Wildlife, Field Botany, and Allied Subjects. 31(2): 321. 2008.

Type, *non vidi.*

= *Prunus pachyclada* Zabel, L.Beissner, E.Schelle & H.Zabel, Handbook Laubholz-Benen.: 254. 1903. Type, **INDIA**, *non vidi*

= *Prunus glauciphylla* Ghora & Panigrahi, Journal of Economic and Taxonomic Botany. Jodpur. 7(1): 228. 1985. Type, **INDIA**, Sikkim, *non vidi*

Description: Deciduous, sub-canopy, small tree up to 15 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth, spines absent; faint almond smell. **Branchlets** stout, blackish-brown with sparse oblong brown lenticels; young twigs purplish-brown, glabrous or sometimes velutinous, with many cataphylls at base; old twigs glabrescent to glabrous.

Axillary winter bud solitary, ovoid, usually glabrous; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral or alternate on annual twigs, oblong to ovate-lanceolate, 6–12 cm long × 3–5 cm wide; *lamina apex* acuminate to short caudate, angle acute; *margin* serrulate, teeth regular spacing, apex small glandular, sinus angular, glabrous; *base* asymmetrical or symmetrical, subcordate to broadly cuneate; young leaves purplish-brown, brownish-green to pale green, dull green adaxially, glaucescent pale green to glaucous abaxially, midrib and lateral veins slightly reddish-purple, blade glabrescent or with tufts of hairs, domatia in vein axils, turning orange to yellow before falling, chartaceous, glabrescent to glabrous; old leaves glabrous adaxially, glabrous or with tufts of hairs, usually without domatia in vein axils abaxially; *basal glands* present or sometimes absent, usually 2, up to 1 mm long, circular, flat, on apex of petiole close to the basal leaf blade, or on the lowest marginal surfaces of the teeth; *2° venation* weaky brochidodromous to brochidodromous, 8–16 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent, inconspicuous abaxial; *5° venation* regular polygonal reticulate; *petioles* pale green to reddish-purple, inflorescence leaves 1–2.5 cm long and ordinary leaves 0.5–1.5 cm long, slender, shallowly canaliculate in cross-section, glabrous; *petiolar glands* present, 0(–2) glands, with basal marginal serrate glands. **Stipules** medium, 3–10 mm long × 0.4–0.6 mm wide, linear, apex acuminate, margin glandular serrate, glabrescent, base sessile, glabrescent, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, mainly on the end of current year's branchlets, 7–16 cm long, many-flowered, densely to sparsely velutinous, basally with 1–4 leaves, base with a soon caducous involucre formed by floral bud scales; *involucral bracts* 2–5, size and shape variable, triangular to oblong, apex acute or obtuse, densely hairy, margin sparsely ciliate, caducous. **Flowers** bisexual, opening before or at the same time as new leaves, white, pedicellate, slender, 5–7 mm long, densely to sparsely covered with short hairs; *bracteoles* linear, 0.7–1 mm long, pale green, sparsely hairy, early caducous; *hypanthium* campanulate, 2–3 mm long, hairy outside, glabrous inside, basally sparsely hairy; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular-oblong, minute, green, 1.5–2 mm long × 0.5–0.8 mm wide, subequal, apex acute to obtuse, margin ciliate, slightly erose, glandular serrulate, base truncate, separate in bud, spreading when mature, deciduous, glabrescent to glabrous outside, yellowish-glabrous inside; *petals* white, spreading, slightly concave, 5, medium, 3–4 mm long × 3–4 mm wide, subequal, petals 1–2 times calyx lobes length, broadly obovate to orbicular, unguiculate, 0.5–0.7 mm long, apex obtuse or slightly erose, margin erose to slightly erose, base rounded and shortly unguiculate, alternate with calyx lobes, glabrescent outside, sparsely tomentose to glabrescent inside; *stamens* 20–30 in 1 to 3 series, exserted, slightly longer than petals; filament filiform, white, 2–2.5 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* glabrous, 1 locular; *style* filiform, slender, 2–2.5 mm long, as long as or shorter than stamens, glabrous; stigma subpeltate, reniform or heart-shape. *Infructescence* 10–18 cm long, sparsely pubescent to glabrous, lenticels numerous, many-fruited. **Fruits** stipitate, 8–10 mm long, lenticellate, young fruit green, turning blackish-brown to dark purple when ripe, ovoid-globose, 7–1.2 cm long, 7–8.5 cm wide, apex obtuse or slightly retuse; young and mature fruits glabrous; exocarp smooth and shiny, without longitudinal groove; mesocarp fleshy, thin, black; endocarp stone bony, smooth and shallowly longitudinally furrowed or ridged; calyx deciduous; style absent or a minute at the end of the fruit. **Seeds** oval to circular in cross-section, thick, with glabrous testa, shallowly grooved.

Additional specimens examined.— **INDIA**., April *s.n.*, fr., *V. Jacquemont 547* (**P**03358030!);– alt. 1,500 m, May 1832, fr., *Wallich*, *s.n.* (**K**000395447!);– Deobaw, 20 April 1922, fr., *Shambu Nath Kaul 54* (**P**03358034!);– **Himalaya**: Chhattisgarh, Lamni, April *s.n.*, fl., *R. Strachery & J.E. Winterbottom 1* (**P**03358036!);– *ibid.*, Sikkim, April 1855, fl., *J.D. Hooker & T. Thomson 413* (**P**03358037!);– *ibid.*, Sikkim, April 1864, fl., *L. Pierre*, *s.n.* (**P**03358027!);– N.E Ranges, Sirohifurar, alt. 800 m, 12 April 1882, fl., *G. Watt 6458* (**E**00010501!);– **Uttarakhand**: Jumnotri, 14 June 1916, fl., *M.A. Rau 15718* (**P**03358032!). **MYANMAR**. **Central Burma, Shan**: Mandalay, alt. 810 m, May 1929, fl., *R.N. Khoshoo 143* (**BKF**049703!);– **Upper Burma, Kachin**: Maikha-Salawin, 26°20'N, 98°48'E, June 1931, fr., *G. Forrest 29684* (**E**00072282!, **RAF**1893!);– *ibid.*, 26°23'N, 98°48'E, alt. 3,150 m, September 1934, fr., *G. Forrest 25051* (**E**00072283!, **RAF**18893!);– *ibid.*, **Kanpehe**t: Mount Victoria, alt. 3,000 m, 27 August 1962, fl., *U.M.G. Gale 5380* (**RAF**7975/3!);– **West Central Burma, Chin**: Mount Victoria, alt. 3,000 m, 6 June 1956, fl., *F. Kingdon-Ward 21958* (**E**00901071!). **NEPAL**. Talkot to Jumla, 11 August 1976, fr., *H. Tabata, R. Keshab*, *Rajbhandari & Y. Shimizu 9185* (**KYO**!).

Distribution.— Afghanistan, Bhutan, India (Himalayas), Nepal and Myanmar (Central throughout Upper Burma), and China (S. Xizang; Cona Xian, Yadong Xian) (**Maps 4.13 & 4.17**).

Vernacular name. — **China**: Guang e chou li. **English name**: Himalayan Bird Cherry.

India: Asjaman, Jamni, Jamun (Mahasu).

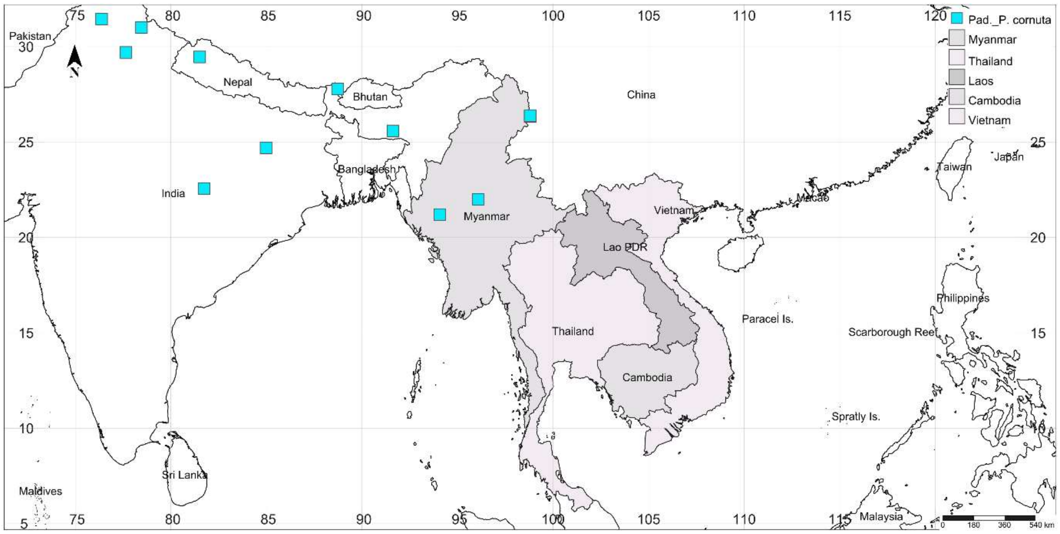
Ecology.— Lower to Upper Montane, secondary forest, in open areas, along trails, alt. 800–3,200 m.

Phenology.— Flowering: April–June. Fruiting: May–October.

Uses.— Ornamental trees and economic fruits.

Conservation.— LC (Least Concern). This species is known from many locations. The number of individuals in each subpopulation is high.

Note .— Young leaves are poisonous to cattle and cause death due to hydrogen cyanide. The ripe fruits are edible, have a sour taste, and are aromatic, with bluish-violet mouth staining.



Map 4.17. Distribution of *Prunus cornuta* (Wall. ex Royle) Steud. of subg. *Padus* in continental Southeast Asia and nearby.

17. ***Prunus brachypoda*** **Batalin** in N.Tischutkin Trudy Imperatorskago S.-Peterburgskago Botaniceskago Sada. 13: 166. 1802; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 537. 1933; Merr., Brittonia; a Series of Botanical Papers. 4: 89. 1941; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification: **CHINA,** Kansu trajectus inter pagus Moping et Wuping 1885, *G.N. Potanin*, *s.n.* (holotype **A**00026993†; isotype **K**000737159!).

≡ *Padus brachypoda* (Batalin) C.K.Schneid. in Feddes Repertorium Novarum Specierum Regni Vegetabilis. 1: 69. 1905.

Description: Deciduous, sub-canopy, small tree 8–15 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth with sparse lenticels, spines absent; faint almond smell. **Branchlets** drooping, stout, blackish-brown; young twigs reddish-brown, velutinous to glabrescent, with many cataphylls at base; old twigs glabrous with prominent whitish-brown lenticels. *Axillary winter bud* solitary, ovoid, usually glabrous; *terminal winter bud* present. **Leaves** plicate in the bud, extended during flowering, fascicled on the short shoots, spiral or alternate on annual twigs, oblong to rarely elliptic or lanceolate, 6–16 cm long × 3–7 cm wide; *lamina apex* acute to acuminate; *margin* double serrate or serrulate, conspicuous acuminate aristate teeth, regular spacing, sinus rounded, apex glandular serrate, glabrescent or with short glandular hairs; *base* asymmetrical or symmetrical, cordate, rounded or slightly truncate; young leaves dull green adaxially, pale green abaxially, turning orange to yellow before falling, chartaceous to herbaceous, sparsely tomentose; old leaves glabrous adaxially, glabrescent or sparsely tomentose abaxially; *basal glands* present or absent, 0–2, up to 1 mm long, circular to oblong or shortly stipitate, on apical side of petiole and base of leaf blade; *2° venation* weaky brochidodromous, 12–16 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°), domatia conspicuous with tufts of greyish-brown pubescence on lateral vein axils beneath; *3° veins* random reticulate; *4° venation* alternate percurrent, inconspicuous abaxial; *5° venation* dichotomizing; *petioles* 1.5–3.5 cm long, slender, shallowly canaliculate in cross-section, glabrous; *petiolar glands* present, (0–)2(–3), near or under the leaf blade. **Stipules** medium, 6–10 mm long × 1–2 mm wide, linear, apex acuminate, margin entire, sparsely ciliate to glabrescent, base sessile, sparsely pubescent to glabrescent, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, mainly on the end of current year's branchlets, 15–30 cm long, many-flowered, sparsely tomentose to glabrescent, basally with 1–4 leaves, base with a soon caducous involucre formed by floral bud scales; *involucral bracts* 2–5, 0.5–1 mm long, size and shape variable, triangular to oblong, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, opening before or at the same time as new leaves, white, rather unpleasant odour, pedicellate, slender, 2–4(–6) mm long, glabrescent; *bracteoles* linear, 0.7–1 mm long, pale green, glabrescent, early caducous; *hypanthium* campanulate, 2–2.5 mm long, glabrescent to glabrous outside, glabrous with hairs at the base inside; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, green, 0.5–1 mm long × 0.5–1 mm wide, subequal, apex acute to obtuse, margin frimbriate, ciliate or glandular serrate, base truncate, separate in bud, spreading when mature, deciduous, glabrescent to glabrous outside, glabrescent inside; *petals* white, spreading to upright, 5, medium, 2.5–3.5 mm long × 2–3 mm wide, subequal, petals 4–6 times calyx lobe length, broadly ovate to orbicular, unguiculate, apex obtuse or slightly erose, margin entire, base cuneate and shortly unguiculate, alternate with calyx lobes, glabrescent outside, sparsely tomentose to glabrescent inside; *stamens* 25–40 in 1 to 3 series, inserted, equal or not longer than petal length; filament filiform, white, turning purplish-when petals fall off, 3–4 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* usually glabrous, sparsely tomentose around the insertion, 1 locular; *style* filiform, slender, 2–2.5 mm long, shorter than stamens, glabrescent; stigma subpeltate. *Infructescence* (15)20–30 cm long, sparsely pubescent to glabrous, many-fruited. **Fruits** stipitate, 3–6 mm long, young fruit green, turning dark purple or black when mature or ripe, ellipsoid to ovoid, globose, 0.5–0.7 cm long, 0.5–0.6 cm wide, apex obtuse or slightly retuse; young fruits sparsely tomentose; mature fruits glabrescent; exocarp smooth and shiny, without longitudinal groove; mesocarp fleshy, thin, black; endocarp stone bony, shallowly reticulate and shallowly longitudinal furrowed or ridged; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** oval to circular in cross-section, thick, with glabrous testa, shallowly grooved.

Additional specimens examined.— **CHINA**. 1 June 1906, fl., *E.H. Wilson 2838* (**A**†, **K**000737150!);– 1 June 1908, fl., *E.H. Wilson 2843* (**A**†, **K**000737152-3!);– Sut chuen oriental, Tchen Keou Tin, 1895-1897, fr., *R.P. Farges s.n.* (**P**03358766-8!, **P**03340457-9!, **P**03340469!, **P**03340473!, **P**03358777-83!);– **Hubei**: September 1907, fr., *E.H. Wilson 115* (**K**000737155!, **P**03340468!);– *ibid.*, August 1907, fr., *E.H. Wilson 190* (**K**000737156-7!, **P**03340463!, **U**00623839†);– *ibid.*, fl. & fr, *E.H. Wilson 2255* (**A**00026994†);– *ibid.*, July 1907, fr., *E.H. Wilson 2836* (**K**000737151!, **US**†);– June 1907, fr., *E.H. Wilson 2839* (**K**000737158!, **P**03340464!);– **Sichuan**: Mupin, 37°22'36.1" N, 121°35'39.3" E, August 1908, fr., *E.H. Wilson 899* (**A**00623838†, **A**00032010†, **HBG**5511093†, **P**03340467!);– *ibid.*, 20 June 1908, fl., *E.H. Wilson 2846* (**A**†, **K**000737154!);– *ibid.*, June 1855, fl., *A. Henry 5739* (**US**00623836†);– *ibid.*, June 1855, fl., *A. Henry 5763* (**P**03340466!, **US**†);– *ibid.*, October 1887, fr., *A. Henry 4077* (**P**03358765!);– *ibid.*, March 1889, fr., *A. Henry 5884* (**P**03358769!);– **Yunnan**: 24°23'42.7" N, 96°54'15.0" E, September 1931, fr., *G. Forrest 28586* (**U**151851†). **INDIA, Temperate Himalaya, Kummaon**, 6,000 ft to Sikkim 7,000–10,000 ft., 1821, *Wallich, 717* (**P**03372371!). **MYANMAR**. **Upper Burma, Laktang**: Adung valley, 21°23'40.19" N, 93°49'49.30"E: alt. 2,600 m, 14 January 1931, fl., *King 9528* (**E**00758056!);– *ibid.*, alt. 3,000 m, 14 January 1931, fl., *F. Kingdon-Ward 9622* (**BM**!, **E**00758056!).

Distribution.— China (Southeast-Central, Hubei, and Yunnan) and Myanmar (Upper Burma) (**Maps 4.13 & 4.18).**

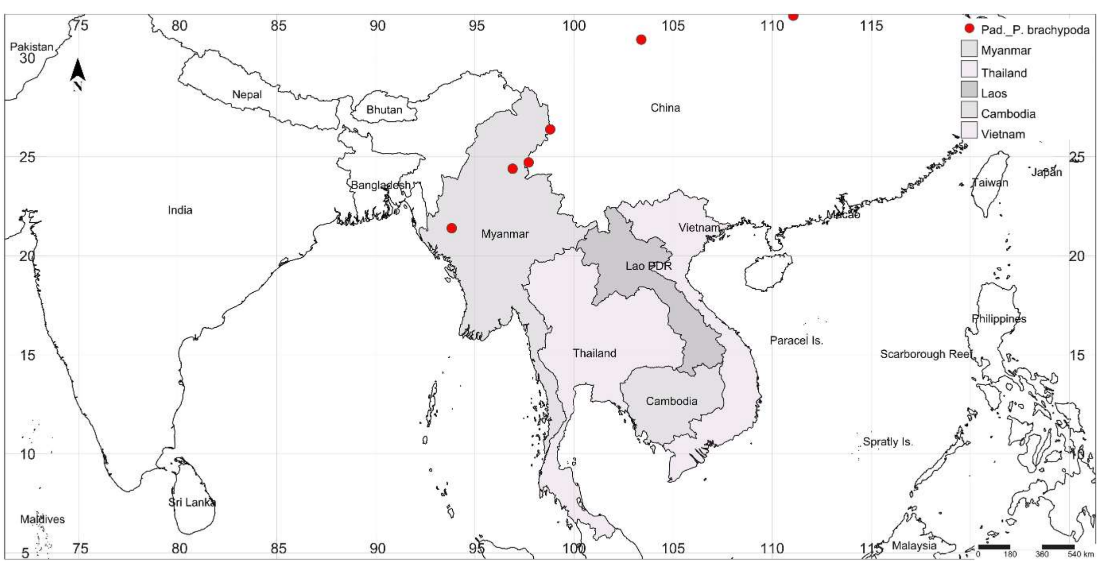
Vernacular name. **— China**: Duan geng chou li.

Ecology.**—** Montane forest, thickets, slopes, and valleys; alt. 1,000–2,500 m.

Phenology.**—** Flowering: April–May. Fruiting: May–October.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 5,403,508.35 km^2; AOO = 228.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.18. Distribution of *Prunus brachypoda* Batalin of subg. *Padus* in continental Southeast Asia and nearby.

18. ***Prunus bracteopadus* Koehne** in Feddes Repertorium Novarum Specierum Regni Vegetabilis. 9: 33. 1910.

Typification: **INDIA, Himalaya**, Khasia reg, temp. 4,000-6,000 ft (1,219–1,829 m alt.), fr., *J.D. Hooker & T. Thomson s.n.* (holotype in Herb. Ind. (*non vidi*); isotypes **BM**000622024!, **K**000737211!, **K**000737212!, **K**000737213!, **M**0214814†, **P**03358762!, **U**151791†).— **Assam**, Jowai, 5,000 ft (1,524 m), 27 October 1893. *King's*, *s.n.* (paratypes **BM**000622025!, **M**0214815†, **K**000737213!, **TCD**!).— **MYANMAR**, **Kachin**, Kachin Montes, Sadon, 6,500 ft., February 1900, fr., *Shaik Mokim*, *s.n.* (paratype, *non vidi*).

≡ *Prunus nepalensis sensu auct.* Hook.f., The Flora of British-India. 2: 316. 1878. *pro parte*, *quoad*. *J.D. Hooker & T. Thomson s.n.*

= *Prunus buergeriana* var. *nudifuscula* Koehne in C.S. Sargent, Plantae Wilsonianae. An Enumeration of the Woody Plants Collected in Western China for the Arnold Arboretum of Harvard University. 1: 60 (1911).

Typification: **CHINA, Western Hupeh**, Fang Hsien, woodlands, alt. 1,200-1,800 m, 20 May 1907, fl., *E.H. Wilson 2834* (holotype non vidi, syntype **A**00026998†).

Description: Deciduous, sub-canopy, small tree 8–10 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth with sparse conspicuous lenticels, spines absent; faint almond smell. **Branchlets** drooping, stout with light brown lenticels; young twigs deep yellow to dark brown, shining in autumn, smooth, glabrescent, with many cataphylls at the base; old twigs glabrous with prominent whitish-brown lenticels. *Axillary winter bud* solitary, 3–4 mm long, rounded to oval, usually glabrous; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, fascicled on short shoots, spiral or alternate on annual twigs, oblong to ovate-oblanceolate, 5–14 cm long × 1.2–5.8 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* serrate or slightly serrate with sharp curved teeth, irregularly spaced, sinus rounded, tip glandular serrate, glabrescent to glabrous; *base* asymmetrical to oblique, acute to rounded; young leaves dull green adaxially, pale green abaxially, turning orange to yellow before falling, chartaceous to coriaceous; sparsely tomentose; old leaves glabrous adaxially, glabrescent or sparsely tomentose abaxial; *basal glands* sometimes absent, usually present, 2 of the lowest teeth, mounted on leaf blade or rarely on the petiole, up to 1 mm long, circular, flattened, ± at junction of leaf blade and petiole, margin glandular serrate; *2° venation* weaky brochidodromous, 10–18 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent, inconspicuous abaxial; *5° venation* regular polygonal reticulate; *petioles* inflorescence leaves 0.8–1.6 cm. long and ordinary leaves 1.5–3.2 cm long, slender, shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** medium, 3–10 mm long × 0.4–0.6 mm wide, narrowly linear, apex acuminate, margin entire, sparsely ciliate, glandular-fimbriate to glabrescent, base sessile, sparsely pubescent to glabrescent, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, mainly on the terminal of lateral branchlets, 10–15 cm long, many-flowered, lax, sparsely tomentose to glabrescent, peduncle erect with 1–4(–6) leaves, base with involucre formed by floral bud scales, persistent at anthesis; *involucral bracts* 6–8, 1–10 mm long, size and shape variable, ovate-triangular to oblong, apex acute or obtuse, margin with glands and ciliate, sparsely hairy to glabrescent, bracts remaining after anthesis or on fruiting specimens. **Flowers** bisexual, opening before or at the same time as new leaves, white, pedicellate, slender, 2–4(–6) mm long, glabrescent; *bracteoles* linear oblong, margin serrate, 1–1.5 mm long, pale green, sparsely hairy, early caducous; *hypanthium* campanulate, 2–3 mm long, 3–5 mm wide, sparsely hairy outside, glabrous inside, subglabrous to desely hairs at the bottom; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, green, 0.5–1 mm long × 0.5–1 mm wide, subequal, apex acute to obtuse, margin entire, base truncate, separate in bud, spreading when mature, deciduous, glabrescent to glabrous outside, glabrescent inside; *petals* white, spreading to upright, 5, medium, 3.5–5 mm long × 2–3 mm wide, subequal, petals 4–6 times calyx lobes length, broadly ovate to orbicular, unguiculate, apex obtuse or slightly erose, margin entire, base cuneate and shortly unguiculate, alternate with calyx lobes, glabrescent outside, sparsely tomentose to glabrescent inside; *stamens* 26–37 in 1 to 3 series, inserted, equal or not longer than petal length; filament filiform, white, 3–5 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* usually glabrescent or sparsely tomentose, rarely glabrous, 1 locular; *style* filiform, slender, 3–4 mm long, shorter than or as long as stamens, glabrescent at the lower half; stigma subpeltate. *Infructescence* 10–20 cm long, sparsely pubescent to glabrous, lenticels numerous, many-fruited. **Fruits** stipitate, 3–5 mm long, young fruit green, turning dark purple or black when mature or ripe, ellipsoid to ovoid, globose, 1.5–1.7 cm long, 1–1.4 cm wide, apex obtuse or slightly retuse; young fruits sparsely tomentose; mature fruits glabrescent; exocarp smooth and shiny, without longitudinal groove; mesocarp fleshy, thin, black; endocarp stone bony, thick, 2–3 mm, smooth and shallowly longitudinal furrowed or ridged; calyx deciduous; style absent or a minute at the end of the fruit. **Seeds** oval to circular in cross-section, thick, with glabrous testa, shallowly grooved.

Additional specimens examined.— **CHINA**. Pin-fa, 6 May 1902, fr., *J. Cavalerie* 1*3* (**E**00010487!). **INDIA**. **Himalaya**: Meghalaya Khasia Hills, alt. 2000 m, 1855, fr., *J.D. Hooker & T. Thomson s.n.* (**K**!, **P**03372372!);– *ibid., S.Coll. s.n.* (**L**1893673†, **P**03372363!, **P**03372366!);– **Assam**: Jawai, 27 October 1893, fl. & fr., *King*, *s.n.* (**K**!);– **Sikkim**: alt. 3,000 m, July 1882, fr., *J.S. Gamble 10359* (**K**!);– **Darjeeling**: alt. 2,100 m, 2 April 1960, fl., *H. Hara*, *M. Togashi 6437* (**KYO**!);– *ibid.*, September 1889, lvs., *J.S. Gamble 8428* (**K**!);– *ibid.*, alt. 2,333 m, April 1876, fl., *J.S. Gamble 27476* (**K**!);– Hungbu, alt. 3',300 m, May 1953, fl., *S. Nakao* & *J.H.E. 195* (**KYO**!). **Myanmar**. **Upper Burma, Chin state**; **Mindat,** roadside approximately 40 miles from Mindat, Natmataung NP., 21°34'13.59” N, 93°47'47.54” E, alt. 2,480 m, 1 March 2014, fl., *P. Srisanga*, *M. Norsaengsri*, *R.U.M. Rodda*, *E. Schuettpelz*, *T.T. Mu & L.S. Man 097438* (**E**00758050! **QBG**!, **US**03718625-6†); – ibid., 21°23'40.19”

N, 93°49'49.30” E, alt. 2,465 m, 4 March 2014, fl., *P. Srisanga*, *M. Norsaengsri*, *R.U.M. Rodda*, *E. Schuettpelz*, *T.T. Mu & L.S. Man 97575* (**E**00758056!, **QBG**!); – ibid., **Hilawng ridge**, 21°22'30.9” N, 93°58'51.2” E, alt. 2,833 m, 9 November 1962, fr., *U.M.G. Gale 9151* (**E**00901052!). **NEPAL**. **Chaurikharka**, Namche Bazaar to Lukla, alt. 2,650 m, 25 May 2004, fr., *Darwin Nepal Fieldwork 324* (**E**00229299!); Topke Gola, alt. 2650 m, 27 June 1972, *H. Kanai, H. Ohashi, K. Iwatsuki, H. Ohba, Z. Iatsuki & P.R. Shakya 723250* (**BM**!).

Distribution.— India (Himalaya, Sikkim, and Assam), Nepal, Myanmar (Upper Burma), and China (Western China, Yunnan) (**Maps 4.9 & 4.19**).

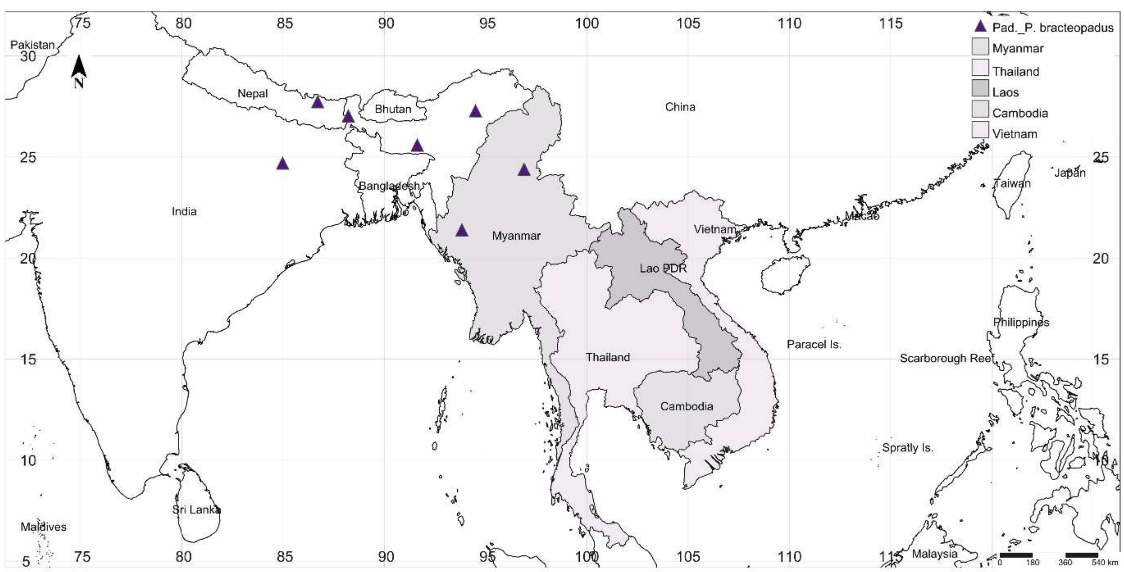
Vernacular name.**— English name**: Bird cherry. **Nepal:** Aarupatey.

Ecology.**—** Scattered on slopes or open Stoney disturbed ground with running water, valleys of the Lower Montane Forest to Alpine forest valleys, alt. 1,500–3,600 m.

Phenology.**—** Flowering: March–May. Fruiting: May–October.

Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 530,418.79 km^2; AOO = 32.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).



Map 4.19. Distribution of *Prunus bracteopadus* Koehne of subg. *Padus* in continental Southeast Asia and nearby.

4.3.7. Subgenus *Laurocerasus* Duhamel, Traite des Arbres et Arbustes que l'on Cultive en France, par Duhamel. 1: 345. 1755; (Tourn. Ex Duh.) Rehd., A Manual of the Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands.: 478. 1927.; ibid., 2nd ed.: 480. 1940 480; Krussmann, Handbuch der Laubgeholze. 2: 245. 1962; Tourn., Institutiones Rei Herbariae.: t. 403. 627. 1700 ex Duhamel, Traite des Arbres et Arbustes que l'on Cultive en France, par Duhamel. 1: 345, t. 133. 1755; Roemer M.J., Familiarum Naturalium Regni Vegetabilis Synopses monographicae. 3: 89. 1847; Schneid., Illustriertes Handbuch der Laubholzkunde. 1: 645. 1906; Hutch., The genera of flowering plants. Dicotyledones. Vol 1: 188. 1964.

Description: Evergreen trees or shrubs. Leaves entire or incised (dentate, crenate, serrate), usually with some (mostly 2) glands at the base, either on the under-surface, or sometimes intrapetiolarly connate, on the petiole. Inflorescence is a raceme with usually more than 10 flowers, rarely a spike, very rarely a compound raceme; racemes usually solitary in the axils of leaves, of their scars, or of the cataphylls, sometimes in bundles (strongly shortened brachyblasts with or without terminal bud); peduncle never with typical leaves. Bracts small, caducous, lower ones often empty, tripartite, or with tridentate apex; bracteoles rarely present. Flowers usually bisexual, sometimes male, with a more or less reduced ovary. Hypanthium funnel shape or campanulate, under the ripening fruit circumscissile ad only the basal part persistent. Periant biseriate and the (4–) 5 (–6)-merous, or all perianth segments more or less equal and commonly more or less than 10. Stamens 10 – ∞. Fruit a drupe, ellipsoid to didymous; mesocarp usually dry, sometimes distinctly fleshy; endocarp bony or woody, usually thin; seedcoat occasionally hairy.

About 75 species, mainly tropical-Asiatic and tropical-American, one or two species in tropical Africa; in America, Europe, and Asia extending into more temperate regions.

Remarks. Kalkman (1965), The first author who described a group with this circumscription on a subgeneric level in the genus *Prunus,* was Rehder (1927). He ascribed the combination *Prunus* subg. *Laurocerasus* to Koehne, which is not correct.

4.3.7.1 Subgenus *Laurocerasus,* section *Laurocerasus* Kalkman, Blumea 13: 1–115. 1965. – subgenus *Cerasus* sect. *Laurocerasus* Ser. In DC., Prodromus Systematis Naturalis Regni Vegetabilis. 2: 540. 1825. – subgenus *Prunus* sect. *Laurocerasus* Benthum & Hooker., Genera Plantarum 1: 364. 1865; Koehne, Deutsche Dendrol.: 429. 1893; Koehne, Botanische Jahrbucher fur Systematik. 52: 292. 1915. – subgenus *Prunus* subsection *Laurocerasus* Koehne in Sarg., Plantae Wilsonianae. 1: 74. 1912. – genus *Laurocerasus* Lingdi & Bartholomew in Lu et al. Flora of China. 9: 399. 2003.

Description: Trees or shrubs, evergreen or very rarely deciduous. Branches unarmed. Stipules small, free, or sometimes connate, soon caducous. Leaves simple, alternate, and conduplicate when young, usually with 2 to rarely several nectaries on the petiole, at the base on the leaf blade abaxial surface, or along the leaf blade margin entire or serrate. Inflorescences axillary, usually racemose, rarely in a fascicle, very rarely paniculate, usually with more than 10 flowers; bracts small, soon caducous, basal ones usually with a tripartite or tridentate apex; bracteoles small, often absent, soon caducous. Flowers usually bisexual, sometimes male with ovary ± reduced; Hypanthium cup-shaped to campanulate, caducous in fruit. Sepals 5, Petals 5, white, conspicuous, different, and longer than sepals. Stamens 10–50, in 2 whorls, inner ones shorter. Ovary superior, 1-loculed, glabrous, or sometimes pubescent; ovules 2, collateral. Style terminal; stigma dis-shaped. Fruit a drupe; mesocarp succulent, not splitting when ripe; endocarp bony or woody, surface smooth or rugose, glabrous inside.

19. ***Prunus javanica*** **(Teijsm**. **& Binn**.**) Miq**., Flora van Nederlandsch Indie. 1(1): 365. 1855; Kurz, Journal of the Asiatic Society of Bengal. 40(2):52. 1871; *ibid.*, Forest Flora of British-Burma 1: 434. 1877; Hook.f., The Flora of British-India, London. 2 (5): 316. 1878; King, Materials for a Flora of the Malayan Peninsula. Singapore 1: 285. 1897; Koord., Flora of Java. 2: 337. 1912; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 297. 1915; Cardot, in Flore Générale de L'Indo-Chine: 622. 1920; Meeuse & Adelb. in Back., Beknopte Flora van Java (ed.) 4(2):24. 1943; J.E.Vidal, Adansonia 4: 1435. 1964; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to Pygeum: 47–49. 1965; *excl. syn. P. adenopoda*; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 174–176, pl. xxiii, 4–6. 1968; J.E.Vidal, in Flora of Thailand 2 (1): 69. 1970; Prance & Whitmore, in Tree Flora of Malaya 2: 338, fig. 8. 1973; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 328. 1993.

Typification**: INDONESIA, Java**, no location, fl., *Teijsman 365* (lectotype probably in **BO** (*non vidi*), isolectotype **K**000737326!, on the same sheet with the fruiting specimen; lectoparatypes *Teijsman 1868* (**K**000737327!); same locality *S. coll.*, *s.n.* **L**0019646† (sheet 908.195-1176), designated by Kalkman, 1965).

≡ *Cerasus javanica* Teijsm. & Binn., Natuurkundig Tijdschrift voor Nederlandsch-Indië. 2: 309. 1851; *ibid.*, Nederlandsch Kruidkundig Archief. 3: 412. 1855.

≡ *Laurocerasus javanica* (Teijsm. & Binn.) C.K.Schneid., Illustriertes Handbuch der Laubholzkunde. 647. 1906.

= *Nelitris alternifolia* Miq., Flora Indica: a systematic account of the plants of British-India, together with observations on the structure and affinities of their natural orders and genera. 1(1): 476. 1855.

Typification**: INDONESIA, Sumatra**, Java, *H. Zollinger 959* (lectotype **L**0019647†, designated by Kalkman, 1965; isolectotypes **K**000737325!, **U**0005871†), Reduced to *Prunus javanica* by Hallier f., 1917.

≡ *Decaspermum alternifolium* (Miq.) Niedenzu in Engler & Prantl, Naturlichen Pflanzenfamilien. 3(7): 70. 1893.

= *Prunus junghuhniana* Miq., Plantae junghuhnianae: enumeratio plantarum, quas, in insulis Java et Sumatra. 402. 1855; Flora van Nederlandsch Indie. 1(1): 366. 1856; Miq., Flora Indica: being a systematic account of the plants of British-India, together with observations on the structure and affinities of their natural orders and genera. 1(1). 366. 1855; C. Muell. in Walp., Annales Botanices Systematicae. 4: 652. 1857; Merr., The Philippine journal of science, 5(C, Botany): 180. 1910; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 298. 1915; Merr., An enumeration of Philippine flowering plants. 2: 234. 1923.

Typification: **INDONESIA, Java**, Medinilla, Oengarang, 2–4,000 ft, Nuam, Pendjalinan, *F.W. Junghuhn*, *s.n.* (lectotype **U**0005872†, designated by Kalkman, 1965; isolectotype **L**0019648–9†).

= *Cerasus martabanica* Wall. in Numer. List: *Wallich n.° 4902*. 1832. *nom. nud.*

= *Prunus martabanica* Kurz, in Forest Flora of British Burma. 1: 434. 1877.

Typification: **MYANMAR, Martaban**, Amherst district, Moalamque (Moulmein), 24 March 1827, fr., *Wallich 4902* (lectotype K!, designated by Kalkman, 1965.; isolectotype **G**00437496†); **India,** South Andaman, *W.S. Kurz s.n.* (lectoparatype **L**0019641†).

= *Pygeum nitidum* Pierre, Plantes Utiles des Colonies Francaises. 284. 1886, *nom. nud.*

≡ *Prunus nitida* (Pierre) Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 298. 1915. *comb*, *non vidi.*, *non* Salisb. (1796). *nom. inval.*

≡ *Prunus nitens* Craib, Florae Siamensis enumeratio. 1: 565. 1931.

Typification: **VIETNAM, Cochinchine, Dinh**, Duchberge near Baria, March 1878, Local name: Viang miong, *Pierre 1717=1719* (holotype in **P**01819068!; isotypes **E**00991972–3!, **K**!, **P**01819068–70!, **G**00437501†, **L**0019639–40†, **US**1270541-2†).

= *Prunus martabanica* Kurz var. *scortechinii* King, Journal of the Asiatic Society of Bengal. 66: 286. 1897; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 298. 1915; Ridl., The flora of the Malay Peninsula. 1: 672. 1922.

Typification: **MALAYSIA, Peninsular Malaysia**, Larut, Perak, 100 m alt., a tree 10 to 20 feet high. Stem 2 to 3 ft. Leaves bright green. Fowers pale green with white tips. [Petils] low brown ground, *Kings Sammler Chanderiang 5638* (lectotype **CAL**, designated by Kalkman, 1964, *non vidi*; isolectotype **L**0019642!; lectoparatypes, *Scortechini 1782* (**G**00437136†, **K**000737288–90!).

≡ *Prunus scortechinii* (King) Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 297–298. 1915.

= *Prunus forbesii* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 297–298. 1915.

≡ *Pygeum glabrifolium* Baker f., in Seem. Journal of Botany. 62 (suppl.): 33. 1924.

Typification**: INDONESIA, Sumatra**, South Sumatra, Palem Bang, River Saling near Tandjong Ning, 213 m alt., 700, small tree, ft, fl., *H.O. Forbes 2728* (holotype probably lost in

B (Kalkman, 1965); isotypes **BM**000622038!, **BRI-AQ**0317672†, **CANB**259091†, **L**0019643–5†, **SING**0068727–8†).

= *Prunus javanica* (Teysm. & Binn.) Miq. var. *angustifolia* Hallier., in Merr., A bibliographic enumeration of Bornean plants. 24. 1917. Type as for the basionym below.

≡ *Platea oblonga* Korth. ex Valeton, Theodoric, Critisch Overzicht der Olacineae B. et H. 252: in obs., 279, pl. 6, f. 42, a-d. 1886. See Sleumer, H. (1969). Materials towards the knowledge of the Icacinaceae of Asia, Malesia, and adjacent areas Blumea 17: 181-264 (248).

Typification**: INDONESIA, Borneo**, Palawan, fr., *Korthals*, *s.n.* (holotype **L**0019654†; isotypes **C**10017916†, **K**000737324!, **L**0019655†, **U**0116140†).

= *Prunus papuana* Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 298. 1915.

Typification: **PAPUA NEW GUINEA,** Kohariberge, 3 Tagereisen s. s. O. von der Tamimundung, 800 m.; syntypes: *L. Schultze 22*, *49* syntypes (*non vidi*), probably lost in B (Kalkman, 1965), untraced (probably a neolectotype is required).

Description: Evergreen, top-canopy, tree up to 35 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown, shallowly fissured with small to large scales, spines absent; *inner bark* reddish-brown; strong almond smell. **Branchlets** moderate, brown with light brown lenticels; young twigs reddish-brown with white lenticels, glabrous, with 3 to 6 small cataphylls at base; old twigs greyish-brown with conspicuous sparsely brown lenticels. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate to oblong-ovate, rarely lanceolate, 7.5–17(–19) cm long × 2.5–6(–7) cm wide; *lamina apex* long-acuminate, angle acute; *margin* entire, revolute, sometimes slightly serrate on upper half or near the apex, glabrous; *base* asymmetric sometimes slightly so, rounded to acute; young leaves reddish-brown, dull green adaxially, pale light green abaxially, turning yellow before falling, chartaceous, glabrous; old leaves glabrous on both surfaces; *basal glands* (–0) 2 (–4), up to 0.5 mm long, ovate-oblong, usually distinctly protruding, petilolar glands usually 2, small, on upper or lateral surface of petiole, usually just abaxial blade, sometimes in the margin leaf blade, densely black-dotted abaxial; *2° venation* weakly brochidodromous, 8–13 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent or just visible abaxially, angle narrow to moderate (30°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.5–1.5 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* present, usually 2, 0.6 × 0.3 mm in diameter. **Stipules** small to medium, 4–5 mm long × 1.2–1.5 mm wide, linear to triangular, apex acuminate, margin entire to sparsely ciliate, base oblong, glabrous to sparsely hairy, intrapetiolar connate with their very excentric keeled midribs, early caducous. **Inflorescences** compound, usually solitary to 3(–5) clusters racemes, lax-flowered, in the axil branchlets of fallen leaves or axils of leaf, 2–6(–11) cm long, > 20-flowered, glabrous or sparsely pubescent, rarely more densely so; *bracts* 1–3, up to 1.5 mm long, green, glabrous outside, hairy inside and on margin, caducous, some empty ones present at the raceme-base. **Flowers** bisexual, opening with mature leaves, white, fragrant; pedicels stout to slender, 2–5 (–7) mm long, glabrous or sparsely pubescent; *bracteoles* ovate to triangular, 1–1.5 mm long, greenish-white, glabrous to sparsely pubescent, early caducous; *hypanthium* cup-shaped, 1.5–2 mm long, glabrous to pubescent outside or with some sparse hairs at base inside, rarely relatively densely pubescent (Vietnam); corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, 0.5–1 mm long × 0.5–1.2 mm wide, subequal, apex acute, margin entire, glabrous to sparse ciliate, hairy especially at the apex, base truncate, separate or valvate in bud, spreading when mature, deciduous, early caducous, glabrous or pubescent outside, glabrous inside; *petals* white, broadly ovate or orbicular, spreading to upright, 5, medium, 2–4 mm long × 2–4 mm wide, subequal, 3–5 times as long as sepals, glabrous, sessile to slightly unguiculate, apex rounded, margin usually entire, base sessile to shortly unguiculate, alternate with calyx lobes, glabrous outside, glabrous or with sparse hairs at the base inside; *stamens* 20–40 in 3 series, exserted; filament filiform, white, 3–6 mm long, glabrous; anthers oblong to subglobose, 0.4–1 mm long; *ovary* glabrous, sometimes with hairs around point of insertion, 1 locular; *style* filiform, up to 4.5–6 mm long (up to 1 cm in Myanmar), slightly shorter to as long as stamens, glabrous; stigma globose. *Infructescence* 2–6 cm long, elongated up to 13 cm at the fruiting stage, glabrous (Malaysia, Indonesia) to densely hairy (Continental Southeast Asia), few, 1–4 fruited. **Fruits** fleshy, stipitate, 3–10 mm long, young fruit green, yellow when mature or ripe, ovoid to ellipsoid, apex acute with a short beak, index 1.7–2.5, 1.5–2.5 cm long by 0.7–1.2 cm wide, apex with a short acute to apiculate beak; young and mature fruits glabrous; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, sour, adnate to endocarp, yellow; endocarp smooth with shallow groove and longitudinal ridge on one side, and shallow reticulation, glabrous; calyx deciduous; style present, peaked or apiculate up to 1 mm long. **Seeds** oval to circular in cross-section, medium, with glabrous testa, reticulate, seedcoat glabrous (**Figures 4.7 & 4.8**).

Additional specimens examined.— **CAMBODIA**. **Cambodge**: Kaoh Touch, Elephant Mountain, Bokor NP., 10°36'06.91" N, 104°5'23.76" E, alt. 266 m, 15 May 2012, lvs., *H. Toyama*, *S. Tagane*, *T. Mishima*, *K. Tagawa*, *M. Zang*, *P. Chhang*, *F. Iwanaga*, *H. Nagamasu & T. Yahara 3293* (**BKF**!, **FU**!);– *ibid.*, 10°36'33.6" N, 104°04'12.6" E, alt. 370 m, 10 August 2013, lvs., *S. Tagane*, *K. Fuse*, *S. Yokota*, *M. Zhang & P. Chang 5833* (**BKF**!, **FU**!);– **Koh Kong**: Thma Baing, Ruessei Chrum, 11°39'38.9" N, 103°23'58.99" E, alt. 342 m, 22 December 2008, fl., *Mark Newman*, *Jean-Noei Labat*, *Oudomphone Insisengmay*, *Loie Cecilio & Viboth 2171* (**P**00577885!);– *ibid.*, *op. cit.*, *2172* (**E**00319101!, **L**4182723†). **INDONESIA**. **Borneo**: Bongan, near Djambu, 30 June 1952, fr., *A. Kostermans 7276* (**L**0576227†, **P**03144208!);– *ibid.*, Papua, West North Guinea, Damabagata, Tafelberg, June 1960, fr., *Chr. B.W. Versteegh BW7478* (**P**03144211!);– *ibid.*, Sebalouw, 23 April 1913, fr., *Teysmann 10837* (**P**03144210!);– **Java**: Java Barat, Jasinga Forest, 6°31'S, 106°24'E, alt. 167 m, 3 April 1984, fr., *A.J.M.*

Leeuwenburg 13154 (**K**!, **L**0908199-200†, **WAG**1117777†);– *ibid.*, Preanger, Tjidadap, 29 May 1918, fl., *W.F. Winckel 176* (**P**03144212!);– *Kolaka*: Sabilambo, Aalaa Koloimba, South East Sulawesi, 4°03'11.0"S, 121°43'30.8" E, 23 May 2008, fl., *Girmansyah 1006* (**L**4183266†). **LAOS**. **Central, Bolikhamxay**: Phou Khao Khuoay, Phou Khao Khuoay National Protected Area, 18°27'14.14" N, 103°08'39.13" E, alt. 330 m, 21 December 2017, lvs., *T. Yahara*, *S. Tagane*, *P. Souladeth*, *H. Nagamasu*, *A. Naiki*, *S. Chayer & D. Kongxaisavath L142*0 (**BKF**!, **FU**!, **RAF**!);– **Veintiane**: Phou Khao Khuoay National Protected Area, 18°23'19.08" N, 102°54'40.61" E, alt. 695 m, 24 December 2017, lvs., *T. Yahara*, *S. Tagane*, *P. Souladeth*, *H. Nagamasu*, *A. Naiki*, *S. Chayer & D. Kongxaisavath L1689* (**FU**!);– *ibid.*, 18°21'10.48" N, 102°48'20.68" E, 2 March 2011, lvs., *K. Nanthavong*, *J. Millet*, *P. Keomanivong 2888* (**HNL**†);– **Southern, Attapeu**: Bolaven, 14°32'36.0" N, 106°51'56.9" E, alt. 540 m, 21 December 2019, lvs., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3721* (**RAF**!, **FOF**!). **MALAYSIA**, 06°01'27.7" N, 116°32'39.3" E, May *s.n.*, fl., *King*, *s.n.* (**K**000737290!, **P**03358316!);– Malay Peninsula, Larut, 5°03'52.4" N, 100°55'56.2" E, March 1884, fl., *King 5638* (**P**!). **MYANMAR**. 14º40'50.45" N, 98º20'51.50" E, alt. 551 m, 13 November 2018, lvs., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Yunn Mi Mi Kyaw*, *Awng Khine Win MY4155* (**FU**!);– July *s.n.*, lvs., *S. Kurz*, *s.n.* (**K**!);– May *s.n.*, fl., *C.W.D. Kermode 7377* (**K**!);– May *s.n.*, fl., *King*, *s.n.* (**K**!, **P**03358315!);– May *s.n.*, fl., *W. Griffith 2072* (**K**!);– Bassein, 16°47'40.5" N, 94°45'04.8" E, alt. 60 m, 21 February 1929, fr., *C.E. Parkinson 8774* (**RAF**1349!);– **Central Burma, Martaban**: Taungoo, Pannyo, 24 March 1827, fl., Wallich, *s.n.* (Geneva Herbarium);– **Lower Burma, Tanintharyi**: Ma Kyone Galet, Bo Cho Island, Lampai NP, 10°40'45.2" N, 98°15'25.6" E, alt. 74 m, 13 November 2018, lvs., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Yunn Mi Mi Kyaw*, *Awng Khine Win MY2270* (**FU**!);– **Moulmein**: Mon, Mawlamyine, Moulmein, February 1827, fr., *Wallich 4902* (**K**001104177!, **K**000737194-5!). **THAILAND**. **Central, Nakhon Nayok,** Khao Yai NP.: 14°26'00.0" N, 101°22'00.0" E, 23 March 2004, fr., *A. Boonkongchart 325* (**L**4183107!);– *ibid.*, 4°22'23.4" N, 101°24'02.9" E, alt. 892 m, 28 February 2018, fr., *S. Kaitongsuk*, *M. Saengsawasti*, *S. Jirakorn*, *T. Yahara*, *S. Tagane & A. Nagahama T5892* (**FU**!);– *ibid.*, 14°25'59.5" N, 101°21'48.7" E, alt. 808 m, 22 November 2002, fr., *P. Charoenchai & S. Poompuang 364* (**BK**262985!, **CMUB**026205!);– *ibid.*, 14°26'N, 101°22'E, 25 December 1997, fr., *P. Charoenchai 741* (**BKF**!, **CMUB**!, **L**4182883†);– *ibid.*, 14°26'N, 101°22'E, alt. 780 m, 15 January 1997, fl., *P. Charoenchai*, *s.n.* (**CMUB**!);– *ibid.*, 14°26'N, 101°22'E, alt. 798 m, 23 March 2004, fr., *P. Charoenchai*, *s.n.* (**CMUB**12288!);– *ibid.*, Mo Singto area: 14°26'00.0" N, 101°22'00.0" E, 22 June 2004, lvs., *S. Chongko & A. Boonkongchart 359* (**L**4183108-9†);– *ibid.*, 14°25'57" N, 101°22'30" E, alt. 760 m, 24 December 1997, fl., *P. Charoenchai 487* (**BKF**156473!, **CMUB**19248!, **L**4182228†);– *ibid.*, 14°25'58" N, 101°22'24" E, alt. 780 m, 16 February 1999, fr., *P. Charoenchai 741* (**BKF**153115!, **CMUB**18868!, **L**4182883-4†, **L**4182924†);– *ibid.*, 14°25'57" N, 101°22'30" E, alt. 760 m, 24 December 1997, fl., *R. Pooma 3421* (**BKF**!);– *ibid.*, 14°26'00" N, 101°22'30" E, alt. 786 m, 10 December 2001, fr., *W.Y. Brockelman 109* (**BKF**156462!, **CMUB**!, **L**4182885†);– **Nakhon**

Rachasima, Khao Yai NP.: 14°25'57” N, 101°22'30” E, alt. 500 m, 30 December 1980, fl., *A. Kostermans 8179* (**BK**213997!, **K**!);– *ibid.*, 14°26'15” N, 101°22'20” E, alt. 860 m, January 1990, fl., *W.Y. Brockelman*, *s.n.* (**BKF**!);– *ibid.*, 14°26'15” N, 101°22'20” E, alt. 860 m, May, fl., *W.Y. Brockelman*, *s.n.* (**BKF**100242!);– **Prachin Buri**, Khao Yai NP.: 14°26'03” N, 101°21'55” E, alt. 792 m, 8 April 2019, lvs., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari*, *S. Chatrupamai & T. Anannat SR197* (**BKF**224934!, **TCD**!);– alt. 750 m, 27 March 1978, *T. Wongprsert s.n.* (**BKF**121069!);– **Eastern, Chantaburi**, Khao Soi Dao, Khao Soi Dao WS.: 13°03'07.29” N, 102°09'46.35” E, alt. 1,200 m, 8 March 2014, fl., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T2666* (**BKF**!, **FU**!);– *ibid.*, 13°04'48.10” N, 102°10'13.70” E, alt. 600 m, 19 May 2013, fl., *S. Tagane*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *N. Wachi*, *W. Kiewbang & P. Pansamrong T1794* (**BKF**207553!, **FU**!);– **Trat**, Koh Chang NP., 12°03'39” N, 102°18'34” E, alt. 48 m, 11 April 2019, lvs., *S. Rueangruea*, *A. Rueangruea & Y. Yujongdee SR201* (**BKF**224928!, **TCD**!);– **Northeastern, Loei**: Phu Ruea, Tha Sala, Phu Laung WS., 17°18'21” N, 101°30'46” E, alt. 1,141 m, 28 March 2019, lvs., *S. Rueangruea*, *P. Poodja*, *C. Hemrat*, *W. Kiewbang & P. Chattathipkul SR174* (**BKF**229990!, **TCD**!);– **Udonthani**: 17°13'48.7” N, 102°28'02.8” E, May 1987, fl., *s.coll.*, *s.n.* (**BKF**!);– **Northern, Chiang Mai**, Mae Wang, Dae Lae Poh fall, Houy Yao stream, 18°39'01.2” N, 98°36'11.6” E, alt. 1,025 m, 23 April 2004, fr., *J.F. Maxwell 04-247* (**CMUB**23562!, **L**†);– *ibid.*, Pang Tawn, 19°40'00.0” N, 98°00'00.0” E, 3 May 1931, fl., *N. Put 3875* (**BM**!, **K**!, **L**112108d!, **L**1892537†, **P**03358308!);– *ibid.*, Mueang, Doi Suthep-Pui NP.: 18°48'17.6” N, 98°54'11.2” E, alt. 1,050 m, 29 June 1995, fr., *S. Kopachon S142b1* (**CMUB**!);– *ibid.*, 18°48'17.6” N, 98°54'11.2” E, alt. 1,100 m, 19 May 1997, fl., *J.F. Maxwell 97-535* (**BKF**117720!, **L**4192229†, **L**4207465†,);– *ibid.*, 18°48'44” N, 98°54'12” E, alt. 1,332 m, 10 March 2019, lvs., *S. Kaithongsuk*, *S. Rueangruea*, *A. Rueangruea*, *P. Uea-Ari*, *S. Chatrupamai 184* (**BKF**221175!, **TCD**!);– **Phitsanulok**, Nakhon Thai, Noen Phoem, Phu Hin Rong Khla NP., 16°59'32” N, 101°00'41” E, alt. 1,251 m, 31 March 2019, lvs., *S. Rueangruea*, *P. Poodja*, *C. Hemrat*, *W. Kiewbang & P. Chattathipkul SR177* (**BKF**229987!, **TCD**!);– **Peninsular, Nakhon Si Thammarat**: Khao Laung NP., 8°22'09” N, 99°43'57” E, 6 March 1962, fl., *P. Suvarnakoses 1843* (**BKF**049622-3!);– **Narathiwat**: 5°47'32” N, 101°48'51” E, alt. 689 m, 26 April 1972, fr., *B. Sangkhachand 1113* (**BKF**!);– **Phang Nga**: Kura Buri, Tai Rom Yen NP., 8°59’N, 98°28’E, alt. 110 m, 12 January 2005, fl., *S. Gardner & P. Tippayasri ST1304* (**K**!);– **Phetchaburi**: Kaeng Krachan, Phanoen Thung ranger substation, Kaeng Krachan NP., 12°48'52” N, 99°23'25" E, alt. 800 m, 22 April 2019, lvs., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari*, *T. Chaowasku*, *A. Danthongdee*, *N. Hathai & W. Kaewmongkul SR209* (**BKF**229937-8!, **TCD**!);– *ibid.*, 12°49'19.7"N, 99°21'57.7"E, alt. 960 m, 22 October 2013, *S. Tagane, H. Nagamasu, A. Naiki, S. Rueangruea, S. Suddee, K. Fuse, W. Keiwbang & P. Pansamrong T2004* (**BKF**206213!, **FU**!);– **Satun**: La Ngu, Ao Pante, Tarutao NP., 06°38’N, 99°20’E, alt. 90 m, 18 February 2005, fr., *S. Gardner & P. Tippayasri ST1557* (**BKF**184176!, **K**!);– Thale Ban, Headquater, Thale Ban NP., 6°42'43"N, 100°10'13"E, alt. 119 m, 20 December 2015, *S. Rueangruea, J. Hemrat, W. Keiwbang, S. Tagane, H. Toyama &H. Nagamasu T5301* (**BKF**!, **FU**!).

VIETNAM. **Cochinchine, Ba Ria Vung Tau**: Barsa, 18 March 1878, fl., *L. Pierre 1717* (**K**!, **L**†);– *ibid.*, Dinh, 1 May 1860, fl., *L. Pierre*, *s.n.* (**L**0019639†);– Dinh and Barin, March 1878, fl., *L. Pierre 1717*, *1719* (**P**!);– **Khanh Hoa**: Hon Ba Mt., 12°07'29.45" N, 108°57'51.11" E, alt. 1,204 m, 20 July 2013, lvs., *S. Tagane*, *T. Yahara*, *H. Nagamasu*, *K. Fuse*, *H. Toyama*, *H. Tran*, *V.S. Dang*, *X.N. Loi*, *N.D. Thach*, *Q.N. Cuong*, *P.N.H. Hieu & K.N. Thach V516* (**FU**!);– **Tonkin, Binh Dinh**: Tay Son, May 1868, fl., *L. Pierre*, *s.n.* (**P**03358310!);– **Dalat**: Lac Duong, Da Chay, Bi Dup Mountain, 21 March 1997, fl., *L.V. Averyanov VH2973* (**MO**1738236†).;– *ibid.*, 1 May 1997, fl., *L.V. Averyanov VH4474* (**MO**01409951†).

Distribution.— India (South Andaman), Myanmar (Peninsular Burma), Thailand, Laos, Cambodia, S. Vietnam, Malaysia, Indonesia, Borneo, Java (type), Maluku, Sulawesi, Sumatra (Tapanuli, Eastc. Palembang), Bali Borneo, Palawan, Celebes, Moluccas, and New Guinea (**Maps 4.20 & 4.21**).

Vernacular name.— **China**: Giu ying shu. **Indonesia:** Merlipas (Borneo); Memot (in Malay language, North Borneo); Pahie (Bukit Raya, Borneo); Kawojang; Djengot (Java, Sumdanese), Sissemohi (New Guinea, Manikion lang). **Malaysia-Borneo**: Ekor Kepang (Kedah); Pepijat Tinggi (Pahang). **Thailand**: พอพญา Pho Phaya.

Ecology.— Evergreen, Dry Seasonal Evergreen, and Montane Forests, alt. 40–1,400 m.

Phenology.— Flowering from December to May, fruiting from February to June.

Uses.— Bark is used as fish poison; the trunk for rice bins (Borneo); the bark is also used as medicine against worms of kerbua, vermicide (North Borneo).

Conservation.— This species is known from many locations (> 10 locations): EOO = 6,752,410.09 km^2; AOO = 304.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— This species differs from other *Prunus* species in the Malay Peninsula by its 2 glands on the upper part of the petiole (rather than on the blade) and the dense and most conspicuous black punctate dots on the lower leaf surface. It has small buttresses, and its bark is reddish-brown to dark brown, with an almond-like smell. Its fruit is green when young, turning red via yellow. In continental SE Asia, *P. javanica* could be confused with *P. phaeosticta* and *P. fordiana*, which also have punctate leaves. Still, from those species, it can be distinguished by the fruit, basal glands, and stipules. *Pygeum nitidum* is typified by a somewhat deviating sample, *Pierre 1717*. The hypanthium in that specimen is much more densely hairy than in other samples.

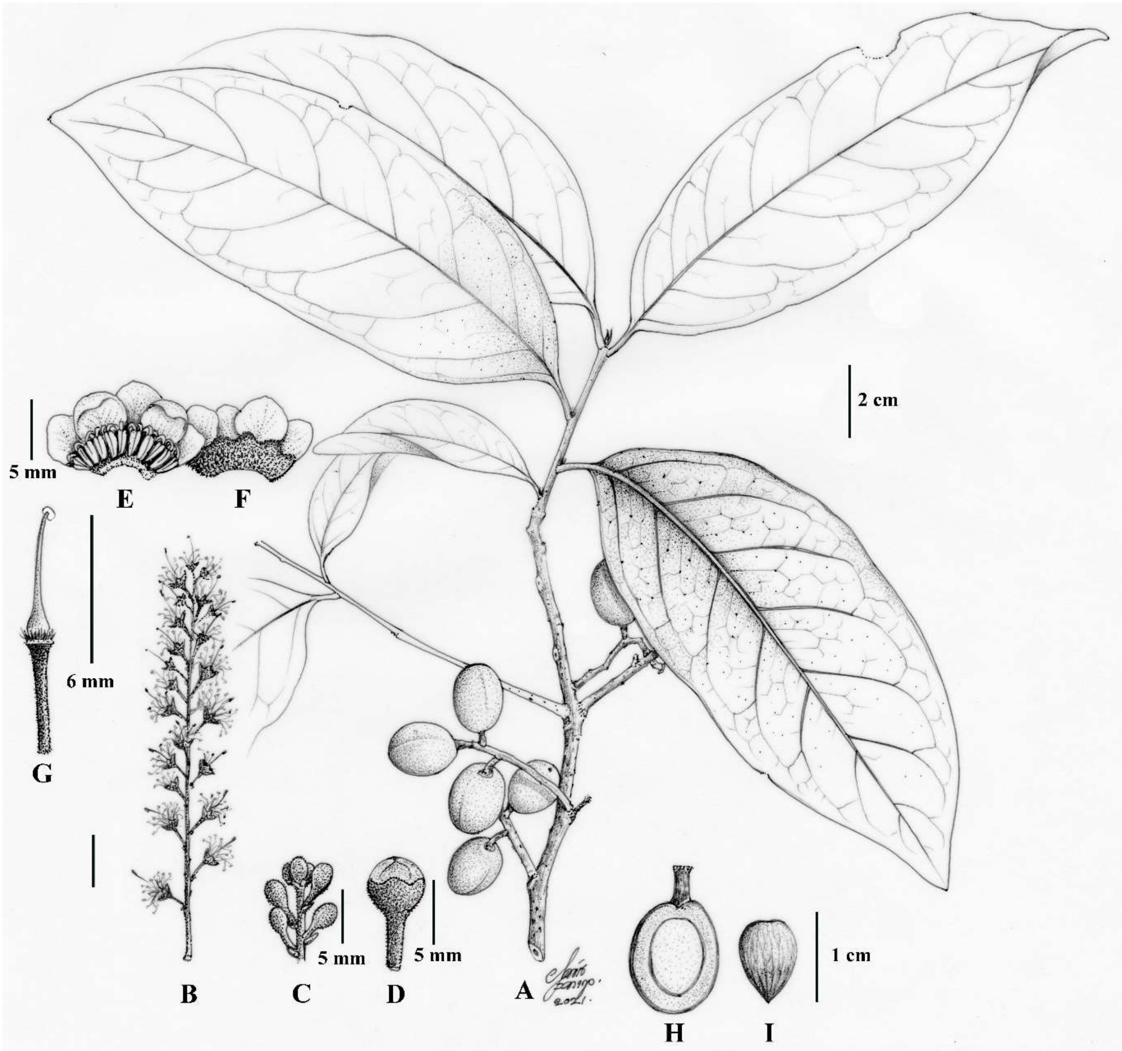


Figure 4.7. *Prunus javanica* (Teijsm. & Binn.) Miq. **A**. fruiting branch, entire leaves with leaf blade densely black-dotted abaxially; **B**. inflorescence, **C** and **D**. flower buds; **E**. flower with stamens inside the flower bud; **F.** hypanthium with sepals and petals; **G**. oblique-peltate stigma, glabrous ovary with hairy insertion. **A**, **H** and **I.** from *S. Rueangruea et al. SR207* (**BKF**); **B–F**. from *D. J. Middleton et al. 1793* (**BKF**). Drawn by Pairuch Rayangkul.

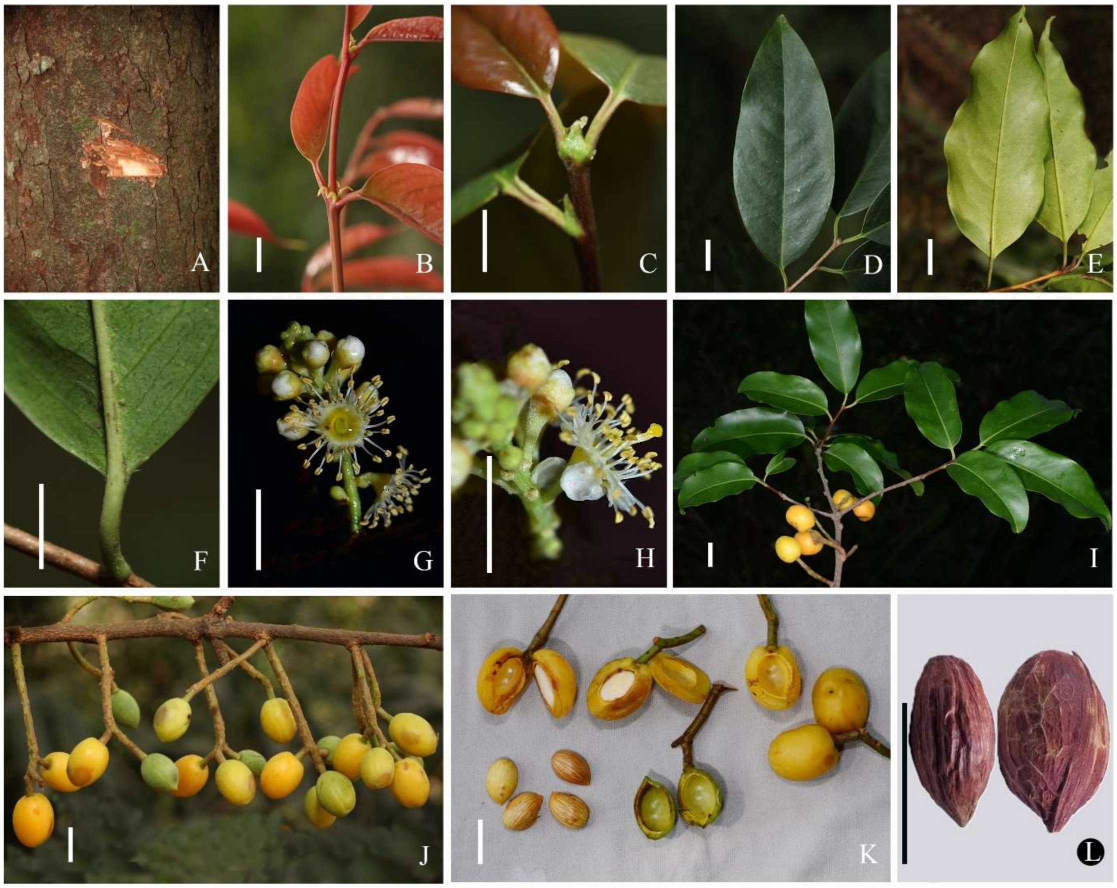
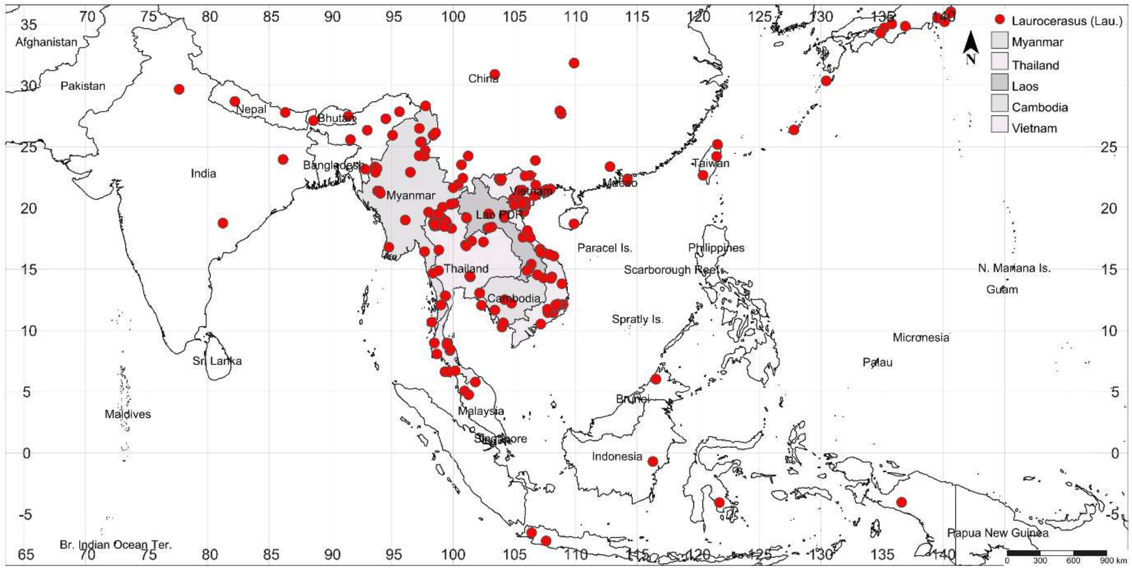
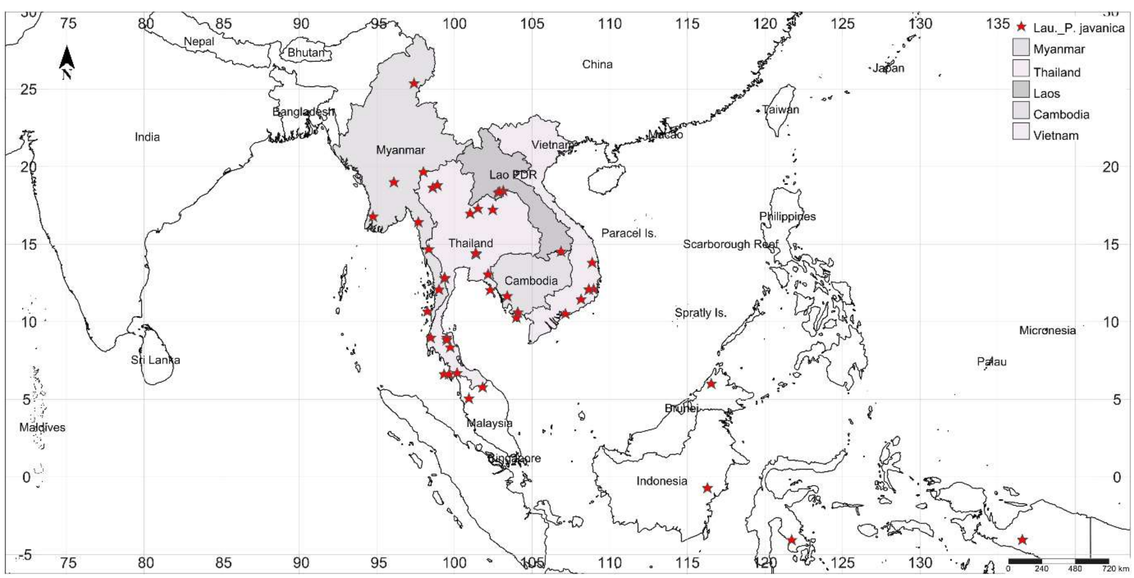


Figure 4.8. *Prunus javanica* (Teijsm. & Binn.) Miq., vegetative and reproductive morphological characters; **A**, outer and inner bark; **B–F**, leaves; **B**, young shoot with stipule; **C**, intra-petiolar connate with sticky resin; **D**, ovate-oblong, adaxial leaf; **E** & **F** abaxial leaves; **F,** margin entire, undulate; **D**, marginal basal gland, additional glands densely black-dotted abaxial; **G** & **H**, inflorescence, usually solitary to 3(–5) clusters racemes; **G**, frontal of flower show stamens in 3 series; **H**, lateral flower, corolla distinctly different from calyx lobes; **I–L**, fruits; **I**, infructescence, solitary or fascicle, on the fallen leaves branch; **J**, mature and ripe fruit with cross-section; L, nut, shallow reticulate and glabrous testa. — Photos: A–F, I–L: by S. Rueangruea; E & D by S. Ruksue. — Sources: **Thailand**; Chiang Mai, D & F from *S. Kaithongsuk et al. 184*; Petchaburi, A–C, G–L from *S. Rueangruea et al. SR207*; Prachinburi, E from *S. Rueangruea et al. SR197*. Scale bar = 1 cm.



Map 4.20. Distribution of *Prunus javanica* (Teijsm. & Binn.) Miq*., P. zippeliana* Miq.*, P. crassistyla* (Card.) Rueangr., J. Parn. & Hodk.*, P. vandebultii* Rueangr., J.Parn. & Hodk.*, P. pygeoides* Koehne*, P. fordiana* Dunn*, P. racemopilosa* (Vidal) Rueangr., J. Parn. & Hodk.*, P. jenkinsii* Hook.f. & Thomson*, P. phaeosticta,* (Hance) Maxim. *and P. undulata* Buch.-Ham. ex D.Don of subg. *Laurocerasus*; in continental Southeast Asia and nearby.



Map 4.21. Distribution of *Prunus javanica* (Teijsm. & Binn.) Miq. of subg. *Laurocerasus* in continental Southeast Asia and nearby.

20. ***Prunus phaeosticta* (Hance) Maxim**., in Bulletin de l' Académie Impériale des Sciences de Saint-Pétersbourg: 3(29):110. 1883; Hook.f., The Flora of British-India, London. 2 (5): 317. 1878; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 300–301. 1915; Cardot, in Flore Générale de L'Indo-Chine 2: 624–625. 1920; Hand.-Mazz., Anzeiger der Akademie der Wissenschaften in Wien. Mathematische-naturwissenchaftliche Klasse 9: 536. 1933; J.E.Vidal in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris 13: 293. 1949; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to *Pygeum*: 40–43. f.15: 42. 1965; J.E.Vidal., Flora du Cambodge, du Laos et du Vietnam 6: 178–179, pl. xxiii, 8–10. 1968; *ibid.*, in Flora of Thailand 2 (1): 69–70. 1970; Type as for the basionym below.

≡ *Pygeum phaeostictum* Hance, in Seem. Journal of Botany. 8: 72. 1870.

Typification: **CHINA, Hong Kong**, Cantonem, Pakwan Mountian, 11 July 1869, communicavit *J.C. Bowring*, *H.F. Hance*, *G.T. Samson 6015* (holotype **BM**000617496!; isotypes **A**00032444!, **GH**00032443†, **K**000737234–6!, **L**0019677!, **P**01819101–3!).

≡ *Laurocerasus phaeosticta* (Hance) C.K.Schneid., Illustriertes Handbuch der Laubholzkunde.: 355f. 355. 1906; Lu Lingdi. *et al.*, in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

= *Prunus punctata* Hook.f. & Thomson, Flora of British-India. 2(5): 317. 1878.

Typification**: INDIA, Assam**, Khasia Montian, 4–5,000 ft alt., *Jenkins*, *J.D. Hooker & T. Thomson*, *s.n.* (holotype, *non vidi*; isotypes **G**00437134†, **K**000737193!, **M**0214868†, **P**01819104–5!.

= *Prunus xerocarpa* Hemsl., Annals of Botany 9: 152. 1895.

Typification: Taiwan, Bankingsing Mountain, tree 10 ft tall. Flowers white, May 1894, fr., *A. Henry 1656* (holotype **NY**00415935†; isotypes **K**000737237!); paratype, same locality, fl., *A. Henry 1658* (**K**000737238!).

=*Lauro-cerasus phaeosticta* f. *ciliospinosa* Chun ex T.T. Yu & L.T. Lu, Bulletin of Botanical Research. Harbin 4(4): 42. 1984. Type, *non vidi*.

=*Prunus phaeosticta* f. *spinulingera* Rehder

–*Lauro-cerasus phaeosticta* f. *dentigera* (Rehder) T.T. Yu & L.T. Lu, Bulletin of Botanical Research. Harbin 4(4): 43. 1984.

Typification**: CHINA, Sichuan**, Kikiang Hsien, 3,500–4,500 ft alt., tree 10 m tall, globose drupe, 11 June 1928, *W.P. Fang 1314* (holotype **A**00032141!; isotypes **E**00010496!, **K**000737239!, **P**01819100!).

=*Lauro-cerasus phaeosticta* f. *lasioclada* (Rehder) T.T. Yu & L.T. Lu, Bulletin of Botanical Research. Harbin 4(4): 42. 1984.

Typification**: CHINA, Yunnan**, Szemao, 5,000 ft alt., small tree 10 m tall, *A. Henry 11666* (holotype *non vidi*; isotype **US**00107981!).

=*Lauro-cerasus phaeosticta* f. *puberula* T.T. Yu & L.T. Lu, Bulletin of Botanical Research. Harbin 4(4): 43. 1984. Type, *non vidi*.

=*Lauro-cerasus phaeosticta* f. *pubipedunculata* T.T. Yu & L.T. Lu, Bulletin of Botanical Research. Harbin 4(4): 43. 1984. Type, *non vidi*.

Description: Evergreen, understory to sub-canopy, small tree to tree up to 20 m tall, canopy shape oval. **Stem** clear bole, erect; outer bark reddish-brown, smooth or shallowly furrowed with brown to reddish-brown lenticels, spines absent; *inner bark* pinkish-brown; strong almond smell. **Branchlets** medium, reddish to blackish-brown with prominent brown lenticels; young twigs reddish-purple, usually glabrous to densely hairy, terete, with many cataphylls at base; old twigs glabrous to densely hairy with prominent lenticels. *Axillary winter bud* solitary, brown, ovoid, 2–4 mm long, glabrous, apex acute to obtuse; *terminal winter bud* present. **Leaves** plicate in bud, extended during flowering, alternate, oblong-lanceolate, narrowly elliptic, oblong, or rarely obovate-oblong, 6–12 cm long × 2–4 cm wide; *lamina apex* long caudate, angle acute; *margin* usually entire, or sometimes acutely serrate in upper half, teeth irregularly spaced, sinus angular, glandular or without glands (the whole leaf), glabrous; *base* symmetrical or slightly asymmetrical, cuneate, broadly cuneate or subrounded; young leaves reddish-purple, dull dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous, glabrous; old leaves glabrous on both sides; *basal glands* 2 (–4), up to 0.7 mm long, ovate to circular, flat or sometimes shallow concave, over the base of leaf blade margin, near the midrib, densely pellucid or black-dotted abaxial; *2° venation* weakly brochidodromous, 6–10 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.4–1 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** medium to large, up to 20 mm long × up to 10 mm wide, shape various, leaf-like, ovoid, ovate, oblong to linear, apex acuminate, margin entire or serrate, base oblong, glabrescent to sparsely hairy, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, in the axil of a leaf or on the basal part of lateral new shoot branchlets, 4–6 cm long, *c.* 10-flowered, glabrescent to pubescent, erect, cataphyll small, soon caducous, apex tridentate; bracts 0(1–2), different size, up to 4 mm long, brown, margin yellowish-grey, caducous. **Flowers** bisexual, opening after new shoot or with young leaves, white; pedicels slender, 3–6 mm long, glabrescent to hairy; *bracteoles* linear to lanceolate, 2–4 mm long, whitish-green, densely hairy to glabrescent, soon caducous; *hypanthium* cup-shaped, 1.5–2.5 mm long, whitish-green, usually sparsely hairy to glabrous outside, glabrous and sparsely hairy at the base inside; corolla distinctly different from calyx lobes; *calyx* lobes 5, rounded, ovate to triangular, minute, 1.5–2 mm long × 1–2 mm wide, subequal, apex obtuse, margin ciliate or minutely serrate, base truncate, separate or valvate in bud, spreading or incurved when mature, deciduous, glabrous outside, glabrescent inside; *petals* white, spreading to decurved, 5, small, 2–3.5 mm long × 2–3.5 mm wide, subequal, 2–4 times as long as sepals, suborbicular, sessile to slightly unguiculate, apex rounded, margin entire, slightly serrate to erose, base sessile to shortly unguiculate, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* 20–35 in 3 series, exserted; filament filiform, white, 5–6 mm long, glabrous; anthers subglobose, 0.3–0.5 mm long, white; *ovary* glabrous, 1 locular; *style* filiform, up to 6 mm long, as long as stamens to slightly longer than stamens, glabrous; stigma peltate. *Infructescence* 2–6 cm long, glabrous to sparsely hairy, few, 1–6 fruited. **Fruits** fleshy, stipitate, 5–10 mm long, young fruit green, green when mature or ripe, globose, subglobose to transversely ellipsoid, 0.6–1.4 cm long, 0.6–1.2 cm wide, apex rounded; young and mature fruits glabrous; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, adnate to endocarp, dark purple or purplish-black; endocarp stone thin, smooth; calyx deciduous. **Seeds** oval to circular in cross-section, thin, with glabrous testa, shallowly reticulate, and endocarp glabrous inside (**Figure 4.9**).

Additional specimens examined.— **CHINA**. **Guizhou**: Jingkou Xian, Heiwan, alt. 1,000 m, 7 September 1986, fr., *B. Bartholomew 986* (**KYO**!);– *ibid.*, alt. 560 m, 24 August 1986, fr., *B. Bartholomew 358* (**KYO**!);– **Hong Kong**: August 1899, fl., *E. Teu 1088* (**P**!);– **Kwangsi**; Yaoa Shan, Tseungyuen, July *s.n.*, fl., *C. Wang 39009* (**KYO**!);– **Sichuan**: Kikikang Hsie, 11 June 1928, fl., *WP. Fang WP. 1314* (**P**01819100!);– **Yunnan**: June 1917, fl., *G. Forrest 17489* (**P**01819099!). **INDIA**. **Assam**: Khasia, October *s.n.*, fr., *J.D. Hooker & T. Thomson*, *s.n.* (**P**01819104-5!). **MYANMAR**. **Upper Burma, Kachin**: Myitkyina, Kang-fang, 26°08'21.3” N, 98°33'37.9” E, alt. 1,830 m, 28 April 1938, fl., *C.W.D. Kermode 17253* (**RAF**5043!);– *ibid.*, Htawgaw, April 1925, fl., *G. Forrest 26500* (**E**!, **US**1377778†);– **Shan**: between Mong Kai and Mong Lao, 26°08'21.3” N, 98°33'37.9” E, alt. 1,830 m, April 1929, fl., *C.W.D. Kermode 8842* (**RAF**!). **TAIWAN**. **Sozan**: Taihoku-shu, alt. 1,830 m, 4 May 1932, fl., *T. Tamaka & Y. Shimada 11008* (**P**01819105!);– **Taipei**: Chutzuhu, Yangmingshan NP., 25°11'40.7” N, 121°33'35.6” E, alt. 50 m, 10 June 1993, fr., *Wen-Pen 1861* (**KYO**!);– **Yuchi**:, Lienhua Chi, 24°12'54.4” N, 121°29'35.2” E, alt. 1,100 m, 22 February 2012, lvs., *T. Yahara*, *S. Tagane & Chau Chin Lin 54* (**FU**!);– *ibid.*, alt. 100 m, 22 February 2012, lvs., *T. Yahara*, *S. Tagane & Chau Chin Lin 33* (**FU**!);– *ibid.*, 18°34'03.8” N, 98°28'57.3” E, alt. 2,200 m, 25 November 1999, fr., *M. Hara & M. Kanzaki D960* (**CMUB**16606!);– *ibid.*, 4 April 1925, fl., *Winit 1336* (**BKF**049588!, **E**01020029!, **K**!, **TCD**0016626!);– *ibid.*, 18°32'15” N, 98°39'26” E, alt. 2,029 m, 9 March 2019, lvs., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 5501* (**BKF**229764!, **TCD**!). **THAILAND**. **Northern, Chiang Mai**: Chom Thong, Doi Inthanon NP., alt. 1,762 m, 9 March 2019, lvs., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 5502* (**BKF**229760!, **TCD**!).;– *ibid.*, 18°31'25.89” N, 98°29'36.88” E, alt. 1,688 m, 6 November 2011, fr., *S. Tagane*, *H. Toyama*, *A. Naiki*, *H. Nagamasu*, *T. Yahara & M. Kanzaki T288* (**BKF**213062!, **FU**!). **VIETNAM**. **Annam, Bachma**: Ban Khwang, 16°12'49.0” N, 107°50'51.0” E, alt. 1,500 m, 8 August 1997, fr., *C. Phengklai 10532*

(**BKF**158610!);– **Bi Doup**: Haut Donnat, 12 October 1904, fr., *E. Poilane 30808* (**L**4192385†, **P**!);– **Hatinh**: Cam Xuyen, Kego Nature Reserve, 31 December 2008, fl., *D. Djendoel Soejarto DDS14281* (**P**00848932!);– **Lam Dong**: Mt. Langbian, Bi Doup Nui Ba NP., 12°02'50.3" N, 108°26'26.7" E, alt. 2,173 m, 27 March 2018, fl., *T. Yahara*, *H. Nagamasu*, *H. Toyama*, *M. Zhang*, *N. Ai*, *N.V. Ngoc*, *H.T. Binh & K. Tsuchiyaojin V8161* (**FU**!);– *ibid.*, Khanh Vinh, Son Thai Commune, Bi Doup Nui Ba NP., 12°06'00.91" N, 108°22'59.28" E, alt. 1,867 m, 24 April 2019, fr., *T. Yahara*, *S. Tagane*, *A. Nagahama*, *N. Komada*, *H.V. Thanh*, *N.C. Thinh V10053* (**FU**!);– Cong Troi, Bi Doup Nui Ba NP., 12°06'06.85" N, 108°23'00.32" E, alt. 1,866 m, 26 June 2018, lvs., *A. Nagahama*, *S. Tagane*, *K. Tsuchiya*, *V.N. Ngoc V9051* (**FU**!);– *ibid.*, 3 October 2018, fr., *S. Tagane*, *A. Nagahama*, *M. Zhang*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên V9454* (**FU**!);– *ibid.*, 27 June 2018, lvs., *A. Nagahama*, *S. Tagane*, *K. Tsuchiya*, *V.N. Ngoc*, *H.T. Binh*, *T.Q. Cuong*, *V.S. Dang V9135* (**FU**!);– *ibid.*, *V9453* (**FU**!);– *ibid.*, Dalat, Lac Duong, Da Chay, Bi Dup, Bi Doup Nui Ba NP., 12°05'N, 108°40'E, 21 March 1997, fl., *L. Averyanov*, *N.Q. Binh*, *& P.K. Loc VH 2973* (**P**03358317!);– **Nghe An**: Ky Son, Na Ngoi, Phu Kha village, Phu Xia Lai Leng Mountain, 23 October 2013, fr., *L. Averyanov*, *N.T. Hiep*, *N.S. Khang*, *N.A. Trang & L.H. Dang CPC 6035* (**P**00994010!);– **Thua Thien-Hue**: A Luoi, Hong Van, Talo village, 29 April 2005, fl., *L.V. Averyanov*, *P.K. Lôc*, *T.V. Thao*, *N.T. Vinh*, *T.M. Duc & N.T. Dung HAL7660* (**MO**15859†);– **Tonkin, Cao Bang,** Khai Son, Pia Houac, alt. 1400 m, 15 February 1931, *E. Poilane 19009* (**P**!);–**Lai Chau**: Tam Duong, Fan Si Pan, Hoang Lien NP., 22°21'04.3" N, 103°46'20.7" E, alt. 1,919 m, 28 April 2016, fl., *T. Yahara*, *H. Toyama*, *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *V.N. Nguyên*, *T.B. Hoang & T.S. Hoang V4552* (**BKF**!, **FU**!);– **Quang Ninh**: Hills between Mong Kai and Mong Lao, April 1929, fl., *F. Kingdon-Ward 8842* (**NY**02649992†);– *Vinh Phuc*: Tam Dao, Tam Dao NP., 5 May 2009, lvs., *J.Wen 10801* (**US**†);– **Sapa**: April 1944, fl., *P.A. Pételot 6159* (**VNM**00013192!);– *ibid.*, Toul Claire, August 1938, fl., *P.A. Pételot 6359* (**P**03342405!);– *ibid.*, Song Ta Van, alt. 1,700 m, August 1942, fr., *P.A. Pételot 8013* (**P**03342404!, **VNM**00013188!);– *ibid.*, alt. 1,500 m, April 1936, fl., *P.A. Pételot 6157* (**VNM**!).

Distribution.— E. Pakistan, N. India, Bangladesh, N. Myanmar, Taiwan, China (type), N. Thailand, N. Laos, and N. Vietnam (**Maps 4.20, 4.22 & 4.23**).

Vernacular name.— **China**: Xian Ye Gui Ying. **Thailand:** นูดหางต่อม Nuut Hang Tom.

Ecology.— Mixed deciduous, Dry Evergreen to Lower Montane Forest, in open areas, mountain valleys, streamsides, along trails or in the shade, alt. 50–2,800 m.

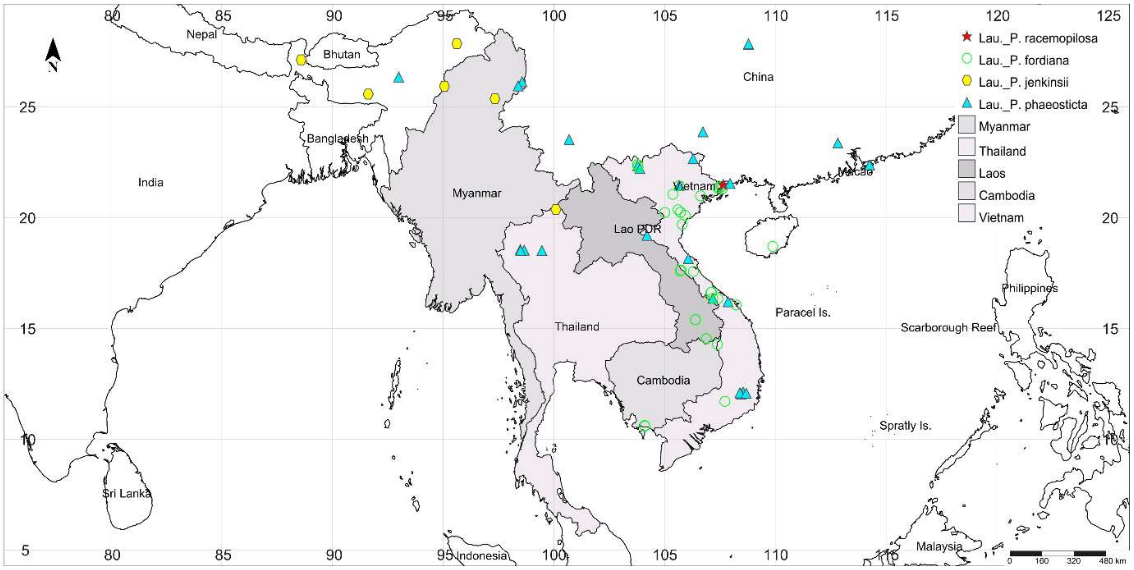
Phenology.— Flowering from March to June, fruiting from June to October.

Uses.— Not known.

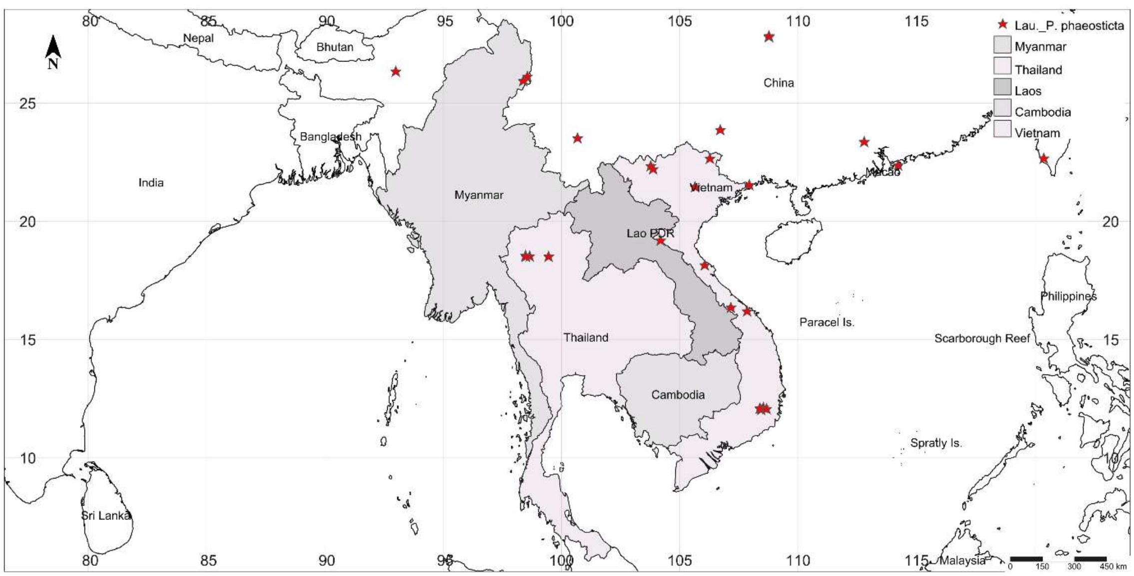
Conservation.—This species is known from many locations (> 10 locations): EOO = 3,475,009.49 km^2; AOO = 1,316.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note. — Rehder divided the species into three forms, differing in the incisions of leaf margin and the pubescence of the twigs: f. *phaeosticta*, leaves quite entire, twig glabrous; f. *lasioclada*, leaves entire or denticulate, on the same twig, twig short-villose; f. *dentigera*, leaves dentate, twig glabrous. I agree with Kalkman (1965) that these two characters' correlation is not as strict as supposed by Rehder. That is why Kalkman did not formally recognize any infraspecific entries.

Figure 4.9. *Prunus phaeosticta* (Hance) Maxim., vegetative and reproductive morphological characters; **A**, outer dark brown with reddish brown lenticels; **B**–**F**, leaves; **B**, young shoot, leaves reddish brown and conspicuous stipules; **C**, stipule, leaf-like, margin serrate; **D**, young, mature, and old leaves, alternate; **E**, glaucous abaxial, **F**, 2-basal glands, and conspicuous sparsely additional black dotted abaxial; **G**–**I**¸ inflorescence; **G**, flower bud with conspicuous bract; **H**, solitary raceme in the axil of leaf; **I**, open flowers, hypanthium yellowish inside, corolla distinctly different from calyx lobes; **J**–**L**, infructescence; **J**, young fruits; **K**, young fruits close up; **L**, mature fruits, ovoid-globose to ellipsoid. — Photos: A–G by Sukid; H & K by W. Khambai; J & L by S. Tagane. — Source: **Taipei**, I, source https://www.gbif.org/tools/zoom/simple.html access on 9 September 2022; **Thailand**, Chaing Mai, A–G, H & K from *S. Suddee et al. 5501*: **Vietnam**, Dalat, J & L from *S. Tagane et al. V10053*. Scale bar = 1 cm.



Map 4.22. Distribution of fordiana's group; *Prunus racemopilosa* (Vidal) Rueangr., J. Parn. & Hodk., *P. fordiana* Dunn, *P. jenkinsii* Hook.f. & Thomson, and *P. phaeosticta* (Hance) Maxim., respectively, of subg. *Laurocerasus* in continental Southeast Asia and nearby.



Map 4.23. Distribution of *Prunus phaeosticta* (Hance) Maxim. of subg. *Laurocerasus* in continental Southeast Asia and nearby.

21. ***Prunus fordiana* Dunn** in Journal of Botany. 45: 402. 1907; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 301. 1915; Cardot, in Flore Générale de L'Indo-Chine: 625–626, fig. 59: 623. 1920; J.E.Vidal, Adansonia 4: 1433. 1964; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus,* including those formerly referred to Pygeum: 43–44. 1965; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 179–181, pl. xxiii, 11–12. 1968; *ibid.*: 181–182, pl. xxiv, 1–3. 1968. Typification: **CHINA, Hongkong**, S. Kaungtung, Sanning, *Dunns Sammler 1329* (*non vidi*).

≡ *Lauro-cerasus fordiana* (Dunn) Browicz in Arboretum Kórnickie. 15: 6. 1970; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

≡ *Lauro-cerasus fordiana* (Dunn) T.T. Yu & L.T. Lu in Y.He & J.Y.Zhang Bulletin of Botanical Research. Harbin. 4(4): 44. 1984.

= *Prunus balansae* Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 301. 1915; Cardot, in Flore Générale de L'Indo-Chine: 625–626, fig. 59: 623. 1920.

≡ *Prunus fordiana* Dunn var. *balansae* (Koehne) J. E. Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 181–182, pl. xxiv, 1–3. 1968.

Typification**: VIETNAM, Tonkin, Sontay**, Wald zwischen, Tu-Phap and Bip, *Balansa 3391* (holotype, *non vidi*; isotypes **K**000737341!, **L**0019584–5!, **P**01819023–5!); paratypes, same locality, En-Theap, En Phap Bip, November 1888, *Balansa 3392* (**BR**0000025288896†, **BR**0000025288902†, **K**000737340!, **L**0019586†, **P**03357916!).

= *Prunus multipunctata* Cardot in Lecomte, Flore Générale de L'Indo-Chine 2: 626, fig. 59 (2: 623). 1920.

Typification **VIETNAM, Tonkin, Ninh Thai**, 21 August 1889, small tree 4–5 m tall, flowers white, *R.P. Bon 4213* (holotype **P**01819018!; isotypes **A**00032421–2†, **E**00991969!, **K**000737338–9!, **L**0019587–9†, **P**01819019–20!).

= *Prunus phaeosticta var. promecocarpa* Cardot in Lecomte Flore Générale de l'Indo-Chine. 5: 625. 1920.

Typification: **VIETNAM, Tonkin, Ninh Thai,** in the name “More Muou”, small tree 4 m tall, flowers white, 22 December 1888, *R.H. Bon 4070* (holotype; isotypes **BKF**!, **P**01819029–31!; paratypes, same locality, Muou Lang, 14 December 1886, *R.H. Bon 3319* (**K**!, **L**0019591†, **MUS**†, **P**01819026–8!).

= *Prunus phaeosticta* (Hance) Maxim. var. *ancyclocarpa* J.E.Vidal, Notulae systematicae. 13: 293. 1948.

Typification**: CAMBODIA, Cambodge**, rout to Bokor, Elephant Mountain, 500 m alt., 7 December 1933, tree 6 m tall., fr., drupes with styles, *E. Poilane 23266* (holotype **P**01819021!; isotypes **A**00032423†, **E**00991970!, **K**000737337!, **L**0019588†, **MUS**†, **P**01819022!, **VNM**00023517!).

= *Prunus phaeosticta* (Hance) Maxim. var. *dimorphophylla* J.E.Vidal, Notulae systematicae. 13: 293. 1948.

Typification: **VIETNAM, Annam, Danang** (Touran), Bana Mountain, Quang Nam-Da Nang, 1,400 m alt., 13 July 1923, Leaves spine-like margin serrate, drupe ob, *E. Poilane 7110* (holotype **P**01819032; isotypes **A**00032424!, **K**00737335!, **L**0019590!, L4193475!, **MUS**†, **P**01819033–4!).

= *Prunus balansae* Koehne var. *ilicifolia* J.E.Vidal, Notulae systematicae. 13: 294. 1948; Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 301. 1915.

Typification: **VIETNAM, Annam, Quang Tri**, An Long, Pirey, 18 Feb. 1919, in Herb, *M. de Pirey*, *Chevalier 40212* (holotype **P**01819035!; isotypes **K**000737336!, **MUS**†, **P**01819036–7!). Note: Mature leaves' spine-teeth margins, the length of inflorescence, and the shape of fruits are distinctive characteristics.

Description: Evergreen, understory, shrub to small tree 5–15 m tall, canopy shape oval. **Stem** clear bole, erect, dbh *c.* 15 cm in diameter; outer bark reddish-brown, smooth or shallowly furrowed with brown lenticels, spines absent; *inner bark* whitish-yellow, thin; strong almond smell. **Branchlets**: young twigs reddish-brown with brown lenticels, usually glabrous or sparsely hairy, terete, with few cataphylls at base; old twigs greyish-brown to dark brown. *Axillary winter bud* solitary, brown, ovoid, 2.5 mm long, apex acute, scale margins ciliate; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic to elliptic-oblong, 5–12 cm long × 2–4 cm wide; *lamina apex* acute, acuminate to caudate, angle acute; *margin* entire, revolute, hyaline, subentire to spine-like serrate, or teeth irregularly spaced, sinus rounded, apex glandular serrate, glabrous; *base* symmetrical or slightly asymmetrical, acute to cuneate; young leaves reddish-purple to light green, glossy dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous, glabrous; old leaves glabrous adaxially and abaxially; *basal glands* 2 (–4), up to 0.5 mm long, ovate to circular, flat or sometimes shallow concave, near or on the basal margins, abaxial scattered pellucid or purplish-black minutely punctate; *2° venation* weakly brochidodromous, 6–12 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially, obscure to prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate, inconspicuous when drying; *5° venation* reticulate, nearly invisible; *petioles* 0.5–1 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** small, 1–2 mm long × 0.8–1.2 mm wide, lanceolate to triangular, apex acute to acuminate, margin entire, base oblong, glabrous, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, in the axil of leaf, 3–9 cm long, *c.* 20-flowered, glabrous or sparsely hairy; *bracts* 1–3, different sizes, up to 5 mm long, brown, ovate, concave, glabrous, margin ciliate, soon caducous. **Flowers** bisexual or with a small to minute pistillodium, opening with mature leaves, white, fragrant;

pedicels slender, 3–10 mm long, glabrous; *bracteoles* ovate to triangular, concave, 2–4 mm long, whitish-green, glabrous, early caducous; *hypanthium* broadly cup-shaped, 1.5–2 mm long, whitish-green, glabrous; *calyx* lobes 5, ovate to triangular, minute, 1–2 mm long × 1–2 mm wide, subequal, apex subacute to obtuse, margin entire, ciliate, base truncate, separate or valvate in bud, spreading or incurved when mature, deciduous, glabrous outside, glabrous inside; *petals* white, spreading to decurved, 5, small, 3–4 mm long × 2–4 mm wide, subequal, 2–3 times as long as sepals, suborbicular, sessile to slightly unguiculate, apex rounded, margin entire to erose, base sessile to shortly unguiculate, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* 25–40 in 3 series, exserted; filament filiform, white, 3–4 mm long, glabrous; anthers subglobose, 0.3–0.5 mm long, white; *ovary* glabrous, green, 1 locular; *style* filiform, up to 4 mm long, as long as stamens to slightly shorter than stamens, glabrous; stigma peltate. *Infructescence* 2–9 cm long, glabrous, few, 1–6 fruited. **Fruits** fleshy, stipitate, 5–8 mm long, young fruit green, blackish-brown to black when mature or ripe, slightly oblique, elongate-ovoid, ovoid-globose to ellipsoid, 0.8–1.5 cm long, 0.6–0.8 cm wide, apex obtuse; young and mature fruits glabrous; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, very bitter, adnate to endocarp, dark purple to black, bitter taste; endocarp thin, slightly reticulately rugose; calyx deciduous. **Seeds** are somewhat triangular in cross-section, medium, and thin, with glabrous testa, shallowly reticulate, and endocarp glabrous inside (**Figure 4.10**).

Additional specimens examined.— **CAMBODIA**. **Cambodge**: Kaoh Touch, Elephant Mountain, Bokor NP., 10°36'18.59” N, 104°6'3.12” E, alt. 529 m, 20 December 2011, fl. & fr., *H. Toyama*, *S. Tagane*, *P. Chhang 2438* (**BKF**!, **FU**!);– *ibid.*, 10°37'40.22” N, 104°05'35.41” E, alt. 721 m, 12 December 2011, lvs., *H. Toyama*, *S. Tagane*, *T. Ide*, *P. Chhang*, *H. Nagamasu*, *T. Yahara 2430* (**BKF**!, **FU**!);– **Rotanah Kiri**: Sekong, Siem Pang, Ho Chi Minh Trail, Virachay NP., 14°17'23.59” N, 107°22'6.84” E, alt. 297 m, 17 December 2005, fl., *P. Thomas*, *Koun Theah*, *Thon Sokhn*, *Seth Teng*, *Srun Sokhon & Yan Bounsoeung 9*0 (**E**00220615!, **L**0407463†);– **Hainan**: Ling Shui, Chim Shan, 18°42'51.9” N, 109°51'52.0” E, alt. 932 m, 20 May 1932, fr., *H. Fung 20182* (**KYO**!). **LAOS**. **Southern, Attapeu**: Bolaven, 14°32'52.0” N, 106°52'01.0” E, alt. 449 m, 21 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3728* (**BKF**!, **RAF**!, **FOF**!);– *ibid.*, 14°33'01.4” N, 106°52'07.5” E, alt. 495 m, 21 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3742* (**BKF**!, **RAF**!, **FOF**!);– *ibid.*, 14°32'57.31” N, 106°51'59.28” E, alt. 520 m, 21 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3718* (**BKF**!, **RAF**!, **FOF**!);– *ibid.*, *op. cit.*, *L3731* (**BKF**!, **RAF**!, **FOF**!);– **Champasak**: Pak Song, Nong Laung village, Bolaven Plateau, 15°24'21.8” N, 106°22'44.4” E, alt. 1,030 m, 22 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3766* (**BKF**!, **RAF**!, **FOF**!);– **Kham Mouan**: Nakai Nam Theun NBCA, Phou Ak, Nam Om catchment, 17º36'37” N, 105º41'20” E, alt. 855 m, 23 May 2006, fl., *M.F. Newman*, *P. Thomas*, *K. Armstrong*, *V.*

Lamxay & K. Sendala LAO1256 (**BKF**183305!, **E**00310933!, **FOF**0002763!, **L**0812267!, **NUOL**0002316!);– *ibid.*, 17º38'33" N, 105°44'10" E, alt. 1,002 m, 22 May 2006, fl., *M.F. Newman*, *P. Thomas*, *K. Armstrong*, *V. Lamxay & K. Sendala LAO1409* (**BKF**183839!, **CMUB**32975!, **E**01020030!, **HNL**0002536!, **NUOL**0002319!, **P**03342403!, **TCD**!);– **Salavan**: Ban Baktheung, Bolaven Plateau, 15°24'16.9" N, 106°22'34.5" E, alt. 1,211 m, 23 February 2019, lvs., *P. Souladeth*, *S. Tagane*, *A. Sengthong*, *A. Nagahama*, *Y. Suyama & N. Ishii L2773* (**BKF**!, **FU**!);– *ibid.*, alt. 1,201 m, 22 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3751* (**BKF!**, **RAF**!, **FOF**!);– **Sekong**: Thateng, Bolaven Plateau, 15°24'28.9" N, 106°22'49.7" E, alt. 1,019 m, 22 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3785* (**BKF**!, **RAF**!, **FOF**!). **VIETNAM**. **Annam**: 25 November 1941, fl., *E. Poilane*, *s.n.* (**P**03357921!);– **Lam Dong**: Bao Lam, Loc Bac, 11°43'10.0" N, 107°42'30.0" E, 20 April 2013, fl., *M.S. Nuraliev 847* (**MW**0750247†);– *ibid.*, Bao Lam, Loc Bac, Bi Doup Nui Ba NP. 11°44'35.0" N, 107°42'05.0" E, 5 April 2013, fr., *A.N. Kuznetsov*, *S.P. Kuznetsova & M.S. Nuraliev 766* (**MW**0739618†);– **Quang Binh**: Dong Hoi, Phong Ke Bang NP., 17°34'35.4" N, 106°17'12.2" E, 25 March 2007, fr., *V.D. Nguyên*, *X.P. Vu*, *T.C. Nguyên*, *R.P.J. Kok*, *T.M.A. Utteridge*, *M. Trudgen & M. Briggs HNK2167* (**K**! **IBER**†);– **Thanh Hoa**: Ninh Thai, Miou Lang, 19°42'22.4" N, 105°46'47.4" E, 22 December 1888, fl., *R.P. Bon 4070* (**BKF**049730!, **P**01819029-31!);– **Tonkin**: 1 January 1883, fl., *R.P. Bon 6163* (**E**00991968!, **K**!, **L**1902766†, **MUS**†);– *ibid.*, 27 December 1887, fl., *B. Balansa 4333* (**K**!, **P**03357905!);– **Bhua-Thien**: Hong, December *s.n.*, fl., *Herbier Eberhard 2431* (**L**0019587†, **P**03357886!);– **Sapa**: Lao-Kai, alt. 1,500 m, 27 October 1963, fl., *T. Przybylski 142* (**E**00991989!);– **Dam Ha**: Sai Wong Mo Shan Lomg Ngong village, 21°24'19.6" N, 107°33'08.6" E, 18 July 1940, fl.: *W.T. Tsang 30337* (**BKF**049713!, **E**00991984!, **K**!, **L**1902768†, **P**03357894-5!);– *ibid.*, *op. cit.*, *W.T. Tsang 30397* (**K**!, **L**1902772†);– *ibid.*, *op. cit.*, *W.T. Tsang 30408* (**E**00991986!, **K**!, **L**1902773†);– *Doi Ngang*: Chong, 8 December 1885, fl., *R.P. Bon 3087* (**P**03357913!);– **Haiphong**: Ha-Coi, Chuk-phai, Taai Wong Mo Shan, 15 September 1939, fr., *W.T. Tsang 29519* (**L**1902770†, **P**03357889!);–*ibid.*, Sortay, Ti Phap village, 21°03'44.8" N, 105°21'38.5" E, 8 December 1940, fl., *P.A. Pételot 6673* (**K**!, K!, **MUS**†, **P**03357908!, **VNM**000013183-4!);– **Ninh Binh**: Tam Diep, Cho Ganh, Giap village, 20°06'49.4" N, 105°54'28.2" E, March, fr., *P.A. Pételot 809* (**VNM**!);– *ibid.*, Cuc Phuong NP, 20°15'0" N, 105°42'0" E, 14 December 1988, fl., *N.M. Cuong 14* (**P**00939029!);– *ibid.*, Nho Quan, Cuc Phuong NP, 20°14'13.2" N, 105°00'00.0" E, 16 December 1999, fl., *N.M. Cuong*, *H.L. Quyen & M.V. Sinh 756* (**L**4192074);– *ibid.*, 20°15'06.0" N, 105°42'31.0" E, alt. 1,000 m, 14 December 1998, fl., *N.M. Cuong*, *H.L. Quyen & M.V. Sinh 8* (**L**4208025†, **MO**1795397†, **P**03357929-30!);– *ibid.*, 20°21'48.0" N, 105°35'21.0" E, 14 November 2000, fl., *N.T. Hiep 4239* (**L**4207901†, **L**4208076†);– Ninh Thai, 21°27'14.8" N, 105°38'38.4" E, 29 March 1887, fr., *R.P. Bon 3367* (**P**03357913!);– **Quang Ninh**: Dam Ha, Lomg Nogong village, 21°18'33.6" N, 107°35'15.0" E, 9 July 1940, fr., *W.T. Tsang 30464* (**BKF**049712!, **E**00991985!, **K**!, **L**1902771†);– *ibid.*, **Son Tay**: Da Chang, 21°03'44.8" N, 105°21'38.5" E, 23 February 1936, fr., *P.A. Pételot 5700* (**K**!, **P**03357907!, **US**1717095†);– *ibid.*, Mont

Bai, 21°03'44.8” N, 105°21'38.5” E, alt. 700 m, 25 November 1940, fl., *P.A. Pételot 6657* (**K**!, **L**1902767†, **VNM**00013181!);– **Thanh Hoa**: Ninh Thai, Miou Lang, 19°42'22.4” N, 105°46'47.4” E, 2 March 1886, fl., *R.P. Bon 3285* (**BKF**049732!, **P**03357912!);– **Thua Thien-Hue**: route Arenes to Hue, 25 January 1945, fr., *J.E.Vidal 22A* (**P**03357922!);– *ibid.*, route Gia Long to Hue, 29 January 1945, fr., *J.E.Vidal 20A* (**P**03357924!);– *ibid.*, alt. 1,000 m, 29 January 1945, fr., *J.E.Vidal 19A* (**P**03357925!);– **Tien Yen**: Kau Nga Shan, Taai Wong Mo Shan, and vicinity, 21°19'19.6” N, 107°23'39.5” E, alt. 1,310 m, 7 October 1940, fr., *W.T. Tsang 30528* (**BKF**049705!, **E**00991990!, **K**!, **L**1902769†, **P**03357890!);– *ibid.*, 21°22'46.4” N, 107°25'02.7” E, 16–22 October 1940, fr., *W.T. Tsang 27006* (**E**00991988!, **K**!);– *ibid.*, 15 September 1940, fr., *W.T. Tsang 23519* (**E**00991983!, **K**!).

Distribution.— Laos, Cambodia, Vietnam, S.to SE. China (Kwangsi, Kwangtung, Hainan) (**Map 4.20, 4.22 & 4.24**).

Vernacular name. **— China**: Hua nan gui ying.

Ecology.**—** Forest, slopes, foothills, river banks, open or shady areas, Dry Evergreen to Lower Montane Forest, alt. (300–)600–1,800 m.

Phenology.**—** Flowering from March to July, fruiting from August to December.

Uses.— Not known.

Conservation.— This species is known from many locations (> 10 locations): EOO = 1,273,771.58 km^2; AOO = 128.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note. — Vidal (1964) distinguished three varieties; according to him, var. *balanse* differs from var. *fordiana* in having larger leaves with a well-marked acumen and extra marginal glands. However, the material I have seen during my field trips does not permit such a subdivision; leaf-variation is continuous, and there are both entire and serrate leaves (dimorphic). I have not, therefore, formally recognized any infraspecific entry. But var. *racemopilosa* is clearly distinguished from typical *Prunus fordiana*. Therefore, I have decided to separate this species: *Prunus racemopilosa* (J.E.Vidal) Rueangr., J.Parn. & Hodk., *stat. nov*.

The main difference with the related *P. phaeosticta* is found in the fruits: those of *P. fordiana* are ovoid or ellipsoid (vs. subglobular to transversely ellipsoid). When flowering, *P. fordiana* can be distinguished by the 3-5 *involucral bracts* (bud-scales) at the base of the racemes, which are always absent in *P. phaeosticta*, or with 1-large leaf-like bract at the base of the raceme.

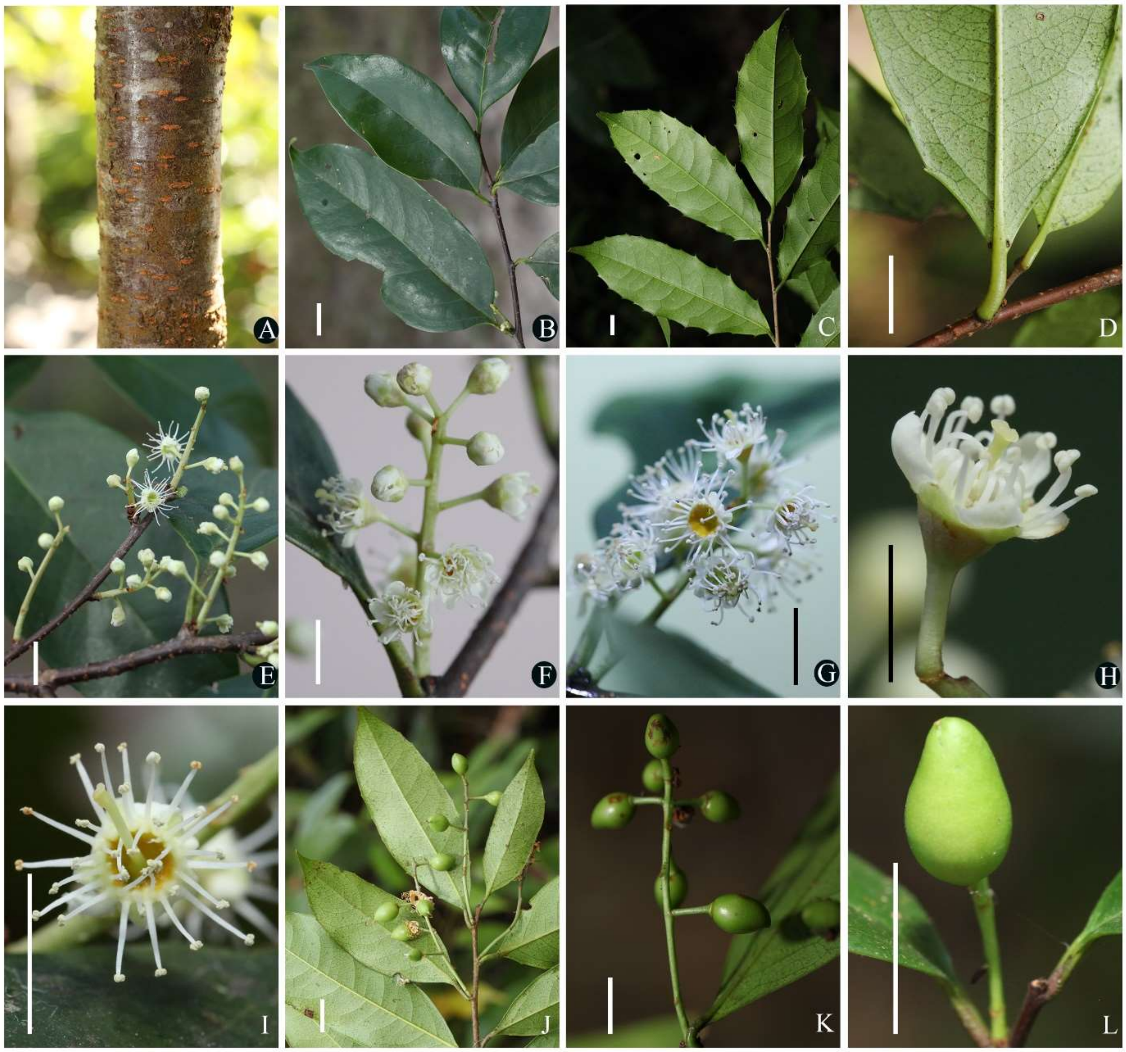
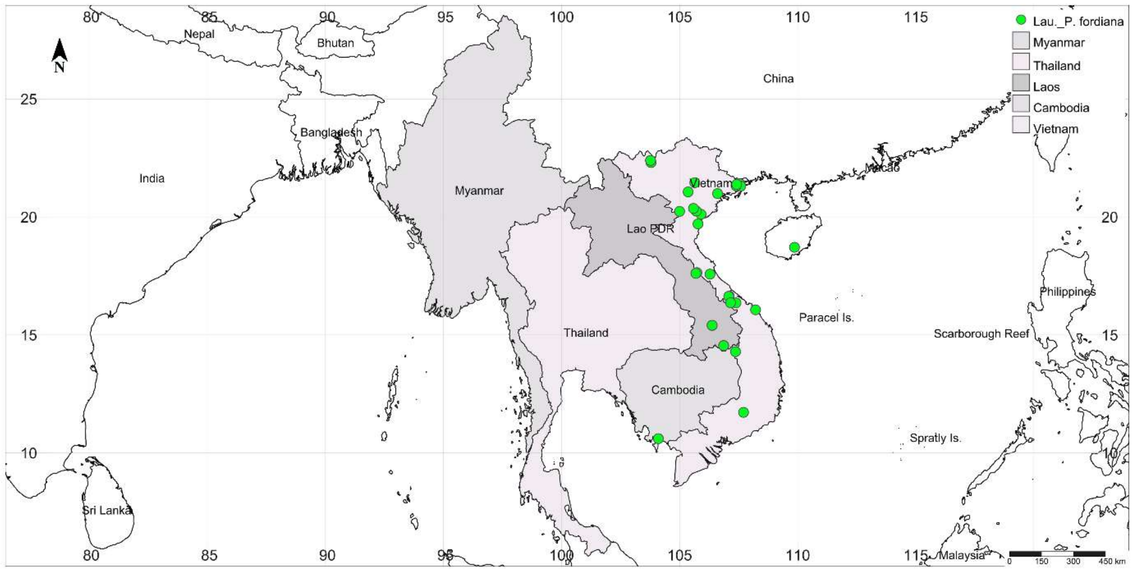


Figure 4.10. *Prunus fordiana* Dunn, vegetative and reproductive morphological characters; **A**, bark, conspicuous horizontal lenticels; **B–D**, leaves; **B**, margin entire; **C**, margin serrate; **D**, 2-basal glands, and sparsely additional black dotted abaxially; **E–G**; inflorescence, solitary raceme, **E**, in axil of leaf or on the fallen leaves branch; **F**, flowers opening and flower buds; **G**, frontal view hypanthium yellowish to orange inside; **H**–**I**, flower; **H**, lateral view showing corolla distinctly different from calyx lobes; **I**, stamens arrangement series; **J**–**L**¸ fruiting; **J**, young fruits; K, mature fruits; L, fruit obovate. — Photos: all by S. Rueangruea. — Sources: all from **Laos**, *P, Souladeth, et al.*; Attapeu, A, B, I–L form *L3718*; Salavan, C & D form *L 3751*; Sekong, E–I from *L3785*. Scale bar = 1 cm.



Map 4.24. Distribution of *Prunus fordiana* Dunn of subg. *Laurocerasus* in continental Southeast Asia.

22. ***Prunus racemopilosa*** **(J.E.Vidal) Rueangr., J.Parn. & Hodk.,** ***stat. nov*****.,** ***ined*****.**

≡ *Prunus fordiana* Dunn. var. *racemopilosa* J.E.Vidal, Adansonia n. s. 4 (fasc.1): 144. 1964; *ibid*., Flora du Cambodge, du Laos et du Vietnam 6: 182, pl. 24, 4–5: 187. 1968.

Typification**: VIETNAM, Tonkin, Mon Cay**, Ha Coi, Chuk-Phai, small tree 7 ft. Woody, common. Growing in a thicket on the sand. Flowers white, fragrant., Taai Wong Mo Shan and vicinity, 1 November 1936, fl., *W.T. Tsang 27163* (holotype **P**03357887!; isotypes **E**00991991!, **K**000737234!, **L**0019592†).

Description: Evergreen, shrub 2.5 m tall, understory, canopy shape oval. **Stem** clear bole, erect; outer bark reddish-brown, smooth or shallowly furrowed with brown lenticels, spines absent; *inner bark* whitish-yellow, thin; strong almond smell. **Branchlets** moderate, reddish-brown with light brown lenticels; young twigs reddish-brown with brown lenticels, usually glabrous or sparsely hairy, terete, with few cataphylls at base; old twigs greyish-brown to dark brown. *Axillary winter bud* solitary, brown, ovoid, 2.5 mm long, apex acute, scale margins ciliate; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, oblong, elliptic-oblong, 12–18 cm long × 2–5 cm wide; *lamina apex* acuminate, angle acute; *margin* entire, revolute, hyaline, subentire to spine-like serrate, teeth irregularly spaced, sinus rounded, apex glandular serrate, glabrescent; *base* symmetrical or slightly asymmetrical, subacute or rounded; young leaves pale green, glossy dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous, glabrous; old leaves glabrous, glabrescent adaxially, glabrescent abaxially; *basal glands* 2 (–4), up to 0.7 mm long, ovate to circular, flat or sometimes with shallow concave abaxially, over the base of leaf blade margin, near the midrib, abaxial scattered pellucid or purplish-black minutely punctate; *2° venation* weakly brochidodromous, 10–15 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles*, 0.2–0.6 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** small, 1–2 mm long × 0.8–1.2 mm wide, lanceolate to triangular, apex acute to acuminate, margin entire, base oblong, glabrous, early caducous. **Inflorescences** compound, solitary raceme, dense-flowered, in the axil of leaf, 2–3 cm long, up to 10-flowered, densely pilose; *involucral bracts* 6–10, triangular to boat-shaped, various sizes and shapes, lowest tri-partite, up to 4 mm long, sparsely brown hairy outside, glabrescent inside, margin yellowish-grey ciliate, present at anthesis. **Flowers** bisexual, opening with mature leaves, white; pedicels stout and short, 1–3 mm long, pubescent; *bracteoles* ovoid to boat-shaped, concave, up to 5 mm long, whitish-green, densely pilose whitish-brown hairs, margin ciliate, caducous after anthesis; *hypanthium* broadly cup-shaped to campanulate, 1.5–3 mm long, whitish-green, densely pubescent outside, hairy at the base, otherwise glabrous inside; corolla distinctly different from calyx lobes; *calyx* lobes 5, ovoid to subtriangular, minute, 1–1.5 mm long × 1–1.5 mm wide, subequal, apex rounded to subacute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, densely hairy outside, glabrescent inside; *petals* white, spreading to upright, 5, small, 2–3 mm long × 2–4 mm wide, subequal, 2–4 times as long as sepals, suborbicular, sessile to slightly unguiculate, apex rounded, margin entire to erose, base sessile to shortly unguiculate, alternate with calyx lobes, glabrescent outside, glabrescent to glabrous inside; *stamens* 25–32 in 3 series, exserted; filament filiform, white, 3–4 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers subglobose, 0.3–0.5 mm long, white; *ovary* glabrous, hairy around point of insertion, green, 1 locular; *style* filiform, up to 4 mm long, as long as stamens to slightly shorter than stamens, usually glabrous or sometimes sparsely hairy; stigma peltate. **Fruits** unknown.

Additional specimens examined.— Not known.

Distribution.— Endemic to N. Vietnam, Tonkin (known only from the specimens cited) (**Maps 4.20, 4.22 & 4.25**).

Vernacular name. — Not known.

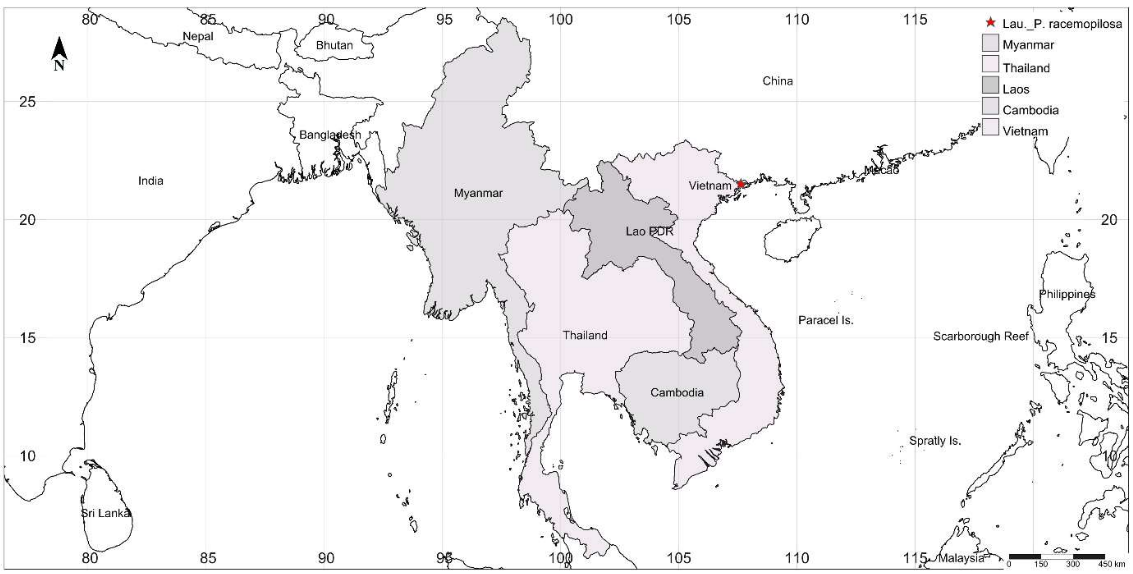
Ecology.— Coastal furrows on sandy substrates. In open areas, on the sand., alt. ca. 1,000 m.

Phenology.— Flowering from December, fruiting unknown.

Uses.— Not known.

Conservation.— The species is endemic to Northern Vietnam, known only for one location. The number of individuals in the population is small, The number of mature individuals < 50. I consider the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1 (IUCN, 2019).

Note.— *Prunus racemopilosa* is somewhat similar to *P. fordiana* var. *balance* (serrate leaf form), J.E.Vidal (1964), in its leaf blade covered with black dots abaxially, serrate leaf margins and racemes subtended basally by involucral bracts. However, it is distinguished from *P. fordiana* its narrower leaves (vs. wider leaves), shorter petiole, 0.2 – 0.6 cm long (vs. longer petiole r, 0.5 – 1 cm long)., racemes densely covered with hairs (vs. racemes glabrous), involucral bracts 5 -- 10 persistent at anthesis (vs. involucral bracts 3 – 5, early caducous at anthesis.). *Prunus racemopilosa* is also somewhat similar to *P. spinntosa* Sieb. & Zucc. var. *pubiflora* Koehne (= *P. limbata* Card.) in its hairy inflorescence, with the latter variety having non-punctate leaves and glands.



Map 4.25. Distribution of *Prunus racemopilosa* (Vidal) Rueangr., J. Parn. & Hodk. of subg. *Laurocerasus* in continental Southeast Asia.

23. ***Prunus zippeliana* Miq**., Flora van Nederlandsch Indie. 1(1): 367. 1855. Cardot, in Flore Générale de L'Indo-Chine: 622, 624, fig. 59: 623. 1920; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to *Pygeum*: 44–47. 1965; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 176–177, pl. xxiii, 7. 1968; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 351. 1993; *ibid.* 11(2): 351. 1993; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003. Typification: Java, *Zippel*, *s.n.* (holotype **L**0019700†. sheet nr. 908.202-880; isotype **L**0931114†).

≡ *Laurocerasus zippeliana* (Miq.) Browicz, in Arboretum Kórnickie. 15: 6. 1970.

≡ *Laurocerasus zippeliana* (Miq.) T.T. Yu & L.T. Lu, in Y.He & J.Y.Zhang Bulletin of Botanical Research. Harbin. 4(4): 49. 1984; Lu Lingdi. et al., in Flora of China 9: 1–494. 2003.

= *Prunus macrophylla* Siebold & Zucc., Abhandlungen der Mathematisch-Physikalischen Classe der Königlich Bayerischen Akademie der Wissenschaften. 4(2): 122. 1845, *nom.*on Poir.

in Lamk. 1816; Miq., Annales Musei Botanici Lugduno-Batavi 2: 91. 1865; Koidz., Journal of the College of Science, Imperial University of Tokyo 34(2): 291. 1913; Kohne, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 303. 1915, Card., Notulae Systematicae. Herbier du Muséum de Paris. 4: 23. 1920; Cardot, in Flore Générale de L'Indo-Chine: 622–624, fig. 59: 623. 1920; Nakai, Journal of the Arnold Arboretum 5: 78. 1924; Kaneh Formos. Tree, 2nd ed. 270, f. 218. 1936; Li, Woody Flora of Taiwan. 283. 1963.

Typification**:** **JAPAN**, *Bürger H. & Siebod*, *s.n.* (holotype **L**0329088!; isolectotypes **HBG**511297!, **M**0154001–2!), designated by Hideaki Ohba & Shinobu Akiyama, 21 August 2013.

≡ *Laurocerasus macrophylla* (Siebold & Zucc.) C.K.Schneid., Illustriertes Handbuch der Laubholzkunde. 1: 647. F. 355. 1906, *nom. nud.*

= *Pygeum oxycarpum* Hance, Journal of Botany, British-and Foreign. London 8: 242. 1870.

Typification**: CHINA, Canton**, Southern province, Pakwan Mountains, flowering in October, fruiting on April, 22 September 1873, *G.T. Sampson & H.F. Hance 16424* (holotype **BM**000622022!; isotypes **GH**00032442†, **K**000737230!, **P**01819088–90!).

≡ *Prunus oxycarpa* (Hance) Maxim. in Eggers Bulletin de l'Académie Impériale des Sciences de Saint-Pétersbourg. 3: 29. 1883.

≡ *Laurocerasus macrophylla* var. *oxycarpa* (Hance) C.K. Schneid., Illustriertes Handbuch der Laubholzkunde. 1: 647. F. 355. 1906.

= *Prunus macrophylla* var. *puberifolia* Koehne, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 304. 1915.

Typification**: CHINA**, Western China, Tree 30 ft. tall, 1 May 1940, *E.H. Wilson 2540*, *non vidi*; 610 m alt., *E.H. Wilson 4071* (isosyntype **HBG**510960†).

= *Prunus macrophylla* var. *sphaerocarpa* Nakai, Journal of the Arnold Arboretum 5: 78. 1924.

–*Prunus zippeliana* var. *sphaerocarpa* (Nakai) Hisauchi, *ibid.*; Makino, Ill. Flora of Japan, 2nd ed. 442, f. 1326 ('Dippeliana'), 1954, include var. infra-velutina Makino, *ibid.*, *nom. inval.*

Typification**: JAPAN, Nagasaki**, 1863, *C.J. Maximowicz*, *s.n.* (lectotype **GH**00032501†, designated by Nakai, 1924; isolectotypes **L**0019699†, **P**01819091–5!).

= *Prunus bakti* Hisauti, in Tsumura Kenkyujo, Journal of Japanese Botany. 12: 55. 1936.

Typification: (holotype, *non. vidi*., no isotype seen.).

= *Prunus kanehirai* Hayata ex Hisauti, in Tsumura Kenkyujo, Journal of Japanese Botany. 12: 54. 1936; Kaneh., Formos. Trees, 2nd ed. 708. 1936. Typification: **TAIWAN**, *Kanehira*, *s.n.* (holotype **TI**, *non. vidi*., no isotype seen).

= *Laurocerasus zippeliana* var. *angustifolia* T.T. Yu & L.T. Lu, in Y.He & J.Y.Zhang Bulletin of Botanical Research. Harbin. 4(4): 49. 1984.

Typification: **CHINA, Shunning**, Hila, 1,700 m alt., tree 20–30 ft. tall, flowers white, raceme, common, *T.T. Yu 16381* (lectotype **PE**, designated by T.T. Yu & L.T Lu, 1984, *non vidi*.; isolectotype **A**00136013†).

Description: Evergreen, understory to sub-canopy, small tree to tree 20(–30) m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark whitish-and reddish-brown, smooth with shallow dipple marks, spines absent; *inner bark* yellowish-brown; strong almond smell. **Branchlets** stout, whitish-brown with light brown lenticels; young twigs greenish, with white lenticels, glabrous, with 3 to 4 small cataphylls at base; old twigs greyish-brown with brown lenticels. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic oblong to elliptic-ovate, 8–19 cm long × 2.5–6 (–8) cm wide; *lamina apex* acute to acuminate, angle acute; *margin* glandular-serrate, sparsely serrate to dentate, revolute, teeth irregularly spaced, sinus angular, glabrous; *base* asymmetric sometimes slightly so, acute, rarely obtuse; young leaves pale green, glossy green adaxially, pale green abaxially, turning yellow before falling, thick, coriaceous; young leaves glabrescent to glabrous; old leaves glabrescent to glabrous, or rarely pubescent, glabrous abaxially; *basal glands* 2 (–3), up to 1.5 mm long, ovate-oblong, short stalk-like glands usually large and distinctly protruding, very rarely wanting, on upper or lateral surface of petiole, margin glandular-serrate; *2° venation* weakly brochidodromous, 7–11 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate, inconspicuous when drying; *5° venation* widely reticulate, inconspicuous when dried; *petioles* 0.8–2 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* present, 2(–3) glands, 1 × 0.5 mm in diameter, stalk-like glands, usually large and distinctly protuding. **Stipules** medium, 6–10 mm long × 1–1.5 mm wide, linear, apex acuminate, margin entire, base oblong, glabrous outside, inside with some hairs on the bottom of midrib slightly keeled, usually entire, sometimes glandular margins, early caducous. **Inflorescences** compound, solitary raceme, or with 2–4 fasciculate racemes, dense-flowered, in leaf axils, on the fallen leaf branchlets, or in axils of cataphylls at base of the shoot, 1.5–12 cm long, > 15 to many-flowered, pubescent; *bracts* 1–3, up to 2 mm long, hairy outside, sub-glabrous inside, lower fertile ones often with tridentate apex, margin ciliate, soon caducous. **Flowers** bisexual, opening with mature leaves, white, 3–5, 5–8 flowers; pedicels stout, 1–4 mm long, pubescent; *bracteoles* ovate to semi–circular, apex with 3 lobes, 1–3 mm long, greenish-brown, pubescent, early caducous; *hypanthium* cup-shaped, *c.* 2 mm long, pubescent (to glabrescent) outside; corolla distinctly different from calyx lobes; *calyx* lobes (4–)5, triangular to suborbicular, minute, 0.6–1.5 mm long × 0.6–1.2 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, tomentose, at least at apex outside, densely hairy inside; *petals* white, spreading to decurved, 5, medium, 2–3(–4) mm long × 2–4 mm wide, subequal, 2.5–3 times as long as sepals, more or less orbicular, sessile, apex rounded, margin usually distinctly ciliate, base sessile to shortly unguiculate, alternate with calyx lobes, sparsely pubescent to glabrescent outside and inside; *stamens* 18–30 in 3 series, exserted; filament filiform, white, 3–4 mm long, glabrous; anthers globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, up to 4 mm long, as long as stamens, glabrous; stigma discoid. *Infructescence* 2–12 cm long, sparsely tomentose to glabrous, few, 1–4 fruited. **Fruits** fleshy, stipitate, 2–3 mm long, young fruit green, black via red and reddish-purple when ripe, ellipsoid to ovoid, rarely subglobose, 1.7–2 cm long, 0.7–1 cm wide, apex acute to obtuse; young fruits glabrescent to glabrous; mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple, smelling like bitter almond when crushed; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal furrows or ridged, canaliculate; calyx deciduous; style present, peaked or apiculate up to 1.5 mm long. **Seeds** are usually transversely globose, thin, testa glabrous, and reticulate (**Figure 4.11**).

Additional specimens examined.— **CHINA**. **Pakwan**: alt. 1,200 m, April *s.n.*, fr., *G.T. Sampson & H.F. Hance 16424* (**P**01819088–90!). **INDIA**. **Assam**: Hmuntha, Lushai hills, 5 April 1951, fl. & fr., *Thakur Rup Chand 4366* (**L**†). **JAPAN**., 17 October 1999, fl., *T. Kobayashi 34263* (**KYO**!);– **Kagoshima**: Kamikoshiki island, 31°49'54.21” N, 109°52'10.19” E, alt. 188 m, 7 November 2019, fl., *S. Tagane 1225* (**BKF**!, **FU**!);– **Honshu**: Aichi, Chita-hanto, Chita-gun, alt. 69 m, 24 September 1979, fl., *G. Murata 41397* (**KYO**!);– *ibid.*, Chiba, Aira-gun, 35°12'32.2” N, 140°05'20.4” E, alt. 85 m, 11 May 1976, fl., *H. Ohashi & Y. Tateishi*, *s.n.* (**KYO**!);– *ibid.*, Kashima, Tanake Bay, 36°01'37.4” N, 140°36'11.5” E, alt. 53 m, 7 April 1965, fr., *Sino Kita*, *s.n.* (**KYO**!);– *ibid.*, **Hyogo**: Nandan-cho, alt. 350 m, 14 September 1998, fl., *Shigeki Nanko 167* (**KYO**!);– *ibid.*, Sumoto, 34°17’N, 134°53’E, alt. 274 m, 2 November 1998, fl., *N. Fukuoka*, *N. Kurosaki & S. Miyake 1132* (**KYO**!);– *ibid.*, alt. 274 m, 2 October 1998, fl., *S. Miyake 6541* (**KYO**!);– Hyogo, Sumoto, Inohana valley, alt. 400 m, 22 January 2012, fr., *T. Kobayashi*, *s.n.* (**KYO**!);– Ibaraki, Kashima, Hondo, 7 April 1965, fr., Sius Ket, *s.n.* (**KYO**!);– Kyoto, Sakyo-ku, Kitachirakawa, 35°01'40.2” N, 135°47'09.6” E, alt. 85 m, 25 April 1991, fr., *N. Fugita & I. Kojima 246* (**KYO**!);– Nagasaki, April 1863, fl. & fr., *C.J. Maximowicz 1863* (**P**01819091–95!);– *ibid.*, *C.J. Maximowicz*, *s.n.* (**P**01819091!);– **Ohsumi**: Yaku-shima, Kyushu, 30°22'57.5” N, 130°26'07.3” E, alt. 171 m, 19 September 1978, fl., *M. Furuse 1327* (**KYO**!);– **Ryukyu**: Okinawa, 26°22'33.5” N, 127°48'22.7” E, alt. 48 m, 2 November 1973, fl., *M. Furuse 4474* (**BKF**109283!). **MYANMAR**., January, fl., *H. Buchanan 72* (**K**!);– July 1916, lvs., *Seruy Jack 159* (**E**00901050!);– May *s.n.*, fr., *H. Buchanan*, *s.n.* (**K**!);– **Upper Burma, Inohlaiy**: alt. 233 m, 24 January 1927, fr., *Eield 4905* (**RAF**1348!);– **Upper Burma, Kachin**: Myikyina, alt. 500 m, April 1909, fr., *E.M. Buchanan 7* (**E**00072289!, **RAF**2268.A2144!);– *ibid.*, March 1909, fl., *E.M. Buchanan 40* (**E**00072290!);– *ibid.*, Sima hill, 30 November 1910, fl., *E.M. Buchanan, s.n.* (**E**00901030!, **E**00901051!, **E**00072286–88!);– *ibid.*, Kachin hill, 20 May 1898, fr., *Shaik Mokim*, *s.n.* (**K**000737190!). **THAILAND**. **Northern, Chiang Mai**: Mae Taeng, Ban Mae Mam, alt. 1,050 m, 2 November 1990, fr., *J.F. Maxwell 90-1310* (**E**01020020!, **L**4207724†);– *ibid.*, Ban Bah Bae, 19°09'08.1" N, 98°54'15.6" E, 6 November 1990, fl., *J.F. Maxwell 90-1220* (**L**4207739!);– *ibid.*, Op village, 19°11'53.6" N, 98°48'04.5" E, alt. 725 m, 17 November 2004, fl., *J.F. Maxwell 04-714* (**BKF**158904!, **CMU**B24482!, **L**4193502†, **L**4193504†, **L**4198834†);– *ibid.*, Mae Lao-Mae Sae WS., 19°11'54.1" N, 98°40'48.3" E, alt. 731 m, 27 February 2014, fl., *S. Suddee*, *S. Rueangruea*, *W. Kiewbang*, *C. Hemrat & P. Pansamrong 4640* (**BKF**208601!);– *ibid.*, Chom Thong, Khun Wang, 18°36'49.9" N, 98°30'31.7" E, alt. 900 m, 3 January 1931, fr., *A.F.G. Kerr 4734* (**BKF**!, **BM**!, **K**!);– *ibid.*, lvs., *A.F.G. Kerr 4720* (**BM**!);– *ibid.*, Chiang Dao, Doi Chiang Dao WS.: 19°25'N, 98°55'E, alt. 1,425 m, 5 December 1965, fl., *E. Hennipman 3233* (**BKF**049589!, **K**!, **L**1904427†, **P**03358878!);– *ibid.*, 19°22'27" N, 98°50'50" E, alt. 1,200 m, 13 November 1963, fl., *K. Bunchuai 1324* (**BKF**049590!, **KYO**!, **L**1904428†);– *ibid.*, Mae Wang, Maewin, Hmong village, 8°04'46.1"N, 98°40'42.4"E, alt. 989 m, 10 March 2005, fr., *J.F. Maxwell 05-210* (**BKF**159396!, **L**4198834†, **QBG**!);– **Chiang Rai**: Mae Sai, 20°17'18" N, 99°48'37" E, alt. 996 m, 22 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR144* (**BKF**229740!, **TCD**!);– *ibid.*, Doi Tung, 20°17'23.4" N, 99°48'35.1" E, alt. 965 m, 5 December 2019, fr., *S. Rueangruea*, *T. Thananthaisong & P. Uea-Ari SR243* (**BKF**229820!, **TCD**!);– **Lampang, Mueang Pan**: Mae Jam village, 18°20'00.0" N, 99°52'00.0" E, alt. 1,025 m, 18 December 1996, fl., *J.F. Maxwell 96-1668* (**BKF**108540!, **CMUB**!, **L**4208147†);– *ibid.*, Chan village, Jae Son NP., 18°20'00.0" N, 99°52'00.0" E, 9 January 1996, fr., *J.F. Maxwell 96-51* (**BKF**108556!, **L**4183485-6†);– **Nan**: Pua, Doi Phu Kha NP., 19°11'00" N, 101°05'46" E, alt. 1,595 m, 25 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR161* (**BKF**229996!, **TCD**!);– **Western, Kanchanaburi**, Thong Phaphum, Chalae: 14°53'38" N, 98°48'29" E, alt. 614 m, 19 April 2019, fl., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari*, *T. Chaowasku*, *A. Danthongdee*, *N. Hathai & W. Kaewmongkul SR206* (**BKF**229803-4!, **TCD**!);– *ibid.*, 14°53'38" N, 98°48'29" E, alt. 614 m, 12 January 2019, fl., *S. Rueangruea*, *A. Rueangruea & A. Veesommai SR255* (**BKF**229845!, **TCD**!). **VIETNAM**. **Tonkin**, 1 March 1882, fr., *M. Bon 1448* (**P**03358847!);– April 1917, fl. & fr., *R.P. Bon 5761* (**E**01020021!, **K**!, **L**1904373†, **P**03358845!);– **Sapa**: alt. 1,500 m, 25 July 1941, fl., *P.A. Pételot 6931* (**K**!, **P**03358844!, **VNM**00013212!);– *ibid.*, 15 March 1882, fl., *R.P. Bon 1846* (**P**03358841!, **P**03358849!);– *ibid.*, July 1930, fl., *P.A. Pételot 6165* (**P**03358843!);– *ibid.*, Bidoup Lamdong, alt. 1,500 m, August 1930, fl., *P.A. Pételot 6162* (**P**03358842!, **VNM**!);– **Hao Binh**: Mai Chau, Pa Co village: 20°30'00.0" N, 104°55'00.0" E, 16 July 1996, fr., *D.D. Soejart*, *T.N. Ninh*, *N.T. Hiep & H.Q. Binh 9672* (**L**4182977†, **US**3333828†);– *ibid.*, alt. 1,235 m, 21 September 2005, fr., *V.X. Phuon*, *N.V. Du, N.T. Coung*, *D.T. Xuye*, *Rogier de Kok G. Bramley*, *Challe Gill*, *N.M. Vorontsova & A. Davis HNK686* (**K**! **IBER**†);– **Lao Cai**: Sapa, Hdam Rong Mt., September 2009, fl., *s.coll.*, *s.n.* (**ITA**406†);– **Ninh Binh**: Cuc Phuong NP: Mac village, December 2009, fl., *s.coll.*, *s.n.* (**ITA**†);– *ibid.*, alt. 250 m, 23 November 2001, fl., *N.M. Coung 1587* (**L**4183780†);– *ibid.*, 27 October 2000, fl., *N.M. Cuong*, *D.T. Kien & M.V. Sinh NMC1192* (**P**03358850!);– *ibid.*, 3 January 2001, fl., *P.K. Loc*, *D.T. Kien & P.M.V. Sinh 10503* (**P**03358851!);– *ibid.*, December 2009, fl., *s.coll.*, *s.n.* (**ITA**†);– *ibid.*, 18 March 1999, fr., *D.D. Soejarto & N.M. Cuong*

10589 (**L**4208021†);– **Thanh Hoa**: Ba Thuoc, Co Lung, Pu Luong, Pu Luong Protected Area, 17 April 2001, fl., *T.H. Nguyên*, *L.V. Averyanov & P.K. Loc 1092* (**MO**†).

Distribution.— India to Japan: India (Assam, Hmuntha, Zobouk, Manipur); Myanmar (Kachin and Inohlaiy); China (Szechwan, Hupeh, Chekiang, Hunan, Kiangsi, Fukien, Yunnan, Kwangsi, Kwangtung, Taiwan); Thailand (Chiang Rai, Chiang Mai, Nan, Lampang and Kanchanauri); Cambodia; Vietnam, and Japan (**Maps 4.20, 4.26.1 & 4.26.2**).

Vernacular name.— **China**: Da Ye Gui Ying. **Japan**: Bakuchi-No-Ki.

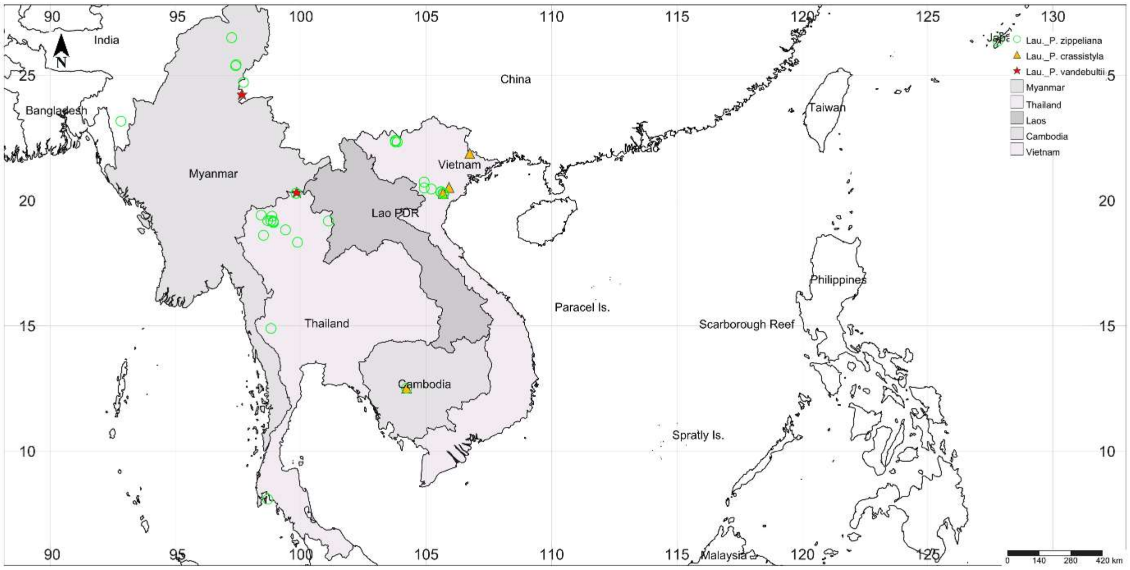
Ecology.— In the open Dry Evergreen Forest to Upper Montane Forest, alt. 40–1,800 (–3,000) m.

Phenology.— Flowering September to January, fruiting from January to May.

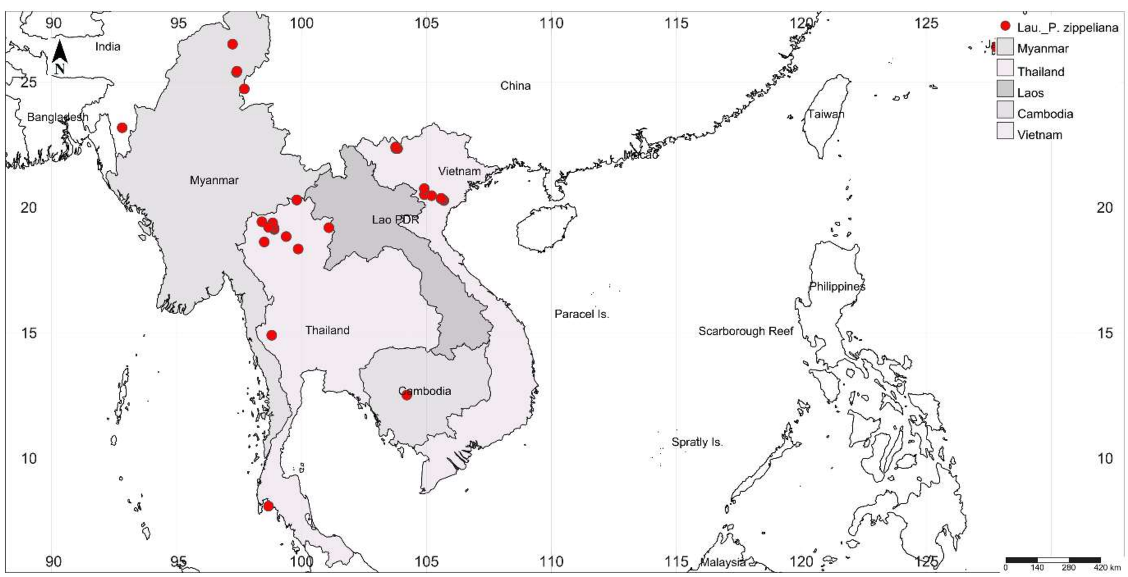
Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 11,667,543.39 km^2; AOO = 1,752.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Figure 10. *Prunus zippeliana* Miq., vegetative and reproductive morphological characters; **A**, bark smooth with shallow dipple marks, reddish brown; **B**–**D**, leaves: **B**, young shoot with conspicuous linear stipules; **C** & **D**, leaves; **C**, leaves abaxial; **D**, margin glandular serrate, petiolar glands distinctly protruding, stalk-like; **E**–**H**, inflorescence; **E**, solitary, or with 2–4 fasciculate racemes; **F**, solitary raceme, flower buds covered with oval bracts; **G**, opening flowers; **H**, inflorescence terminal with flower buds; **I** & **J**, infructescence; **I**, mature (reddish brown), turning black when ripe; **J**, fruit with longitudinal section. — Photos: A–F & I by S. Rueangruea; G by M. van de Bult; H by U. Veesommai. — Sources: all from **Thailand**: Chiang Rai, Doi Tung; A & J from *S. Rueangruea et al. SR114*; and G: Kanchanaburi; B–F from *S. Rueangruea et al*. *SR206*; and H. Scale bar = 1 cm.



Map 4.26.1. Distribution of zippeliana's group 3 species: *P. zippeliana* Miq.*, P. crassistyla* (Card.) Rueangr., J. Parn. & Hodk.*,* and *P. vandebultii* Rueangr., J.Parn. & Hodk.*,* respectively of subg. *Laurocerasus* in continental Southeast Asia.



Map 4.26.2. Distribution of *Prunus zippeliana* Miq. of subg. *Laurocerasus* in continental Southeast Asia.

24. ***Prunus crassistyla*** **(Cardot) Rueangr**., **J**.**Parn**. **& Hodk**. *stat. nov. ined.* Typification: **VIETNAM, Tonkin, Sapa**, Thinh Chan Mountain, 16 March 1888, *R.P. Bon 3814* (lectotype **P**0335885! designated by Vidal, 1968; isolectotypes **K**000737330!, **P**03358806–8!).

≡ *Prunus macrophylla* var. *crassistyla* Cardot in Lecomte Flore Générale de l'Indo-Chine. 5: 624. 1920

≡ *Prunus zippeliana* Miq. var. *crassistyla* (Card.) J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 178. 1968.

≡ *Laurocerasus zippeliana* var. *crassistyla* (Cardot) T.T.Yu & L.T.Lu in Y.He & J.Y.Zhang Bulletin of Botanical Research. Harbin. 4(4): 53. 9184.

Description: Evergreen, sub-canopy, tree 10–15 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 20 cm in diameter; outer bark greyish-brown, corky and warted, slash deep brown, spines absent; *inner bark* yellowish-brown; strong almond smell. **Branchlets** are stout, whitish-brown with light brown lenticels; young twigs are greenish with white lenticels, glabrous, with 3 to 6 small cataphylls at the base. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic oblong, elliptic-ovate to obovate-oblong, 5.5–15 cm long × 3–6 cm wide; *lamina apex* curved, acuminate, acute, mucronate to obtuse, angle acute; *margin* entire or mixed, spine-like serrate in the lower half of leaf blade, teeth irregularly spaced, sinus rounded, glabrous; *base* asymmetric sometimes slightly so, acute or obtuse; young leaves pale green, glossy green adaxially, pale green abaxially, turning yellow before falling, thick, coriaceous, glabrescent to glabrous; old leaves glabrescent to glabrous, glabrous adaxially, glabrescent to glabrous abaxially; dried leaves different in colour, greyish-adaxially, brown abaxial; *basal glands* additional marginal glandular-serrate, sharp spine-like; *2° venation* weakly brochidodromous, 8–16 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate, inconspicuous when dry; *5° venation* widely reticulate, inconspicuous when dry; *petioles*, 0.8–2 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* present, (0–)2(–3) glands, 1 × 0.5 mm in diameter, ovate-oblong, short stalk-like glands usually large and distinctly protruding, on upper or lateral surface of petiole. **Stipules** medium, 4–8 mm long × 1–2 mm wide, linear to triangular, apex acuminate, margin entire, base oblong, glabrous, usually entire, sometimes with glandular margins, early caducous. **Inflorescences** compound, solitary, or (rarely with 1–2 racemes, side-branches at the very base of the shoot, dense to lax-flowered, usually in leaf axils or sometimes in their scars, 1–6 cm long, generally less than 15-flowered, glabrous to sparsely hairy; *involucral bracts* 6–12, up to 5 mm long × 3.5–4 wide, size and shape variable, boat-shape, deltoid to oblong, apex lobed, tri-partite, glabrescent to glabrous outside, sparsely tomentose inside, margin ciliate, usually present at anthesis. **Flowers** bisexual, opening with mature leaves, white, pedicellate, stout to slender, 3–8 mm long, glabrescent; *bracteoles* oval, up to 5 mm long, greenish-brown, glabrescent, not early caducous; *hypanthium* cup-shaped, 2–3 mm long, sparsely pubescent (to glabrous) outside; corolla distinctly different from calyx lobes; *calyx* lobes (4–)5, triangular to suborbicular, minute, 0.6–1.5 mm long × 0.6–1.2 mm wide, subequal, apex obtuse to slightly acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, glabrescent to glabrous outside, glabrescent inside; *petals* white, spreading to decurved, 5, medium, 2–3(–4) mm long × 2–4 mm wide, subequal, 2.5–3 times as long as sepals, more or less orbicular, sessile, apex rounded, margin usually sparsely to distinctly ciliate, base sessile to shortly unguiculate, alternate with calyx lobes, sparsely pubescent to glabrescent outside, sparsely pubescent to glabrescent inside; *stamens* 30–40 in 3 series, exserted; filament filiform, white, 2.5–4 mm long, glabrous; anthers globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, *c.* 3 mm long, shorter or as long as stamens, glabrous; stigma discoid, *c.* 1 mm in diameter. *Infructescence* 1–6 cm long, sparsely tomentose to glabrous, few, 1–4 fruited. **Fruits** not seen. (**Figure 4.12**).

Additional specimens examined.— **CAMBODIA**. **Mondulkiri**, Sen Monorom, in a community forest near Pulung Village. Mixed deciduous forest., 12°30'40.7” N, 104°12'57.2” E, alt. 630 m, 2 November 2016, lvs., *S. Tagane*, *M. Zhang*, *P. Chhang*, *K. Hatake*, *T. Ota & K. Mase 7178* (**BKF**!, **FU**!). **VIETNAM**. **Tonkin, Lang Son**: Van Lanh, alt. 400 m, February 1938, fl., *P.A. Pételot 6321* (**P**03358804!, **US**1759432†, **VNM**!);– **Ninh Binh**: Nho Quan, Cuc Phuong NP, 20°17'21.0” N, 105°40'16.8” E, 25 May 2000, lvs., *D.D. Soejarto & N.M. Cuong 11623* (**L**4208114†);– *ibid*., 20°17'36.6"N, 105°39'51.6"E, alt. 300 m, 17 March 2001, fl., *D. Djendoel Soejarto, N.M. Coung DD11768* (**L**0808899†).

Distribution.— Cambodia and Vietnam (**Maps 4.20 & 4.26.1 & 4.27**).

Vernacular name. **—** Not known.

Ecology.**—** In open areas, by streams, Dry Evergreen forest to Lower Montane Forest, alt. 300–1,400 m.

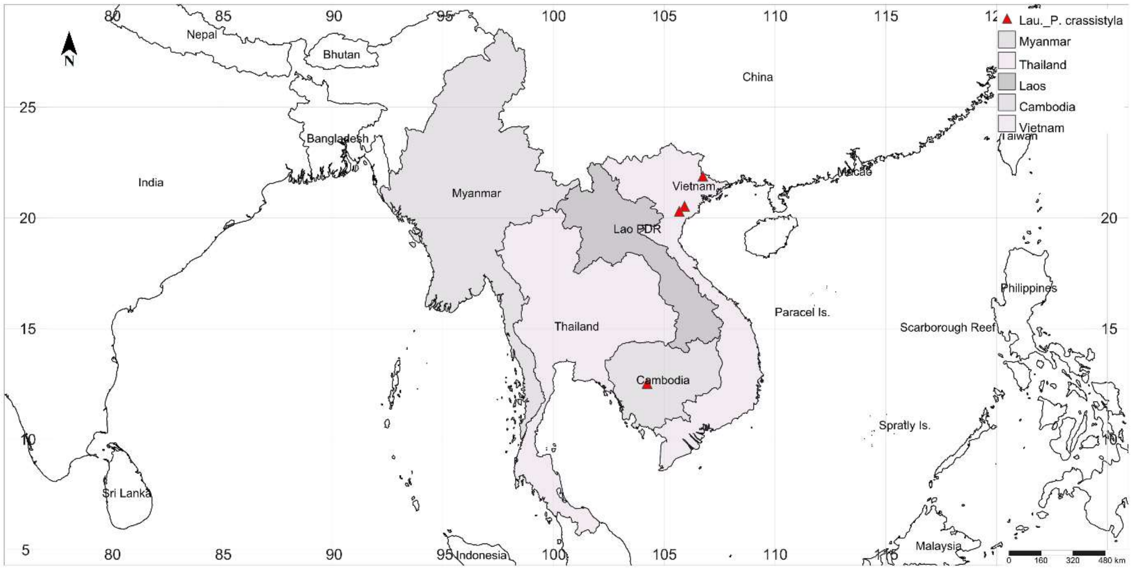
Phenology.**—** Flowering specimens were collected from February to March, fruiting from April to June.

Uses.— Not known.

Conservation.— The type locality is in The Royal Research Project, restricted to limestone in a small microclimate area. The number of individuals in the population is small, EOO = 757.96 km^2; AOO = 12 km^2 (< 20 km^2). The number of mature individuals < 1,000. I consider the conservation status of the species currently to be VU (Vulnerable); B1aC2aiD2. (IUCN, 2019).

Note.— Vidal (1968) recognized this taxon as *Prunus zippeliana* Miq. var. *crassistyla*. My herein elevate it to species level. *Prunus crassistyla* is most similar to *P. zippeliana* and *P. vandebultii* in having serrate leaves and petiolar glands. However, it is highly distinctive from *P. zippeliana* in its leaf and floral morphology due to its entire leaf margin sometimes mixed with scarce spine-like serration (vs. the whole of leaf margin serrate or dentate), stamens more than 30 (vs. stamens 18–30)., inflorescence a solitary raceme (vs. inflorescences solitary or/ and mixed with compound racemes in 2–4 bundles). It is easily distinguished from *P. vandebultii* by its whitish-grey (vs. branchlets brown) branchlets, involucral bracts 3–8 (vs. involucral bracts 1–3), and peduncle glabrescent or glabrous (vs. peduncle densely hairy)., fruits ellipsoid to slightly globose, apex shortly acute (vs. fruits oblong-lanceolate, apex acuminate), peduncle, rachis, pedicel, hypanthium, and bracts are usually glabrous or glabrescent (vs. peduncle, rachis, pedicel, hypanthium, and bracts hairy), and involucral bracts 4–10, persistent at anthesis (vs. involucral bracts 3–5, early caducous).

Figure 4.12. *Prunus crassistyla* (Cardot) Rueangr., J.Parn. & Hodk. **A**. flowering branch, mixed serrate and entire leaves with a pair of petiolar glands; **B**. flowers; All from *P.A. Pételot 6321* (**P**, **VNM**). Drawn by Pairuch Rayangkul.



Map 4.27. Distribution of *Prunus crassistyla* (Card.) Rueangr., J. Parn. & Hodk. of subg. *Laurocerasus* in continental Southeast Asia.

25. ***Prunus vandebultii*** **Rueangr**.**, J**.**Parn**. **& Hodk**. ***sp*. *nov*. *ined*.**

Typification**: THAILAND, Chiang Rai**, Mae Sai, Pa Hoong, Wat Phatat Doitung, Doi Tung, 20°19'32.7" N, 99°50'01.9" E, alt. 1344 m, 2 May 2019, fl., *M. Van de Bult 1662* (holotype **BKF**219553!; isotype **CMUB**!).

Description: Evergreen, sub-canopy, tree 6 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 6 cm in diameter; outer bark greyish-brown, smooth, spines absent; *inner bark* yellowish-brown; strong almond smell. **Branchlets** stout, whitish-brown with light brown lenticels; young twigs greenish-with white lenticels, glabrous, with 3 to 8 small cataphylls at the base, apex tripartite, lobed to acute; old twigs greyish-with prominent brown lenticels. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* present. **Leaves** plicate in the bud, alternate, ovate-oblong, elliptic obovate to elliptic-oblong, 5–12 cm long × 3–5 cm wide; *lamina apex* acute to obtuse, angle acute; *margin* usually entire, hyaline, revolute, sometimes mixed with glandular-spine to glandular-serrate on the same tree, some leaves spiny-serrated in the lower half, teeth irregularly spaced, sinus angular, glabrous; *base* asymmetric sometimes slightly so, obtuse to subacute; young leaves pale green, glossy green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous, glabrous; old leaves glabrous on both sides; *basal glands* (–0) 2 (–3), up to 1.5 mm long, ovate-oblong, short stalk-like glands usually large and distinctly protruding, very rarely wanting, on upper or lateral surface of petiole, sometimes margins glandular-serrate, sharp spine-like; *2° venation* weakly brochidodromous, 8–12(–14) alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.5 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* present, (0–)2(–3) glands, 1 × 0.5 mm in diameter, sometimes stalk-like glands, usually large and distinctly protuding. **Stipules** small to medium, 2–4 mm long × 1–1.5 mm wide, triangular, apex acute, margin entire, base oblong, glabrous, and early caducous. **Inflorescences** compound, solitary, or (rarely with 1–2 racemes, side-branches at the very base of the shoot, dense to lax-flowered, usually on branches with fallen leaves, 1–5(–8) cm long, up to 20-flowered, sparsely pubescent to glabrescent; *involucral bracts* 3–5, up to 3 mm long, size and shape variable, apex lobed, or shallowly tri-partite, hairy both sides, margin ciliate, soon caducous. **Flowers** bisexual, opening with mature leaves, white, pedicellate, pedicel stout to slender, 1–4(–6) mm long, pubescent; *bracteoles* elliptic, triangular to boat-shaped, the middle with shallow keel, up to 4 mm long, apex acute to shallowly tripartite, whitish-green, glabrescent outside, hairy inside, usually persistent at anthesis, then caducous; *hypanthium* cup-shaped, white outside, light green inside, *c.* 2 mm long, pubescent (to glabrescent) outside; corolla distinctly different from calyx lobes; *calyx* lobes (4–)5, triangular, minute, 0.6–1.5 mm long × 0.6–1.2 mm wide, subequal, apex obtuse to slightly acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, sparsely pubescent inside; *petals* white, spreading to decurved, 5, medium, 2–3(–4) mm long × 2–4 mm wide, subequal, 2.5–3 times as long as sepals, more or less orbicular, sessile, apex rounded, margin usually sparsely to distinctly ciliate, base sessile to shortly unguiculate, alternate with calyx lobes, sparsely pubescent to glabrescent outside, sparsely pubescent to glabrescent inside; *stamens* 38–42 in 3 series, exserted; filament filiform, white, 3–4.5 mm long, glabrous; anthers globose, 0.4–0.6 mm long; *ovary* glabrous, 1 locular; *style* filiform, up to 4 mm long, as long as stamens, glabrous; stigma discoid. *Infructescence* 1–5 cm long, sparsely tomentose to glabrous, few, 1–4 fruited. **Fruits** fleshy, stipitate, 3–5 mm long, young fruit green, black via red and reddish-purple when ripe, ellipsoid to ovoid, subglobose, 0.7–1.2 cm long, 0.7–1.2 cm wide, apex acute to obtuse; young and mature fruits glabrous; exocarp smooth and shiny, with shallow longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal ridge, canaliculate; calyx deciduous; style present, peaked or apiculate up to 1 mm long. **Seeds** usually transversely globose, thin, glabrous testa, and reticulate (**Figures 4.13 & 4.14**).

Additional specimens examined.— **THAILAND**. **Northern, Chiang Rai**: Mae Sai, Pa Hoong, Wat Phatat Doitung, Doi Tung, 20°19'38.6" N, 99°50'02.2" E, alt. 1,344 m, 6 December 2019, fr., *S. Rueangruea*, *T. Thananthaisong & P. Uea-Ari SR245* (**BKF**229825!, **TCD**!). **MYANMAR**. **Upper Burma, Shan**: Bhau, Panghok, Lahpye Kha, alt. 2,167 m, 8 March 1927, fl., *Maung Mya 4989* (**E**00901065!).

Distribution.— Thailand and Myanmar (known only from the specimens cited) (**Maps 4.20, 4.26.1 & 4.28**).

Vernacular name. **—** Not known.

Etymology.— The specific epithet, '*vandebultii*' honors Mr. Martin Van de Bult, the collector of the type specimen.

Ecology.**—** In the open Lower Montane Forest, limestone bedrock steep slopes with loose limestone rocks. alt. 1,200–1,400 m. Uncommon.

Phenology.**—** Flowering specimens were collected from May to June, fruiting from June to December.

Uses.— Not known.

Conservation.— The type locality is in The Royal Research Project and is restricted to limestone. The number of individuals in this population is small, EOO = 0.12 km^2; AOO = 8 km^2. The number of mature individuals < 50. And it is likely that the species is no longer extant in its only recorded location in Myanmar as the only known specimen comes from Bhamo district which has been the site of considerable urbanization since the specimen was collected ca. 100 years ago. We consider, therefore, the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1 (IUCN, 2019).

Note.— *Prunus vandebultii* is most similar to *P. zippeliana* and *P. crassistyla* in having serrate leaves and petiolar glands present. However, it is highly distinctive, as mentioned in the note for *P. crassistyla*.

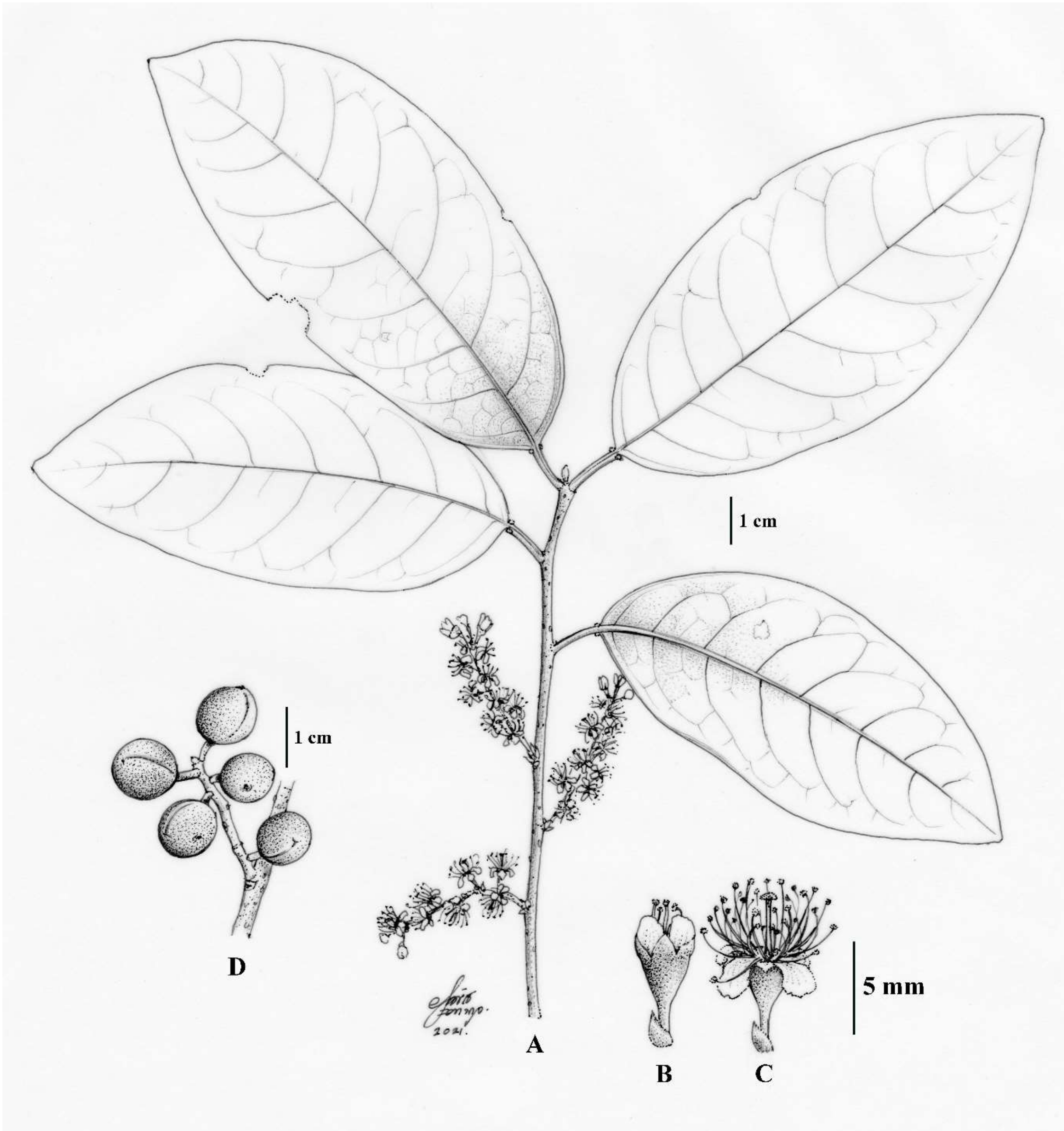
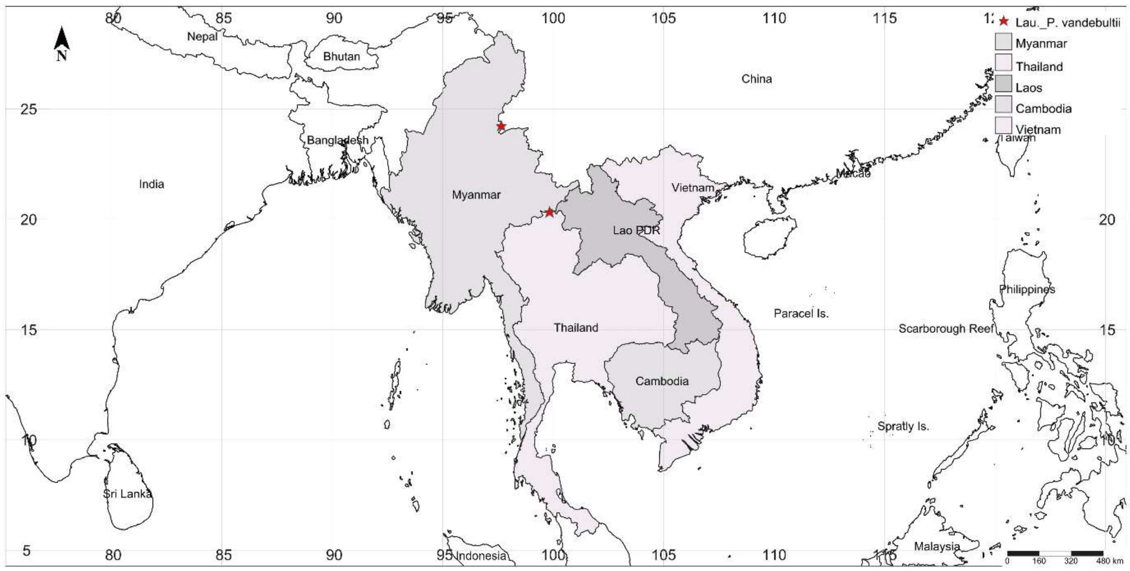


Figure 4.13. *Prunus vandebultii* Rueangr., J.Parn. & Hodk. **A**. inflorescence branch, simple raceme with lax flowers, leaf margin usually entire, petiole with two protruding glands; **B**. flower bud, sepals different from petals; **C**. bracts usually present at anthesis; **D**. fruits. All from *M. Van de Bult 1662* (**BKF**). Drawn by Pairuch Rayangkul.

Figure 4.14. *Prunus vandebultii* Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters; **A**, outer bark with conspicuous lenticels; **B** & **C**, leaves; **B**, alternate; **C**, leaf margin entire, sometimes mixed with glandular-spine to glandular-serrate, *basal glands*, (–0) 2 (–3), short stalk-like; **D** & **E**, inflorescence, solitary raceme, on the fallen leaves branch; **D**, flowering and flower buds; **E**, open flowers; **F** & **G**, flower; **F**, frontal view with stamens arrangement; **G**, lateral view showing corolla distinctly different from calyx lobes. — Photos: A, B by P. Ue-aree; C–I: by M. van de Bult. — Source: all from **Thailand**, Chiang Rai, Doi Tung, *M. van de Bult 1662*. Scale bar = 1 cm.



Map 4.28. Distribution of *Prunus vandebultii* Rueangr., J.Parn. & Hodk. of subg. *Laurocerasus* in continental Southeast Asia.

26. ***Prunus pygeoides*** **Koehne** in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 297. 1915; Hook.f., The Flora of British-India, London. 2 (5): 320. 1878; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to *Pygeum*: 31. 1965; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification**: INDIA, Baster** state, Ballaisilla Range, 10 November 1947, *H.F. Mooney*, *s.n.* (lectotype **K**000737202!), designated by Dr. Chatterei, 1948.

≡ *Lauro-cerasus pygeoides* (Koehne) Browicz, Arboretum Kórnickie. 15: 5. 1970.

= *Pygeum andersonii* Hook.f., Flora of British-India. 2(5): 320. 1878; Chatterjee, Journal of the Indian Botanical Society. Madras. 27: 9. 1948.

Typification: **INDIA, Bihar**, Bengal, the summit of Parusnath, alt. 4000 ft., 15 November 1858, s. coll., *s.n.* (lectotype **K**000737201!, isotype **BM**000622032!), designated by D. Chatterei, 1948, stamens 24 in one flower (not 15 as described on the sheet).

≡ *Laurocerasus andersonii* (Hook.f.) T.T.Yu & L.T.Lu, Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

≡ *Pygeum lucidum* T. Anderson ex Prain, Bengal Plants. 1: 464. 1903. *nom. superfl.*; Anders, Journal of the Asiatic Society of Bengal. Calcutta. 32: 203. 1863.

= *Prunus semiarmillata* Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 303. 1915.

Typification: **CHINA, Yunnan**, W. Szemao Mountain, 5,00 ft alt., tree 15 m tall, 1900, *Henry, Augustine 12887* (holotype, *non vidi*; isotypes **E**00010492!, **K**00737248!, **L**0019684!, **MO**1578942†, **NY**00429951†).

= *Pygeum mooneyi* Raizada in P. P. Bhojvaid Indian Forester. 68: 421. 1942.

Typification: **INDIA, Basta**r state, Bailadila Hill, rocky ravine 3,300–3,400 ft alt., a small tree up to 30 ft high, 10 ft diameter, bank of a stream in a rocky ravine, under shade, cool ravine, 11 October 1940, *Ahmed Ali* per *H.F. Mooney 1551a* (holotype in Herb. Dehra, *non vidi*; isotypes **K**000737203!, **K**000737205–6!; paratype, *ibid*., December 1938, *H.F. Mooney 904* (**K**000737204!).

= *Pygeum jajarkotensis* H.Hera in The Journal of Japanese Botany. 52: 355. 1977.

Typification: **NEPAL**, **Mid-Western, Nawngmun,** Bheri, Jajarkot, alt. 1,074 m, 17 October 1952, *O.V. Polunin, W.R. Sykes & L.H.J. Williams 5784* (lectotype **BM**000522035!, isolectotype **BM**000522041!), designated by Hiroshi Hara 1999.

Description: Evergreen, sub-canopy, tree up to 20 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh c.30 cm in diameter; outer bark greyish-brown to dark brown with prominent brown lenticels, rugged and slightly flaking, spines absent; *inner bark* pinkish-white (young tree) to reddish-brown at maturity; strong almond smell. **Branchlets** moderate, brown with light brown lenticels; young twigs light grey to reddish-purple, glabrous, with few cataphylls at base; old twigs greyish-brown with sparse brown lenticels. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, oblong, elliptic-oblong to oblong-lanceolate, 8–15 cm long × 2.5–5 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* serrate, infrequently serrate to subentire, hyaline, and slightly revolute, teeth regular spacing, sinus angular, apex glandular serrate, glabrous; *base* asymmetric sometimes slightly so, usually rounded or sometimes acute; young leaves light green, dull dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous, glabrous; old leaves, glabrous adaxially, glabrous abaxially; *basal glands* (–0) 2 (–4), up to 0.5 mm long, ovate to circular, flat, usually with 2 glands on margin of the basal leaf or absent, additional glands at the apex of marginal serrate; *2° venation* weakly brochidodromous, 8–12 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 1–1.5 cm long, shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** small, 1–2 mm long × 0.8–1.2 mm wide, lanceolate to triangular, apex acute to acuminate, margin entire, base oblong, glabrous, very early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, in the axil of leaf, 1–4.5 cm long, 10–30-flowered, glabrous; bracts 1–3, up to 2 mm long, green, ovate, concave, glabrous, caducous, or some empty ones present at the raceme-base. **Flowers** bisexual, opening with mature leaves, white, pedicellate, stout to slender, 2–5 mm long, glabrous; *bracteoles* ovate to triangular, concave, up to 2 mm long, whitish-green, glabrous, caducous; *hypanthium* cup-shaped to broadly campanulate, 1.5–2 mm long, whitish-green, glabrescent to glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, 0.5–1 mm long

× 0.5–1 mm wide, subequal, apex acute, margin entire, sparsely hairy, margins and apex ciliate, base truncate, imbricate in bud, spreading or slightly incurved when mature, deciduous, early caducous, sparsely pubescent outside, glabrescent inside; *petals* white, spreading to upright, 5, small, 1.5–2 mm long × 0.5–1 mm wide, subequal, 2–3 times as long as sepals, oblong, sessile to slightly unguiculate, apex rounded, margin entire, ciliate, base sessile to shortly unguiculate, alternate with calyx lobes, glabrescent to sparsely pubescent, ciliate margin outside, sparsely pubescent to glabrescent inside; *stamens* 20–26 in 3 series, exserted; filament filiform, white, *c.* 2.5 mm long, glabrous; anthers subglobose, 0.3–0.5 mm long, light yellow; *ovary* glabrous, green, 1 locular; *style* filiform, up to 3 mm long, as long as stamens to slightly shorter than stamens, glabrous; stigma peltate. *Infructescence* 2–6 cm long, glabrous, few, 1–5 fruited. **Fruits** fleshy, stipitate, 5–7 mm long, young fruit green, black via red and reddish-purple when mature or ripe, usually globose to slightly transverse ellipsoid, 0.8–1 cm long, 0.8–1.2 cm wide, apex obtuse; young and mature fruits glabrous; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, very bitter taste, adnate to endocarp, dark purple to black; endocarp stone fruits, trigonal to subglobose, smooth with shallow groove and longitudinal ridge on one side, and shallowly reticulate; calyx deciduous; style absent or present forming a peak or apiculate up to 1 mm long. **Seeds** are triangular to circular in cross-section, medium, woody, with glabrous testa, reticulate, endocarp inside, and seedcoat glabrous (**Figure 4.15**).

Additional specimens examined.— **INDIA**. **Bengal**: top of Parasnath, 15 April 1858, lvs., *T. Tomson*, *s.n.* (**SNSB-M**0214827†!);– **Parasnath**: 15 November 1858, fl., *S.Coll.*, *s.n.* (**K**!). **THAILAND**. **Northern, Chiang Rai**: Mae Sai, Doi Tung, 20°19'32.7” N, 99°50'01.9” E, alt. 1,334 m, 4 December 2019, fr., *S. Rueangruea*, *T. Thananthaisong & P. Uea-Ari SR241* (**BKF**229817!, **TCD**!);– *ibid.*, 20°17'18” N, 99°48'37” E, alt. 996 m, 22 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR143* (**BKF**!, **TCD**!);– *ibid.*, 20°19'39” N, 99°50'03” E, alt. 1,352 m, 22 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR139* (**BKF**229748!, **TCD**!);– *ibid.*, Pha Hoong, Wat Pratat, 20°19'33” N, 99°49'27” E, alt. 1,334 m, 11 November 2010, fl., *M. Van de Bult 1107* (**BKF**185440!, **CMUB**33886!);– **Phitsanulok**: Nakhon Thai, Noen Phoem, Phu Hin Rong Khla NP., 16°54'17” N, 101°04'29” E, alt. 1,589 m, 1 April 2019, lvs., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari & S. Chatrupamai SR182* (**BKF**229985!, **TCD**!); Pru16°34'27” N, 98°50'04” E, alt. 778 m, 5 March 2019, fr., *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 5476* (**BKF**221173!, **TCD**!).

Distribution.— India (Madhya Pradesh, Bihar, Orissa), Nepal, N. Myanmar, China (Yunnan, South-Central)**,** and W. and N. Thailand (new record) (**Maps 4.29**).

Vernacular name. **—** Not known.

Ecology.**—** Dry Evergreen Forest to Lower Montane Forest, in open areas or shade along streams, granite or limestone bedrock, alt. 700–1,600 m.

Phenology.**—** Flowering from October to January, fruiting from November to March.

Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 1,834,186.65 km^2; AOO = 32.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

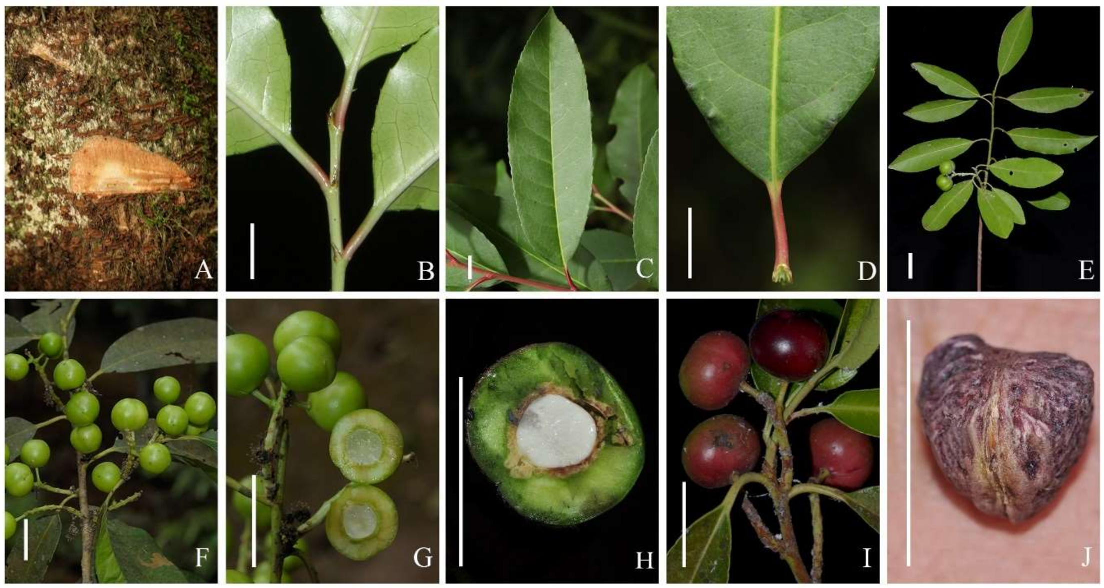
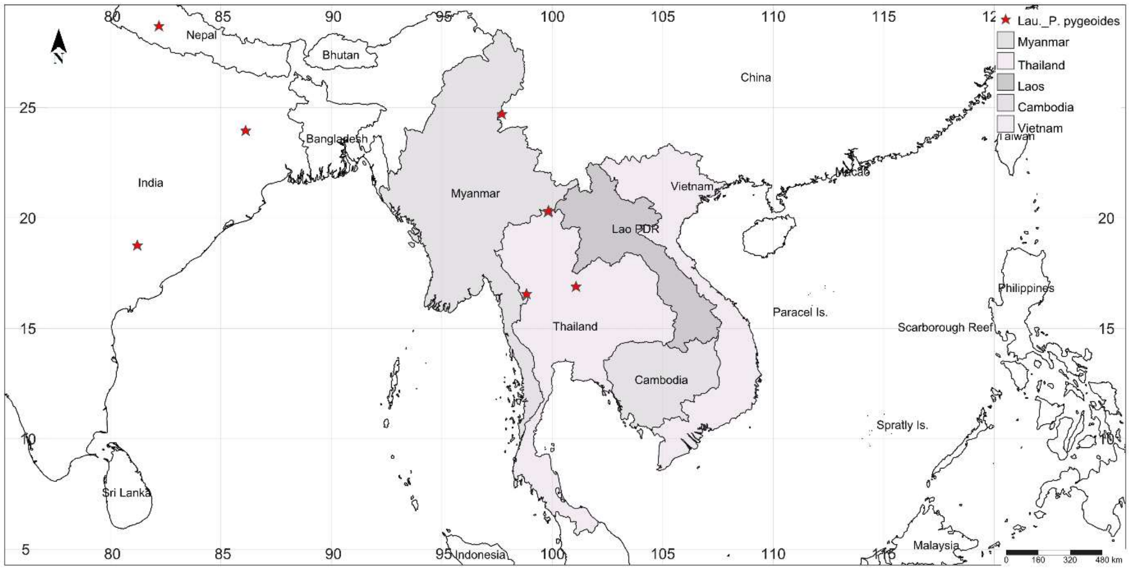


Figure 15. *Prunus pygeoides* Koehne, vegetative and reproductive morphological characters; **A**, outer bark, conspicuous brown lenticels; **B–D**, leaves; **B**, young leaves with small lanceolate to triangular stipules; **C**, leaves adaxial; **D**, 2-glands on the margin of the basal leaf, immature leaf with red petiole; **E–I**, infructescence, fruits, and seed; **E**, fruiting and leaves abaxial, fruits globose; **F**, young erect infructescence; **G**, immature fruits cross-section; **H**, mature fruit cross-section; **I**, fruits turning to reddish-brown, and black when ripe; **J**, seed triangular to deltoid-like shape, endocarp, shallow ridge, glabrous. — Photos: A–D, F & G by S. Rueangruea; E & I by S. Kaithongsuk; H by W. Kaewbing. — Sources: all from **Thailand**; Chiang Rai, B & D from, *S. Rueangruea et al. SR143*; Pisanulok, A & C from *S. Rueangruea et al.* SR182; Tak, E–I from *S. Suddee et al. 5476*. Scale bar = 1 cm.



Map 4.29. Distribution of *Prunus pygeoides* Koehne of subg. *Laurocerasus* in continental Southeast Asia and nearby.

27. ***Prunus jenkinsii* Hook.f. & Thomson**, Flora of British-India. 2(5): 317. 1878; Schneid., llustriertes Handbuch der Laubholzkunde. 1: 650. 1906; Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 300. 1915; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus,* including those formerly referred to *Pygeum*. 37–38. 1965; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

Typification: **INDIA, Assam**, Upper Assam, Khasia, fl., *Jenkins*, *s.n.* (lectotype **K**000737197!, designated by Kalkman, 1965; isolectotypes **K**000737199–200!); lectoparatypes: B**ANGLADESH**, East Bengal, Choorpura, fr., *W. Griffith 2067* (**K**000737196!, **L**0019650†, **P**01819067!); *W. Griffith s.n.* (**K**000737198!).

≡ *Cerasus jenkinsii* (Hook.f. & Thomson) Ohle, in R. Mansfeld, Verz. Landwirtsch. Gartn. Kulturpfl., Auf. 2, ed. J. Schultze-Motel. 1: 421. 1986.

≡ *Laurocerasus jenkinsii* (Hook.f. & Thomson) Browicz, in Arboretum Kórnickie. 15: 5. 1970; Lu Lingdi. et al., in Flora of China 9: 1–494. 2003.

≡ *Laurocerasus jenkinsii* (Hook.f. & Thomson) *T.T. Yu* & *L.T. Lu,* in Bulletin of Botanical Research. 4(4): 48. 1984.

= *Prunus limbata* Cardot, Notulae Systematicae. Herbier du Muséum de Paris. Phanérogramie. Paris. 4: 21. 1920.

Typification: **CHINA, Yunnan**: Yuanchang, 5,000 ft alt., tree 30 ft tall, flowers white, *A. Henry 13228* (holotype **E**00010493!; isotype **A**00032100†, **BM**000622019!, **K**000737242!).

Description: Evergreen, sub-canopy, small tree 10 m tall, canopy shape oval. **Stem** clear bole, outer bark dark brown, smooth or with small scales, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** moderate, dark brown with brown lenticels; young twigs reddish-brown with sparse globose brown lenticels, glabrous to sparsely hairy, with many cataphylls at base; old twigs glabrous. *Axillary winter bud* solitary, brown, reddish-brown, ovoid, 2–4 mm, glabrous; *terminal winter bud* present. **Leaves** plicate in bud, alternate, oblong to rarely obovate-olong, (6-)8–16.5 cm long × 2.5–5 cm wide; *lamina apex* acuminate to caudate up to 1 cm long, angle acute; *margin* usually spine-like serrate to dentate, sometimes entire in the basal part, teeth irregularly spaced, sinus rounded, without glands, glabrous; *base* symmetrical or slightly asymmetrical, acute, rarely more rounded; young leaves pale green, glossy dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous; old leaves glabrous on both sides; *basal glands* (0–) 2, up to 1 mm long, ovate to oblong, purplish-black, basal glands near the margin or along the base of midrib, leaf blade without or sometimes with sparsely scattered pellucid glands purplish-black minutely punctate; *2° venation* weakly brochidodromous, 10–14 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate, inconspicuous abaxial; *5° venation* regular polygonal reticulate; *petioles*, 0.5–1 cm long, grooved to shallowly canaliculate in cross-section, glabrous to glabrescent; *petiolar glands* 0 (–2) beside the petiole near leaf contraction. **Stipules** small, 2–3 mm long × 0.8–1.2 mm wide, lanceolate to triangular, apex acute to acuminate, margin entire, base oblong, glabrous to sparsely hairy, early caducous. **Inflorescences** compound, solitary raceme, slightly dense to lax-flowered, in the axil of leaf, (3–)5–9 cm long, up to 30-flowered, erect to slightly pendulous, densely brown pilose; *involucral bracts* (3–)5–15, 1.5–6 mm long, size and shape variable, ovate-triangular, boat-shaped to oblong, apex tripartite, bilobed to acute, apiculate or obtuse, glabrescent, densely to sparsely hairy at base, margin densely ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white; pedicels stout and short, 2–4 mm long, pubescent; *bracteoles* ovoid to boat-shaped, concave, up to 3.5 mm long, whitish-green, densely pilose whitish-brown hairs, caducous after anthesis; *hypanthium* broadly cup-shaped to shortly campanulate, 1.5–2.5 mm long, whitish-green, glabrescent to densely pubescent outside, glabrous inside or sparsely hairy at base; corolla distinctly different from calyx lobes; *calyx* lobes 5, ovoid to subtriangular, minute, 1–1.5 mm long × 1–1.5 mm wide, subequal, apex rounded to subacute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, densely hairy outside, sparsely hairy to glabrescent inside; *petals* white, spreading to upright, 5, small, 2–3 mm long × 2–4 mm wide, subequal, 1.5–3 times as long as sepals, suborbicular, sessile to slightly unguiculate, apex rounded, margin entire to erose, base sessile to shortly unguiculate, alternate with calyx lobes, glabrescent outside, glabrescent to glabrous inside; *stamens* 15–25 (-30) in 3 series, exserted; filament filiform, white, 3–5 mm long, glabrous; anthers subglobose, 0.4–0.7 mm long, white; *ovary* glabrous, green, 1 locular; *style* filiform, up to 5 mm long, as long as stamens to slightly longer than stamens, glabrous; stigma peltate. *Infructescence* 2–8 cm long, densely hairy, few, 1–5 fruited. **Fruits** fleshy, stipitate, 5–8 mm long, young and ripe fruit green, ovoid, ellipsoid, narrow towards base and apex, but apex more obtuse, 1.7–2.2 cm long, 1.2–1.6 cm wide, apex acute to slightly obtuse; young and mature fruits glabrous; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, adnate to endocarp, dark brown to dark purple; endocarp stone thick, 1–2.5 mm, hard, prominently coarsely ridged reticulately rugose; calyx deciduous. **Seeds** oval to circular in cross-section, thick, with glabrous testa, shallowly reticulate, seedcoat glabrous.

Additional specimens examined.— **CHINA**. **Yunnan**: Xishuangbanna, Menghai, Mangao Nature Reserve, alt. 1,300 m, 23 October 2005, fr., *Wang Hong 7988* (**QBG**42212!). **INDIA**, October *s.n.*, fr., *W. Griffith*, *s.n.* (**K**!);– September 1845, fl., *Jenkins*, *s.n.* (**K**!);– September *s.n.*, fl., *A.C. Chatterjee 80195* (**MPU**1172994†);– **Assam**, 1855, fr., *J.D. Hooker & T. Thomson 336?* (**P**03358307!); Khasia hill, 27°51'25.9" N, 95°37'16.4" E, September *s.n.*, fl., *Master*, *s.n.* (**L**1903120†);– *ibid.*, Sadya, alt. 1150 m, 26 March 1894, *G.A. Gamble 240* (**BM**!);– *ibid.* 27°51'25.9" N, 95°37'16.4" E, February 1902, lvs., *A.C. Chatterjee*, *s.n.* (**P**03358305!);– *ibid.*, Sataka, 8 September 1942, fl., *N.L. Bor NL16318* (**L**1903119†);– Choonpura: 28 January 1829, fr., *W. Griffith 2067* (**K**!);– **East Bengal**: 27°07'54.0" N, 88°35'58.2" E, September *s.n.*, fl., *W. Griffith 2069* (**P**01819067!);– **Ukhrul**: September *s.n.*, fl., *F. Kingdon-Ward 18015* (**BM**!, **NY**02649987!);– **Nagaland**: Kohima, Naga hills, alt. 1500 m, 30 October 1885, fl., *C.B. Clarke 41397B* (**BM**!). **MYANMAR**. **Upper Burma, Kachin**: Myitkyina, Sima, 25°22'27.4" N, 97°20'20.1" E, alt. 1,130 m, 5 October 1925, fl., *A. Kostermans 3* (**RAF**1347!);– *ibid.*, Triangular (Hkinlun), alt. 1,167 m, 30 September 1953, fl., *F. Kingdon-Ward 21358* (**E**00901044!, **L**1903118†, **P**03358306!, **US**2440372†).

Distribution.— E. Pakistan, N. India (Assam, Himalaya), Nepal, N. Myanmar, and China (Western, Yunnan, Southeast-Central) (**Maps 4.20, 4.22 & 4.30**).

Vernacular name.**— China**: Jian He Gui Ying. **India:** Bonthereju (Hindi).

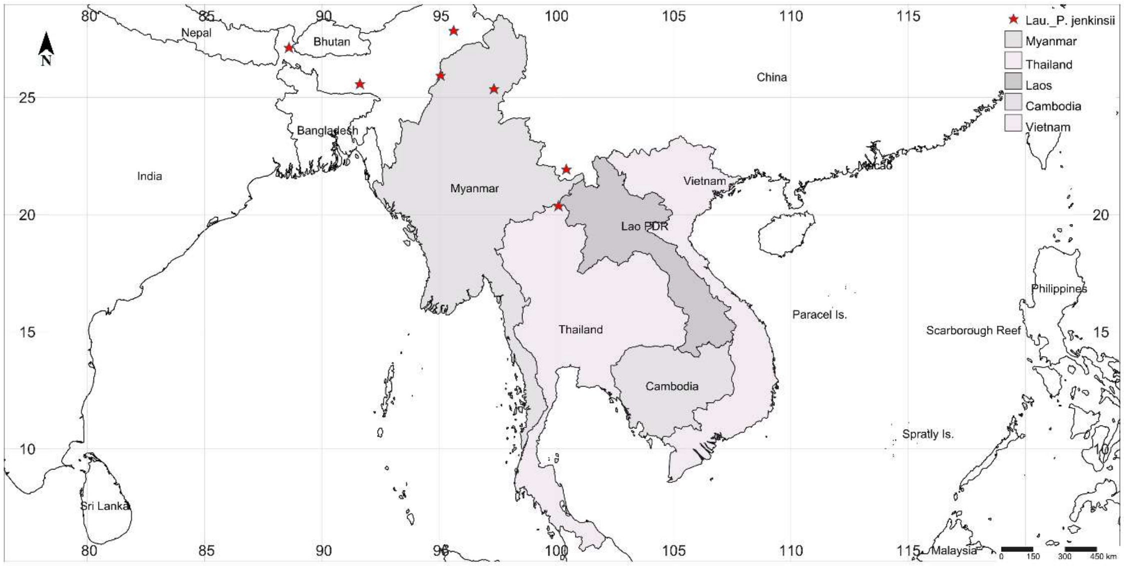
Ecology.**—** Lower Montane Forest, alt. 1,000–1,800 m.

Phenology.**—** Flowering from September to October, fruiting from October to January.

Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 355,442.24 km^2; AOO = 24.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— This species is distinguished from *P. spinulosa* by its much larger fruits. The leaves are larger in *P. jenkinsii*: in specimens of *P. spinulosa,* the giant leaf is rarely longer than 9 cm; in *P. jenkinsii,* it is not shorter than 12 cm. The fruits may be very variable in shape and dimensions.



Map 4.30. Distribution of *Prunus jenkinsii* Hook.f. & Thomson of subg. *Laurocerasus* in continental Southeast Asia and nearby.

28. ***Prunus undulata*** **Buch**.**-Ham**. **ex D**.**Don,** Prodromus Florae Nepalensis.: 239. 1825; Hook.f., The Flora of British-India, London. 2 (5): 316. 1878; Franch., Plantae Delavayanae. 198. 1890; Koehne, Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. 52: 285. 1915.

Typification: Nepal. Harain Letty, November 1802, *F. Buchanan*, *s.n.* (holotype **BM**000522034!; isotype, *non vidi*).

≡ *Cerasus undulata* (Buch.-Ham. ex D.Don) Ser. in DC. Prodromus Systematics Naturalis Regni Vegetabilis (DC.). 2: 540. 1825, *nom. nud.*

≡ *Lauro-cerasus undulata* (Buch.-Ham. ex D.Don) M.Roem., Familiarum naturalium regni vegetabilis synopses monographic; Rosiflore. 3: 92. 1847; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003.

= *Cerasus integerrima* Wall., A numerical list of dried specimens of plants in the East India Company's Museum. n. 722. 1829.

Typification**: NEPAL,** 1821, *Wallich 722* (holotype, *non vidi*; isotype **K**001111708!).

= *Cerasus acuminata* Wall., Plantae Asiaticae Rariores. 2: 78, pl.181. 1831; *ibid.*, Cat. n. 719. 1829, *nomen*; Spaxh, Hist. Nat. Veg. 1: 421. 1834. Typification: as below.

≡ *Prunus wallichii* Steud., Nomenclator Botanicus, Edition 2. 2: 404. 1841, *nomen*; Cardot, in Flore Générale de L'Indo-Chine 5: 174. 1920; Merr., Contra. Arn. Arb. 8: 72. 1934; *ibid.*, Brittonia; a Series of Botanical Papers 4: 88. 1941; J.E.Vidal in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris 13: 293. 1949; *ibid.*, Adansonia 4: 146. 1964; Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to *Pygeum*: 38–39. 1965; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6:

172–174, pl. xxiii, 1–3. 1968; *ibid.*, in Flora of Thailand 2 (1): 68–69. 1970; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 329. 1993; Lu Lingdi. et al., in Wu, Z. & Raven, P.H. (eds.). Flora of China 9: 1–494. 2003. – *Cerasus wallichii* (Steud.) M.Roem. in Synopsis. 3: 81. 1847.

≡ *Prunus acuminata* (Wall.) Dietr., Syn. 3: 42.1843, *comb. nom. nud.*; Walp., Rep. 2 (1843) 10, *comb*, *illeg*.; Hook.f., Fl. Brit. Ind. 2:317. 1878; Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(3): 296. 1915; *incl.* f. *wallichii* (Steud.) Koehne, *op. cit*.

≡ *Lauro-cerasus acuminata* (Wall.) M.Roem. in Synopsis. 3: 81, 92. 1847.

≡ *Lauro-cerasus wallichii* (Steud.) Browicz in Arboretum Kórnickie. 15: 5. 1970.

Typification**: NEPAL,** local name: Aroa, 1829, fl., *Wallich 719* (holotype **G**00437130†; isotypes **G**00437131†, **K**000737207–8!).

= *Prunus acuminata* (Wall) Dietr. f. *confusa* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(3): 296. 1915, quoad sterile specimen mixed with *Pygeum glaberrimum* Hook.f.

Typification: **BANGLADESH, Khasia**, subtropic regions, 1,000–1,300 m alt., *Hooker f. & Thomson*, *s.n.* (holotype; isotype, *non vidi*); paratype, Himalaya, Patlabong, alt 2,000 m, unnamed, *Sammler 693E* (paratypes, *non vidi*).

= *Prunus acuminata* (Wall) dietr. f. *vulgaris* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(3): 296–297. 1915.

Typification: **MYANMAR, Kapru**, 2,330 m alt., *A. Meebold 6532*; syntypes, Assam and E. Bengal, without location. March 1862, W. Griffith 2063 (P!); W.R. Fisher *s.n.*; Phalang, Nagaberge, 1,600 m alt, *A. Meebold 7093*, *non vidi*; Jowai, 1,600 m alt., *King Sammler s.n.*, *non vidi*;– Khasia, Ohne Standort, Schlagintweit 14372;– Sikkim, Bigte Region, 1,660–2,330 m alt., *Hook.f. & Thomson s.n.*;– Yok-som, W. Rompook, 1,660–2,000 m. alt., *Anderson T. 509b*., *non vidi*.

= *Prunus acuminata* (Wall) Dietr. f. *elongata* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(3): 297. 1915; Craib, Fl. Siam. Enum. 1:564. 1931; Vidal, Not. Syst. 13: 293. 1948;– *Lauro-cerasus undulata* f. *elongata* (Koehne) *T.T. Yu & L.T. Lu,* in Y.He & J.Y.Zhang Bulletin of Botanical Research. Harbin. 4(4): 47. 1984.

Typification**: INDIA, Himalaya**, Mahaderan, 2,000 m alt., *Sammler 895C*; syntypes–Sikkim, Looyd Gard. In Darjeeling, *A. Engler 55575*;– China, Yunnan, *Henry 11173*, 1*3187,13187A*; all in E, *non vidi*.

= *Prunus microbotrys* Koehne in Sarg. Plantae Wilsonianae. 1(1): 62. 1911.

Typification**: CHINA**, **W**. **Szechuan**, October 1908, *E.H. Wilson 2847* (lectotype in **A**, *non vidi*, designated by Kalkman, 1965; isolectotypes **E**000101495!, **K**000737244!).

≡ *Prunus acuminata* f. *microbotrys* (Koehne) Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(3): 296. 1915.

≡ *Lauro-cerasus undulata* f. *microbotrys* (Koehne) *T.T. Yu* & *L.T. Lu* in Y.He & J.Y.Zhang Bulletin of Botanical Research. Harbin. 4(4): 47. 1984.

=*Prunus edentata* Hand.-Mazz., in Sinensia; Contributions from the Metropolitan Museum of Natural History. Nanjing. 2: 216. 1932.

Typification: **CHINA, Kwangsi**. Yeo Mar Shan, N. Lin Yen, 4,800 ft alt., Shrub or small tree, 35 ft. tall, dbh 10 cm. Bark and branch dark grey leaves glossy green adaxially, light green below, 2-ranked glands, Fruit ovate, deep purple edible, 27 August 1928, *R.C. Ching 7174* (holotype **NY**00429945†; isotype **M**0214796†).

Description: Evergreen, sub-canopy, tree up to 20 m tall, canopy shape oval. **Stem** clear bole, erect; outer bark greyish-brown to dark brown, smooth or with small scales and brown lenticels, spines absent; *inner bark* yellowish-white; strong almond smell. **Branchlets** moderate, greyish-brown with brown lenticels; young twigs reddish-purple or pale green, usually glabrous, with few cataphylls at base; old twigs glabrescent to glabrous. *Axillary winter bud* solitary, pale green, 1.5–4 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic to oblong-lanceolate, rarely ovalish, 6–15 cm long × 2–6 cm wide; *lamina apex* acuminate, angle acute; *margin* usually entire, undulate, sometimes remotely serrate or crenate, mainly in the upper half, teeth irregularly spaced, sinus angular, without glands, glabrous; *base* symmetrical or slightly asymmetrical, broadly cuneate to rounded; young leaves reddish-brown to light green, dull dark green to sub glossy green adaxially, pale green abaxially, turning yellow before falling, texture thin, chartaceous to subcoriaceous, glabrous; old leaves glabrous on both sides; *basal glands* 1–2 (–10), up to 0.5 mm long, ovate-oblong to circular, flat, glands young leaves reddish-brown, on the surface of the blade, additional glands usually numerous, in 2 rows more or less parallel to midrib, especially in lover part of leaf, but sometimes up to the apex; *2° venation* brochidodromous, looped and anastomosing 3–10 mm from the margin, 6–10 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–1 cm long, grooved to shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** small to medium, 3–10 mm long × 0.8–1.5 mm wide, narrowly triangular, linear to oblong, apex acuminate, margin entire, base oblong, glabrous, free, and early caducous. **Inflorescences** compound, solitary raceme or 2–4 in fascicles, erect, lax-flowered, in axil of the leaf or on the basal part of new shoot branchlets, 2–10 cm long, 15–35-flowered, glabrous or sparsely pubescent; *bract*s 3–5, 1–1.5 mm long, glabrous or almost so, lower ones sometimes with tridentate apex, caducous. **Flowers** bisexual, opening with mature leaves, white, fragrant; pedicels slender, 2–8 mm long, glabrous or sparsely pubescent; *bracteoles* linear, 1–2 mm long, whitish-green, densely hairy to glabrescent, soon caducous; *hypanthium* cup-shaped, 1.5–2.5 mm long, whitish-green, usually glabrous; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, 0.5–0.8 mm long × 0.3–0.5 mm wide, subequal, apex acute, margin ciliate or minutely serrate, base truncate, separate in bud, spreading or incurved when mature, deciduous, glabrous outside, at least the apex hairy inside; *petals* white, spreading to decurved, 5, small, 2–4 mm long × 1.5–3.5 mm wide, subequal, 3–4 times as long as sepals, elliptic, sessile to slightly unguiculate, apex acute, margin glabrous to sparsely hairy, slightly entire or erose, base sessile to shortly unguiculate, alternate with calyx lobes, glabrous outside, glabrous inside; *stamens* 10–20(–30) in 3 series, exserted; filament filiform, white, 3–4 mm long, glabrous; anthers subglobose, 0.6–0.8 mm long, white to pale brown; *ovary* glabrous, to sparsely hairy at part of insertion, or hairs on doral side, 1 locular; *style* filiform, up to 4 mm long, as long as stamens to slightly longer than stamens, glabrous or hairy at base; stigma peltate to subglobose. *Infructescence* 2–10 cm long, glabrous to sparsely hairy, few, 1–5 fruited. **Fruits** fleshy, stipitate, 5–6 mm long, young fruit green, green when mature or ripe, obovoid, ellipsoid, subacute apex, base rounded, 1–1.8 cm long, 0.6–1.5 cm wide, apex rounded, beaked c. 1 mm long; young and mature fruits glabrous; exocarp smooth with shallow longitudinal groove; mesocarp fleshy, succulent, adnate to endocarp, dark purple or purplish-black when ripe; endocarp stone thin, smooth; calyx deciduous. **Seeds** oval to circular in cross-section, thin, with glabrous testa, shallowly reticulate; endocarp, and seedcoat glabrous (**Figure 4.16**).

Additional specimens examined.— **BHUTAN**. **Eastern Himalaya**, 10 May 1967, fr., *H. Hara*, *H. Kanai*, *G. Murata*, *H. Ohashi*, *O. Tanaka & T. Yamaraki 13533* (**L**†). **CAMBODIA**. **Cambodge**: Lobausok, Gaout Chouc, 10 January 1969, fl., *Martin Mono A 1439* (**P**03359136!). **CHINA**. **Guizhou**: Tongren, Jiangkou Xian, 27°41'42.0" N, 108°48'53.8" E, alt. 800 m, 9 October 1986, fl., *L. T. Ling 2293* (**KYO**!);– *ibid.*, Leng Jiaba, Son Gtao Xian, Fanjing Shan Mt., 9 October 1986, fl., *B. Bartholomew 2015* (**KYO**!);– **Kwangsi**: Tong Shan, September 1933, fl., *W.T. Tsang 22874* (**P**03359131!);– *ibid.*, 23°52'47.6" N, 106°42'52.8" E, alt. 654 m, May *s.n.*, fr., *s.coll. 39184* (**KYO**!);– **Kwangtung**: Tou Ngok Shan, alt. 1,141 m, November 1933, fl., *W.T. Tsang 23145* (**P**03359132!);– *ibid.*, Ho-yuen, Tsing-lo-kong village, Kwai Shan, alt. 1,146 m, 1 April 1915, fl., *W.T. Tsang 28807* (**KYO**!, **P**03359128!);– *ibid.*, Lung-men, Sheung Ping village, Naam Kwan Shan, alt. 1,146 m, 1 June 1919, fr., *W.T. Tsang 25361* (**KYO**!);– Yingjiang Xian: Huguoshi, 23 September 1986, fl., *B. Bartholomew 1519* (**L**†);– **Szechaun**, Omei Hsien, Mt. Omei, alt. 1,200 m, 4 August 1928, *W.P. Fang 2460* (**P**03359125!);– *ibid.*, alt. 1,400 m, 5 August 1928, *W.P. Fang 2572* (**P**03359124!);– **Yunnan**: alt. 1,200 m, 23 November 1993, fl., *T. Smitinand 865* (**BKF**171720!);– Zhenyuan, Qianjiazhai, alt. 2,100 m, 7 September 2011, fl., *Li Jianwu 1134* (**QBG**64263!);– *ibid.*, Jinghong, Mansang village, alt. 950 m, 25 April 2010, fr., *Z. Shishun 7001* (**QBG**69467!). **INDIA**. November 1843, fl., *W. Griffith*, *s.n.* (**P**03359098!, **P**03359119!);– **Assam**: November 1892, fl., *King*, *s.n.* (**P**03359099-102!, **P**03359115!);– **East Bengal**: March 1862, fl., *W. Griffith 2063* (**P**03359112-3!);– **Khasia**: November *s.n.*, fl., *J.D. Hooker & T. Thomson*, *s.n.* (**P**03359109-11!, **P**03359114!, **P**03359117!, **P**03359120!, **P**03359123!).

JAPAN., 13 May 1963, fr., *s.coll. 6301920* (**KYO**!). **LAOS**. **Northern, Xiang Khouang**: alt. 1,500 m, 1 September 1929, fl., *E. Poilane 16851* (**K**!, **P**03359105!);– Southern, Champasak: Pak Song, Nong Laung village, Bolaven Plateau, 11 November 1938, fl., *E. Poilane 8335* (**P**03359104!);– *ibid.*, 15º04'36.40" N, 106º12'20.64" E, alt. 1,268 m, 19 February 2019, fl., *P. Souladeth*, *S. Tagane*, *A. Sengthong*, *A. Nagahama*, *Y. Suyama & N. Ishii L2468* (**FU**!);– *ibid.*, 15°04'30.9" N, 106°12'31.2" E, alt. 1,249 m, 17 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3335* (**BKF**229800!, **RAF**!, **LAOS**!);– *ibid.*, 15°04'44.53" N, 106°12'27.36" E, alt. 1,249 m, 18 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3468* (**BKF**229797-8!);– *ibid.*, *L3469* (**BKF**229796!, **BKF**229798!, **FOF**!, **RAF**!, **LAOS**!);– *ibid.*, 15°04'26.35" N, 106°12'24.15" E, alt. 1,210 m, 9 December 2018, fr., *S. Tagane*, *A. Nagahama*, *P. Souladeth & P. Pisuttimarn L1894* (**BKF**!, **FU**!);– *ibid.*, 14°53'44.73" N, 106°01'02.36" E, alt. 1,210 m, 13 December 2018, fr., *S. Tagane*, *A. Nagahama*, *P. Souladeth & P. Pisuttimarn L2293* (**FU**!);– *ibid.*, alt. 1,200 m, 11 November 1938, fl., *E. Poilane 28335* (**E**00991997!, **K**!, **MUS**†, **VNM**00023518!);– *ibid*., alt. 1100 m, 5 October 1928, *E. Poilane 15805* (**P**!). **MALAYSIA**. **Pahang**: Sungai Telom, 4°45'25.9" N, 101°16'09.9" E, 23 August 1930, fr., *Kiah & J. Strugnell SFN23929* (**K**!). **MYANMAR**. **Central Burma, Shan**: Rulz Mines, Mogok Beruard Myo, 25 October 1912, fl., *J.H. Lace 6013* (**E**00901059!);– **North Eastern Burma, Shan**: Kuy Juny, September 1909, fl., *Capt. R.W.Mac Gregor*, *I.M.S. 722* (**E**00901063!);– **Upper Burma, Chin**: 23°13'25.3" N, 93°47'56.8" E, alt. 2,122 m, 23 February 2019, fl. & fr., *N. Tanaka*, *S. Akiyama, Mu Mu Aung & S. Rueangruea MY5642* (**RAF**!, **BKF**!);– *ibid.*, Mindat Township, along the road toward Maha Myaing Village, Natmataung NP., alt. 2,526 m, 27 February 2014, fl., *P. Srisanga*, *M. Norsaengsri*, *Unwin*, *Tin Tin Mu*, *L.S. Man & Law Shine 97367* (**E**00757959!, **QBG**!, **US**03718627†);– **Kachin**: Mytikyina, Pyepat, 23 December 1938, fl., *F. Kingdon-Ward 150* (**NY**02649998†);– *ibid.*, Htawgaw, Ngawchang valley, 12 December 1938, fl., *F. Kingdon-Ward 197* (**NY**02649999†).;– *ibid.*, Htawgaw, February 1924, fr., *G. Forrest*, *s.n.* (**E**00072291!);– *ibid.*, Bhamo, Sin Lun Reserve, November *s.n.*, fl., *Ukhin Mg Aye & Gottwald 9071* (**E**00901060!);– *ibid.*, Myitkyina, Kang-fang, 4 December 1938, fl., *F. Kingdon-Ward 8*0 (**NY**02649997†);– *ibid.*, Triangular (Hkinlun), alt. 1,333 m, 22 November 1962, fl., *F. Kingdon-Ward 21623* (**BM**!, **E**00901062!);– *ibid.*, 25 November 1953, *F. Kingdon Ward 21680* (**E**00901058!);– *ibid.*, Sadon and Yunnan Chinese border at Changtiang and Kambaiti, 21°39'42.1" N, 100°00'48.6" E, November 1922, fl., *J.F.C. Rock 7452* (**NY**02649989†, **US**1332904†);– *ibid.*, Adung valley, alt. 2,100 m, November 1931, fl., *F. Kingdon-Ward 9217* (**E**!);– *ibid.*, *F. Kingdon-Ward 9240* (**E**!);– *ibid.*, alt. 1750 m, 21 September 1937, *F. Kingdon-Ward 13275* (**BM**!);– **Upper Burma, Kachin**: Myitkyina, Chiwi, Htawgaw, November 2928, fl., *G. Forrest 25399* (**RAF**1895!);– **West Central Burma, Chin**: Mindat, Hikawng ridge, alt. 2,833 m, 8 November 1962, fl., *U.M.G. Gale 9123* (**BKF**049701!, **E**00901061!);– *ibid.*, Kanpetlet, alt. 2,660 m, April 1956, fl., *U Mg Gale & Uchitkoko 5383* (**RAF**5776!);– *ibid.*, Victoria Mountain, alt. 2,660 m, 17 November 1956, fl., *U Mg Gale & Uchitkoko 6054* (**RAF**5966!);– *ibid.*, Falam, Fort White, alt. 2,309 m, 17 November

1962, fl., *U.M.G. Gale 9202* (**BKF**049700!, **E**00901057!). **NEPAL**. **Bajhang**: Barigaon, 29°42'44.7" N, 80°52'50.7" E, alt. 2,120 m, February 1976, fr., *H. Tabata, R. Keshab*, *Rajbhandari & Y. Shimizu & K. Tsuchiya 9989* (**KYO**!);– *ibid.*, alt. 1,500 m, 8 February 1976, fr., *T. Hideo*, *R. Keshab*, *Rajbhandari*, *Y. Shimizu & K. Tsuchiya 2348* (**KYO**!);– *ibid.*, February 1976, fr., *H. Tabata, R. Keshab*, *Rajbhandari & Y. Shimizu & K. Tsuchiya 2475* (**KYO**!);– Roluwaling Himal, 26 April 1963, fl., *s.coll.*, *s.n.* (**KYO**!). **THAILAND**. **Northern, Chiang Mai**: Mae Jam, alt. 1,500 m, October 1922, fl., *A.F.G. Kerr 6411* (**BK**214000!, **E**00991995!, **K**!, **P**03359087!, **TCD**0016630!);– *ibid.*, Mae Ton Laung, 18°58'13" N, 99°20'16" E, 25 November 1993, fl. & fr., *S.S. Larsen, K. Norgaard*, *N. Pharse*, *P. Puudja & W. Uerchirakan 44831* (**BKF**213019!, **K**!);– *ibid.*, Mae Taeng, Ban Bah Bae, 6 November 1990, fl., *J.F. Maxwell 90-1237* (**L**4207721†);– *ibid.*, Pok Nai village, 18°55'28.1" N, 98°45'21.9" E, alt. 1,240 m, 14 October 2008, fl., *N. Pimsiri PN118* (**QBG**105878!);– *ibid.*, Mae Taeng, Doi Toong Jaw, 19°10'54.3" N, 99°02'09.7" E, alt. 1,000 m, 14 November 1993, fl., *Kulchalee Thonggisan 3* (**CMUB**01132!);– *ibid.*, Mae Ton Laung, 18°58'13" N, 99°20'16" E, alt. 900 m, 25 November 1993, fr., *S.S. Larsen 1116* (**BKF**!);– *ibid.*, Chom Thong, Doi Inthanon NP.: 18°32'16" N, 98°29'37" E, alt. 1,749 m, 9 March 2019, lvs., *S. Kaithongsuk*, *S. Suddee*, *S. Rueangruea*, *C. Hemrat*, *W. Kiewbang 5504* (**BKF**229756!, **TCD**!);– *ibid.*, 18°31'25.89" N, 98°29'36.88" E, alt. 1,700 m, 9 October 1999, fl., *K. Chaiuudom D614* (**CMUB**!);– *ibid.*, 18°31'25.89" N, 98°29'36.88" E, alt. 1,688 m, 6 November 2011, fr., *S. Tagane*, *H. Toyama*, *A. Naiki*, *H. Nagamasu*, *T. Yahara & M. Kanzaki T26*0 (**BKF**213100!, **FU**!);– *ibid.*, 18°31'33" N, 98°24'59" E, alt. 1,687 m, 7 March 2019, lvs., *S. Suddee*, *S. Rueangruea*, *S. Kaithongsuk*, *C. Hemrat*, *W. Kiewbang 5489* (**BKF**229770!, **TCD**!);– *ibid.*, 18°32'28" N, 98°35'57" E, alt. 850 m, 22 July 1988, fl., *C. Phengklai 6817* (**BKF**!);– *ibid.*, Fang, Pong Nam Ron, Doi Phahompok NP., 20°03'51" N, 99°08'30" E, alt. 2,206 m, 12 March 2019, fl., *S. Kaithongsuk*, *S. Rueangruea*, *A. Rueangruea*, *P. Uea-Ari*, *S. Chatrupamai 187* (**BKF**221167!, **TCD**!);– *ibid.*, Mae on, San Kampong, Doilan, 18°45'00.0" N, 99°12'00.0" E, 23 October 1996, fr., *J.F. Maxwell 96-1399* (**BKF**108900!, **L**4207863†);– *ibid.*, Wiang Haeng, Khun Khlong, 19°30'49.4" N, 98°48'10.8" E, alt. 800 m, 24 January 1970, fr., *T. Smitinand 10783* (**BKF**041820!, **K**!, **L**1903615†);– *ibid.*, Mae Chaem, Mae Sanga Management, 18°45'04.5" N, 98°22'12.3" E, alt. 1,300 m, 6 May 2000, fl., *D. Sookchaloem*, *T. Sangnin & S. Sillapasuwan 3344* (**BKF**138873!);– *ibid.*, Mae Wang, Mae Win, Doi Pha Ngaem, Mae Wang NP., 18°41'08.0" N, 98°29'49.5" E, alt. 1,675 m, 5 October 2004, fl., *J.F. Maxwell 04-559* (**CMUB**24121**!, L**4183305†);– *ibid.*, Mueang, Doi Suthep-Pui NP.: 18°49'33.0" N, 98°53'41.1" E, alt. 1,500 m, 19 May 1997, fr., *J.F. Maxwell 97-532* (**BKF**117702!, **CMUB**10992!, **L**4183596†);– *ibid.*, 18°49'33.0" N, 98°53'41.1" E, alt. 1,410 m, 11 July 1997, fr., *T. Sritong S336b*1 (**CMUB**!);– *ibid.*, 18°48'17.6" N, 98°54'11.2" E, alt. 1,400 m, 21 May 1990, fr., *J.F. Maxwell 90-540* (**E**00991999!, **L**1903669†);– *ibid.*, Chang Khian village, 4 October 1990, fl., *J.F. Maxwell 90-1102* (**L**4207688†);– **Chiang Rai**: Mae Sai, Doi Tung pagoda, 20°19'39.3" N, 99°49'43.2" E, 26 October 2015, fl., *M. Van de Bult 1422* (**BKF**219551!, **CMUB**39785!);– *ibid.*, 20°19'33" N, 99°49'27" E, alt. 1,294 m, 22 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR141* (**BKF**229743!, **TCD**!);– Lampang: Mueang Pan, Chae Son NP., 18°49'42” N, 99°23'13” E, alt. 1,125 m, 23 August 1996, fr., *J.F. Maxwell 96-1116* (**BKF**111847!, **BKF**111885!, **CMUB**09322!, **L**4195887†);– *ibid.*, alt. 1,025 m, 27 October 1995, fl., *J.F. Maxwell 95-1034* (**BKF**090849!, **CMUB**!, **L**4207669†);– **Lamphoon**: Mae Tah, Doi Khun Tan NP., 18°29'51” N, 99°16'17” E, alt. 1,200 m, 28 June 1994, fr., *J.F. Maxwell 94-744* (**BKF**079907!, **L**4207635-6†);– **Nan**: Pua, Doi Phu Kha NP., 19°10'28” N, 101°06'22” E, alt. 1,688 m, 25 March 2019, fr., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR163* (**BKF**229993!, **TCD**!);– *ibid.*, 19°10'28” N, 101°06'22” E, alt. 1,670 m, 26 September 2000, fr., *P. Srisanga 1716* (**CMUB**!, **QBG**18163!);– *ibid.*, 19°10'28” N, 101°06'22” E, alt. 1,670 m, 13 November 2001, fr., *P. Srisanga 2240* (**BKF**188586!, **CMUB**!, **QBG**22180!);– *ibid.*, 19°13'00"N, 101°05'00"E, alt. 1150 m, 13 November 2001, *P. Srisanga 2215* (**BKF**188586!, **CMUB**!, **QBG**22155!);– *ibid.*, 19°12'00” N, 101°04'56” E, alt. 1,265 m, 24 March 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Jirakorn & M. Inpa SR157* (**BKF**229997!, **TCD**!);– *ibid.*, 19°12'00” N, 101°04'56” E, alt. 800 m, 23 July 2001, fl., *P. Srisanga & C. Maknoi 2102* (**BKF**191349!, **CMUB**!, **QBG**21228!);– **Eastern, Chantaburi**: Khao Soi Dao, Khao Soi Dao WS., 13°02'18.87” N, 102°09'58.52” E, alt. 1,555 m, 7 March 2014, fl., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T2558* (**FU**!);– *ibid.*, 13°02'23.97” N, 102°09'56.19” E, alt. 1,500 m, 9 March 2014, fl., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T2723* (**FU**!);– **Peninsular, Nakhon Si Thammarat**: Kiri Wong, Khao Laung NP., 8°28'54.7” N, 99°45'01.5” E, alt. 884 m, 14 February 2015, fl., *S. Tagane*, *H. Toyama*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *H. Kanemitsu*, *W. Kiewbang & C. Hemrat T4078* (**FU**!). **VIETNAM**. **Annam, Cao Bang**: Khai Son, Pia Houac, 15 February 1931, fr., *E. Poilane 19003* (**L** 4184913†);– **Dalat**: 11°53'16.5” N, 108°23'52.2” E, alt. 1,750 m, 29 December 1979, fl., *C. Phengklai 10720* (**BKF**153658!, **P**!);– **Haut Donai**: Djiring, Broian, 3 February 1935, fl., *E. Poilane 4090* (**P**03359090!);– *ibid.*, alt. 1500 m, 24 February 1935, *E. Poilane 24583* (**PL**02775815!);– **Kon Tum**: Ngok Pan, 17 December 1946, fl., *E. Poilane 35915* (**P**03359091!);– *ibid.*, Tou Morang, alt. 1,000 m, 10 March 1941, fr., *E. Poilane 32211* (**K**! **MUS**!, **P**03359092!);– *ibid.*, 12º02'48.13” N, 108º26'06.67” E, alt. 1,918 m, 24 June 2018, fl., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya & V.N. Ngoc V8952* (**FU**!);– *ibid.*, 12º02'48.13” N, 108º26'06.67” E, alt. 1,918 m, 24 June 2018, fr., *S. Tagane*, *A. Nagamasu*, *K. Tsuchiya & V.N. Ngoc V8996* (**BKF**!, **FU**!);– *ibid.*, 12º02'48.13” N, 108º26'06.67” E, alt. 1,905 m, 24 June 2018, lvs., *S. Tagane*, *A. Nagamasu*, *K. Tsuchiya & V.N. Ngoc V7907* (**FU**!);– *ibid.*, 12°05'57.43” N, 108°22'55.86” E, alt. 1,845 m, 26 June 2018, fr., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V9045* (**BKF**!, **FU**!);– **Lam Dong**, Bi Doup Nui Ba NP., 12°05'50.4"N, 108°22'36.0"E, alt. 1,711 m, 4 June 2019, *N. Meeprom, S. Yooprasert, Nguyen Van DU, & Nguyen Shin Khang 146* (**BKF**229748!);– *ibid.*, Cong Troi, 12°06'06.85” N, 108°23'00.32” E, alt. 1,866 m, 3 October 2018, fr., *S. Tagane*, *A. Nagahama*, *M. Zhang*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên V9447* (**BKF**!, **FU**!);– *ibid.*, 12°06'06.85” N, 108°23'00.32” E, alt. 1,866 m, 3 October 2018, fr., *S. Tagane*, *A. Nagahama*, *M. Zhang*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên V9456* (**BKF**!, **FU**!);– *ibid.*, Dinh Gia Rieng, Giang Ly, 12º09'36.61” N, 108º32'11.16” E, alt. 1,656 m, 14 June 2018, fl., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A.*

Nagahama, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8253* (**BKF**!, **FU**!);– *ibid.*, Mt. Langbian, Bi Doup Nui Ba NP., 12°09'27.6” N, 108°32'06.6” E, alt. 1,602 m, 23 March 2018, lvs., *T. Yahara*, *H. Nagamasu*, *H. Toyama*, *M. Zhang*, *N. Ai.*, *N.V. Ngoc.*, *H.T. Binh & K. Tsuchiyaojin V7554* (**FU**!);– *ibid.*, Lac Duong, Xa Lat commune, Bi Doup Nui Ba NP., 19 November 2010, fl., *H. van der Werff*, *Bruce Gray*, *T.H. Nguyên & N.S. Khang 23903* (**MO**100330851†, **P**00871491!);– **Cochinchine, Djiring**: Di Linh, Braian, 3 February 1935, fl., *E. Poilane 24090* (**KYO**!, **MU**!, **P**03359090!, **VNM**!);– **Ko Tum**: Dak gley, 2 November 1995, fl., *L. Averyanov*, *N.T. Ban*, *A. Budantzev*, *L. Budeantzev*, *N.T. Hiep*, *D.D. Huyen*, *P.K. Loc & G. Ykovlev VH 1894* (**P**03359139!);– *ibid.*, 30 November 1995, fl., *L. Averyanov*, *N.T. Ban*, *A. Budantzev*, *L. Budeantzev*, *N.T. Hiep*, *D.D. Huyen*, *P.K. Loc & G. Ykovlev VH 2149* (**P**03359135!);– **Tonkin, Cao Bang**: 11 November 1998, fl., *L. Averyanov CBL047* (**MO**1317281!, **P**04167684!);– **Sapa**: August 1929, fl., *P.A. Pételot 3596* (**P**03359106-7!, **US**1525915†);– *ibid.*, October 1932, fl., *P.A. Pételot 4587* (**P**03359108!);– *ibid.*, October 1935, fl., *P.A. Pételot 5705* (**P**03359093!, **P**03359096!);– *ibid.*, Muong Xey, alt. 900 m, 1 August 1944, fl., *J.E.Vidal 37* (**P**03359097!);– *ibid.*, Muong Xey, rout to Lao Cai, alt. 900 m, 25 September 1943, fl., *P.A. Pételot 8406* (**L**†, **K**!, **L**1903620†, **MUS**†, **P**03359088!, **VNM**00013207!);– *ibid.*, Lao Cai, Muong Xen, alt. 700 m, 30 July 1944, fl., *P.A. Pételot 8745* (**P**03359089!, **VNM**!);– *ibid.*, Song Ta Van, alt. 1,700 m, September 1942, fl., *P.A. Pételot 7850* (**K**!, **L**1903617†, **P**03359094!, **VNM**00013204!);– **Ninh Binh**: Nho Quan, 22 July 2000, fr., *Phan Ke Loc CP1513* (L†);– *ibid.*, On the trail between Bong and old Dracontomelon, Nho Quan, on the trail, Cuc Phuong NP., 22 July 2000, fl. & fr., *Lc P.K.*, *N.T. Hiep & N.X. Tam 10295* (**L**1903667†, **P**03359137!);– *ibid.*, Cuc Phuong NP, 10 August 1999, fr., *N.M. Cuong 423* (**L**4207866†);– *ibid.*, 20°22'54.0” N, 105°34'13.2” E, 28 August 2000, lvs., *N.M. Cuong*, *H.L. Quyen & M.V. Sinh 1060* (**L**4207900†);– Vinh Phuc; Tam Dao: Tam Dao NP., 21°27'14.8” N, 105°38'38.4” E, 5 May 2009, fl., *J.Wen 10790* (**US**084459704†);– *ibid.*, 21°27'40.3” N, 105°38'31.2” E, 5 May 2009, fl., *J.Wen 10806* (**US**34871!);– *ibid.*, 21°27'08.4” N, 105°25'33.8” E, alt. 900 m, 29 December 1979, fr., *C. Phengklai 10661* (**BKF**148621!, **P**!).

Distribution.— East Pakistan, Bhutan, E. India (Sikkim, Darjeeling, Assam), China (Szechwan, Kweichow, Kiangsi, Yunnan, Kwangsi, Kwangtung), Myanmar (Chin, Kachin, Sagaing), Thailand, Laos, Cambodia, Vietnam, Malaysia (Pahang), Sumatra (West., East.), and Japan (**Map 4.31**).

Vernacular name.— **China**: Jian Ye Gui Ying. **India**: Lali (India, Chittagong). **Indonesia:** Katjihe (Sumatra, Karo). **Thailand**: หมากม่วง Mak Muang.

Ecology.— Evergreen Forest, Montane or Subalpine Forest, alt. (300–)1,000–3,000(–3,600) m.

Phenology.— Flowering October to March, fruiting February to July.

Uses.— Fruits were once noted as edible (Assam) (Kalkman, 1965).

Conservation.— This species is known from many locations (> 10 locations): EOO = 8,845,352.41 km^2; AOO = 836.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman (1965, 1993) and Vidal (1968) used the name *Prunus wallichii*. *P. undulata* and *P. wallichii* are taxonomically identical, and *P. undulata* has the nomenclatural priority. *Prunus undulata* is therefore accepted in my treatment (also see Gu et al., 2003). Flowering and fruiting throughout the year.

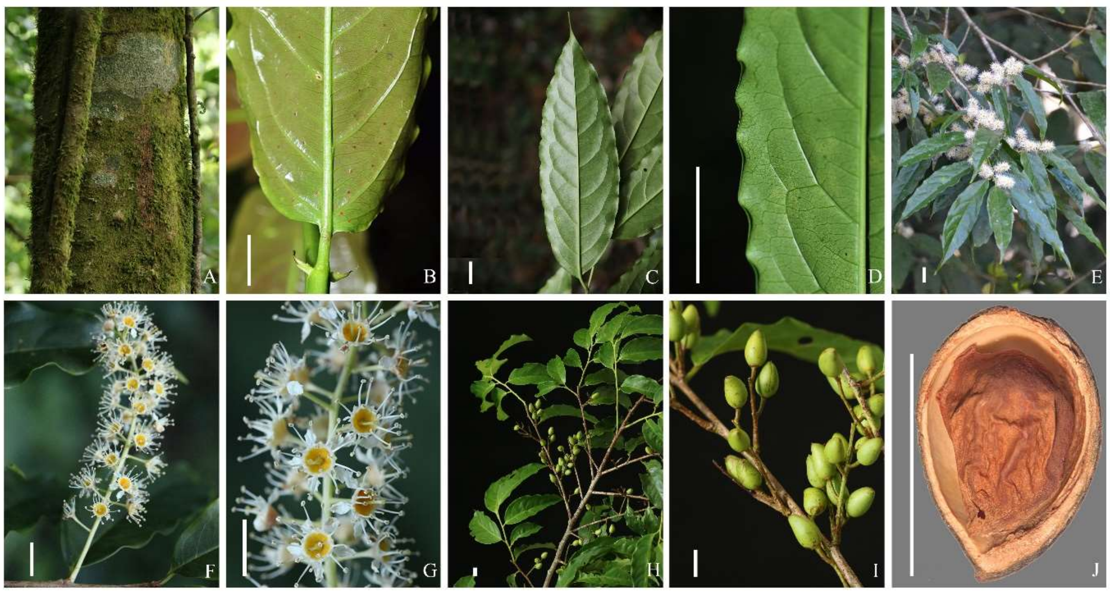
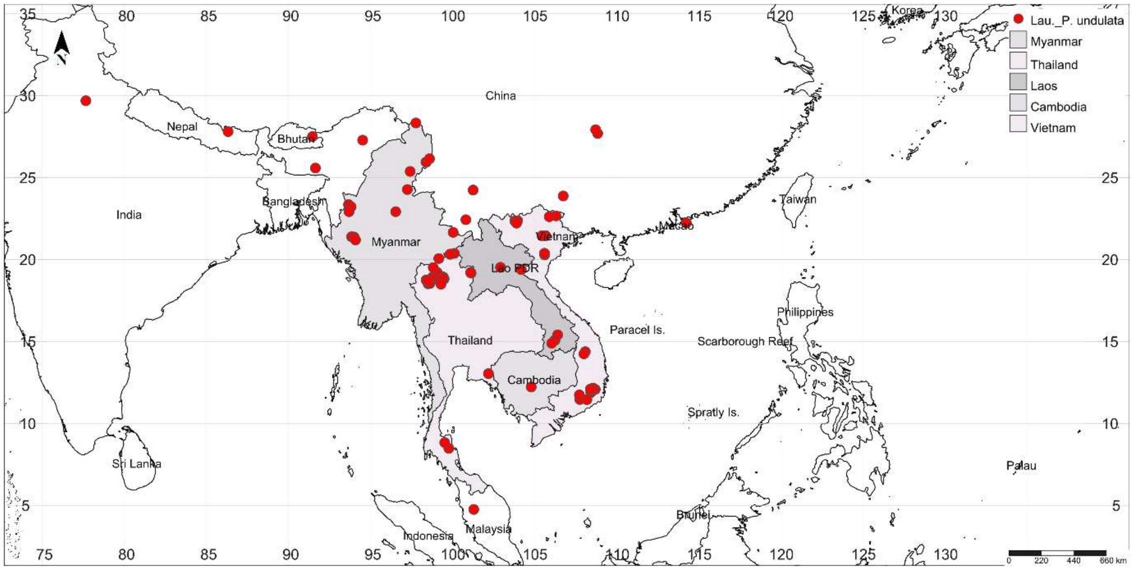


Figure 4.16. *Prunus undulata* Buch.-Ham. Ex D.Don, vegetative and reproductive morphological characters; **A**, outer bark; **B–D**, leaves; **B**, young leaf with sparse reddish-brown glands along the midrib; **C**, abaxial, lateral veins anastomosing; **D**, other glands along the midrib and margin undulate; **E**–**G**, inflorescence; **E**, inflorescence in the axil of a leaf; **F**, inflorescence erect; **H**, corolla distinctly different from calyx lobes, hypanthium yellowish to orange inside; **H** – **J**, fruiting; **H**, infructescence erect; **I**, fruits obovoid to ellipsoid; **J**, fruit cross-section, endocarp, and seedcoat glabrous. — Photos: A, B, F, G by S. Rueangruea; C, D by Kaewbang W.; E by M. van de Bult; H & I by Khambai W.; J by Daonurai K. — Sources: **Myanmar**, Chin State, I & G from *N. Tanaka et al. MY5642*: **Thailand**, Chiang Mai, A–E, H & I from *S. Suddee et al. 5504*: **Vietnam**, Annam, Lam Dong, J from *S. Tagane et al. V9456*. Scale bar = 1 cm.



Map 4.31. Distribution of *Prunus undulata* Buch.-Ham. ex D.Don of subg. *Laurocerasus* in continental Southeast Asia and nearby.

4.3.7.2 Subgenus *Laurocerasus,* section *Mesopygeum* (Koehne) Kalkman, in De Fructibus et Seminibus Plantarum. 1: 218. 1788; Kalkman, Blumea. 13: 1–115. 1965; Kalkman, In: Foundation Flora Malesiana (ed.), Flora Malesiana ser. I, 11(2): 227–351. 1965; Koehne, Botanische Jahrbücher fur Systematik. 51: 177–224. 1913; Koehne, Botanische Jahrbücher fur Systematik. 52: 279–333. 1915; Zhao et al. Journal of Systematics and Evolution. 56(6): 637–651. 2018. – genus *Pygeum* Gaertn., De Fructibus et seminibus Plantarum. 1: 218. 1788; Yu et al. in: Flora Reipublicae Popularis Sinicae 38: 1–133. 1986; Lingdi & Bartholomew in Lu et al. Flora of China. 9: 399. 2003.

Description: Trees or shrubs, evergreen. Branches unarmed. Leaves simple, alternate, petiolate; leaf blade abaxially with a pair of flat to depressed nectaries near the base and additional nectaries sometimes near margin, margin entire or very rarely minutely serrate. Stipules small, free, soon caducous, and rarely persistent. Racemes axillary, solitary or sometimes several in a fascicle, unbranched or branched; bracts small, soon caducous, rarely persistent after anthesis. Flowers bisexual or unisexual, sometimes polygamo-dioecious. Hypanthium obconic, campanulate, or cyathiform, caducous at the fruiting time, only annular base remained. Perianth segments 5–10(–14), small. Sepals and petals are often similar at maturity but sometimes distinct in shape and texture. Petals white, as many as sepals; Stamens 10–85, filaments filiform, usually glabrous, sometimes hairy. The ovary is superior, 1-loculed, glabrous, or hairy; ovules 2 are collateral and pendulous. Style terminal; stigma capitate. Fruit a drupe, dry, usually transversely oblong to ellipsoid, obscurely didymous, sometimes subglobose to oblong and distinctly longer than wide; endocarp cartilaginous, glabrous or hairy inside; seed coat glabrous or hairy.

Note:-- Kalkman (1965) considered the undifferentiated perianth in *Pygeum* as an overlapping character with *Prunus*, which prompted him to transfer *Pygeum* species into *Prunus* subgenus *Laurocerasus* (Duhamel) Rehder (specifically to section *Mesopygeum* (Koehne) Kalkman). According to this study, I have treated *Pygeum* as *Mesopygeum.*

29. ***Prunus* "yalaensis"** sterile specimens. *ined.*

Description: Evergreen, sub-canopy, small tree up to 15 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 12 cm in diameter; outer bark greyish-brown, smooth or shallowly furrowed with brown lenticels, spines absent; *inner bark* pinkish-brown; strong almond smell. **Branchlets** dark brown with sparse brown lenticels; young twigs ferrugineous, densely pubescent when very young, cataphylls absent; old twigs sparsely hairy. *Axillary winter bud* solitary, 1.5–4 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic-lanceolate, oblong-lanceolate or lanceolate, rarely ovate, 5–18 cm long × 2–6.5 cm wide; *lamina apex* acuminate to acute, angle acute; *margin* entire, when young, sometimes slightly serrate upper half, ciliate; *base* slightly asymmetric to oblique, rounded to broadly acute; young leaves greenish-brown, dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous or herbaceous, thin when dry, densely brown pubescent when young; old leaves brown pubescent on both sides, remaining sparsely pubescent, or at least on the midrib and lateral veins adaxially, midrib brown tomentose abaxially; *basal glands* usually absent, 1 or 2, rarely 4, up to 0.5 mm long, globose to ovate, flat or (rarely) slightly hollowed, flat or slightly circular glands adaxially, near the margin or inside the loop of lateral vein, and small pellucid dotted of glandular hairs, not turning black when drying; *2° venation* brochidodromous or weaky brochidodromous, 6–12 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, flat or slighly impress adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate, not very conspicuous or almost invisible; *5° venation* reticulate, inconspicious adaxially; *petioles*, 0.4–1 cm long, terete or shallowly canaliculate in cross-section, densely brown pubescent to glabrescent; *petiolar glands* absent. **Stipules** small to medium, (3)5–8 mm long × 0.5–1.5 mm wide, linear to oblong, apex acuminate, margin entire, ciliate, marginal glands usually present, base oblong, pubescent outside, less densely so or almost glabrous inside, early caducous. **Flowers and fruits** are not seen (**Figure 4.17**).

Additional specimens examined.— **THAILAND**. **Peninsular, Yala**: Betong, The Winter Flower Garden Nature Trail, 5°53'19" N, 101°01'21" E, alt. 864 m, 14 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR233* (**BKF**229966!, **TCD**!);– *ibid.*, 5°53'37" N, 101°01'29" E, alt. 937 m, 14 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR236* (**BKF**229811!, **TCD**!);– *ibid.*, Bannang Sata, Yala, 6°19'10" N, 101°23'29" E, alt. 499 m, 15 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR239* (**BKF**229816!, **TCD**!).

Distribution.— Endemic to Thailand, Yala Province (known only from the specimens cited) (**Maps 4.32, 4.33 & 4.34**).

Vernacular name. **—** Not known.

Ecology.**—** Evergreen to Lower Montane Forest, in shaded or open areas, alt. 400–1,000 m.

Phenology. **—** Not known.

Uses.— Not known.

Conservation.— The species is endemic to Southern Thailand, known only from two locations. The type locality is in Yala province. The number of individuals in the population is small, EOO = 0.00 km2; AOO = 79.343 km2. The number of mature individuals < 50. I consider the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1 (IUCN, 2019).

Note.— *Prunus* "yalaensis" is similar to *Pygeum griffithii* Hook.f., W. Griffith 2050, the synonym of *Prunus patens* (Ridl.) J.Wen (the protologue not seen) has a sinuate leaf margin, a small or inconspicuous pair of glands at the leaf base and leaves, and a young, densely brown hairy twig. However, it is distinguished from *Prunus patens* by its narrow lanceolate leaves (vs. ovate, to ovate-oblong), leaf index of 2.5–3.5 (vs.1.5–2.5), leaf thin (vs. leaf coriaceous), veinlet reticulate and conspicuous when drying (vs. veinlet inconspicuous). The leaf morphology and solitary raceme are similar to *Prunus spicata* Kalkman, a species known from the Philippines to Borneo.

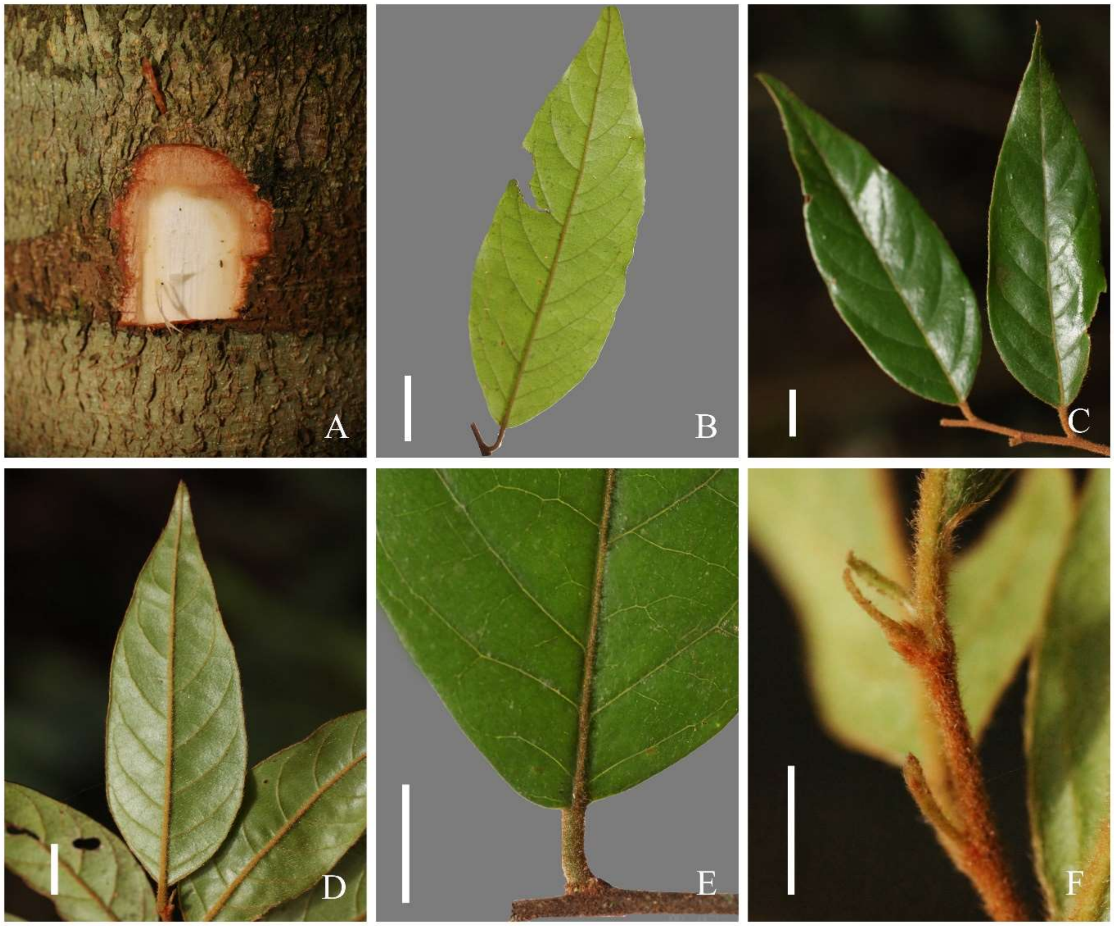
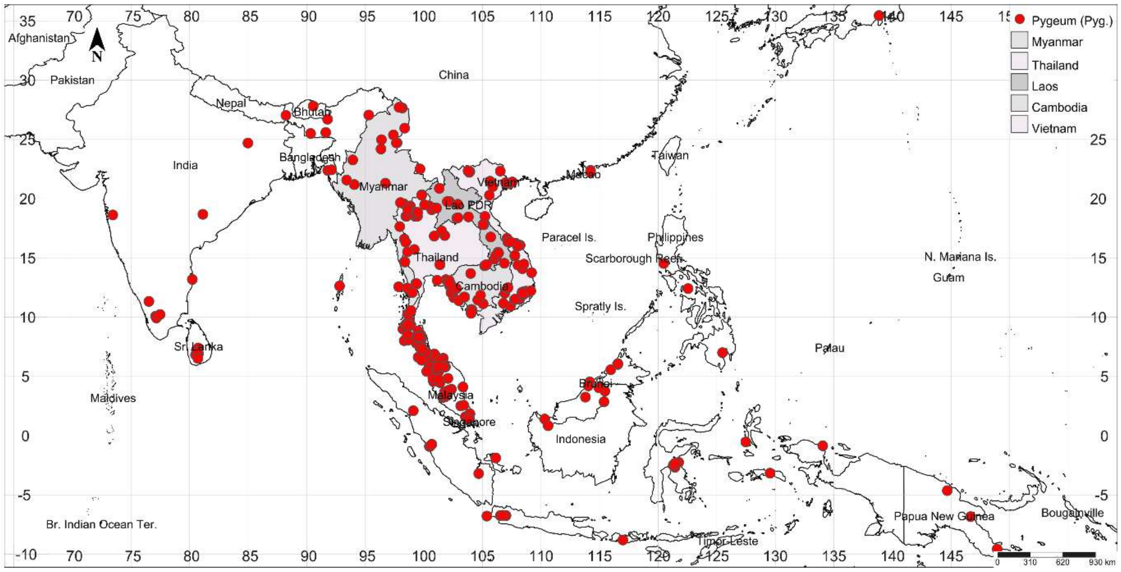
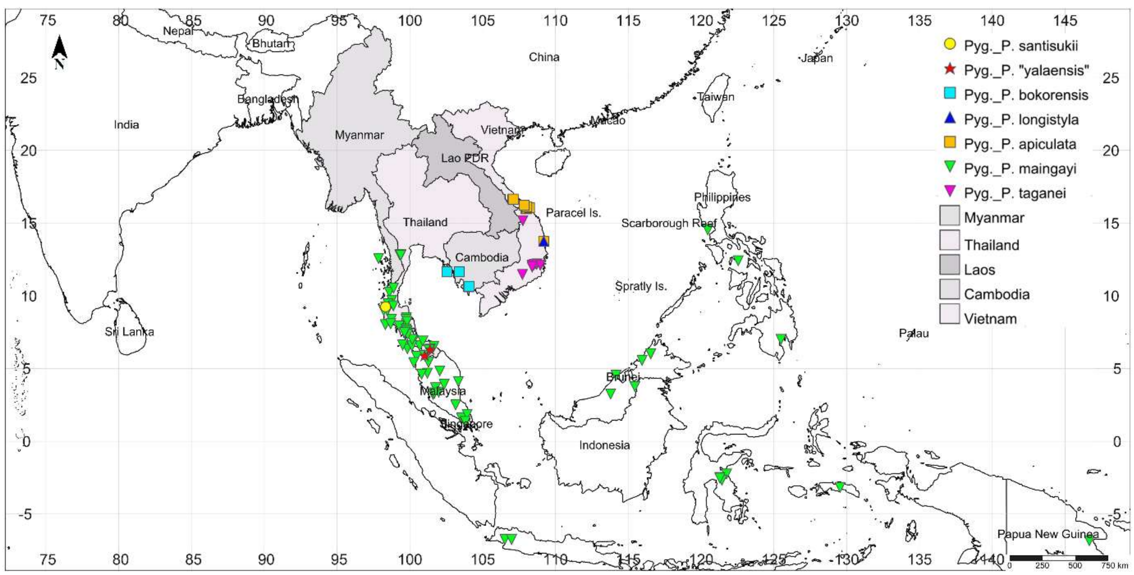


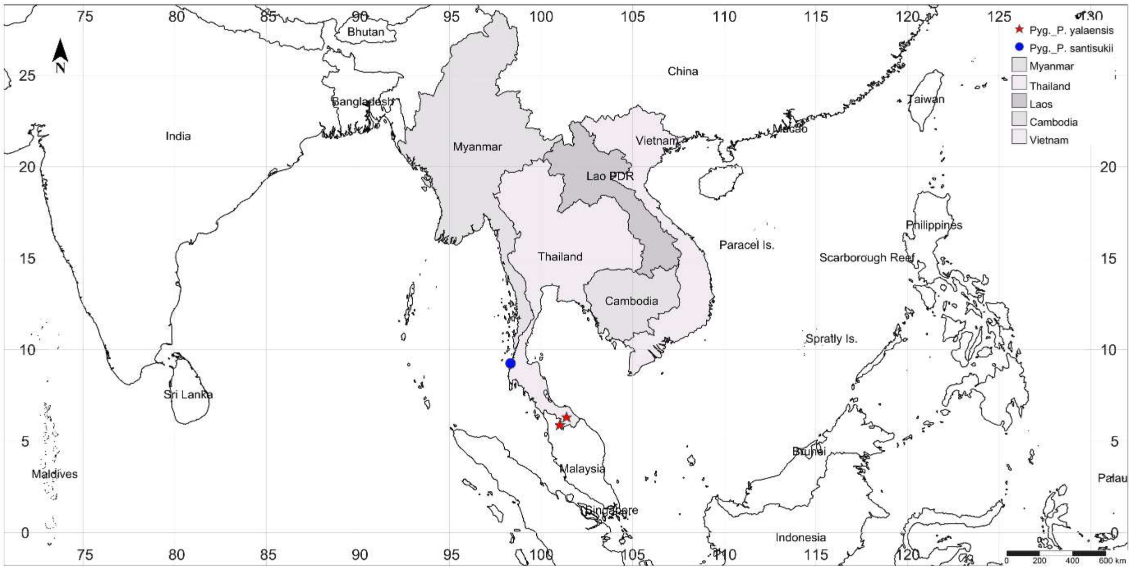
Figure 4.17. *Prunus* sp. 'yalaensis', vegetative and reproductive morphological characters. **B**, outer bark; **B–E**, leaves; **B**, young leaf, margin slightly serrate; **C**, additional protruding gland on the leaf blade adaxial; **D**, margin ciliate, densely brown hairy abaxial; **E**, leaf base with 2 inconspicuous glands; **F**, stipule linear-oblong, brown tomentose. — Photos: all by S. Rueangruea. — Sources: **Thailand**, Yala; A, C, D, F, from *Rueangruea et al. SR233*; B & E from *SR236*. Scale bar = 1 cm.



Map 4.32. Distribution of sect. *Mesopygeum* (Pyg.) in continental Southeast Asia and nearby.



Map 4.33. Distribution of *Prunus santisukii* Rueangr., J.Parn. & Hodk*., P.* "yalaensis", *P. bokorensis* Rueangr., J.Parn. & Hodk.*, P. longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk.*, P. apiculate* (Vidal) Rueangr., J.Parn. & Hodk.*, P. maingai* (Hook. f.) J.Wen *i,* and *P. taganei* Rueangr., J.Parn. & Hodk. respectively of sect. *Mesopygeum* (Pyg.) a solitary short raceme group in continental Southeast Asia and nearby.



Map 4.34. Distribution of *Prunus* "yalaensis", and *P. santisukii* Rueangr., J.Parn. & Hodk. of subg. *Laurocerasus* in continental Southeast Asia.

30. ***Prunus taganei*** **Rueangr**., **J**.**Parn**. **& Hodk**. ***sp*. *nov*.**, ***ined***.

Typification: **VIETNAM, Annam, Lam Dong**, Cong Troi, Bi Doup Nui Ba NP., Lower Montane Forest, 12°05'57.43" N, 108°22'55.86" E, alt. 1845 m, 27 June 2018, *S. Tagane*, *V.N. Ngoc & T.Q. Cuong V9174* [fl.] (holotype **BKF**!, isotypes **FU**; paratypes;– *ibid.*, Hon Giao, Hon Giao, Bi Doup Nui Ba NP., Lower Montane Forest, 12°11'12.0" N, 108°42'51.0" E, alt. 1666 m, 24 September 2018, fr., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên. V9337* (**BKF**! & **FU**!).

Description: Evergreen, sub-canopy, tree up to 25 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown, smooth with sparse lenticels, spines absent; *inner bark* yellowish-brown; strong almond smell. **Branchlets** moderate, greyish-with brown lenticels; young twigs greenish-grey, brown pubescent, glabrescent to densely brown hairy, cataphylls absent; old twigs glabrescent to glabrous. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in the bud, alternate, elliptic, elliptic-oblong to ovate, 8–13 cm long × 2.5–5.5 cm wide; *lamina apex* acuminate to acute, angle acute; *margin* entire revolute, glabrous to sparsely ciliate; *base* asymmetrical to oblique, cuneate to obtuse; young leaves dull green adaxially, pale green abaxially, greyish-brown when dry, turning yellow before falling, chartaceous to subcoriaceous, sparsely hairy; old leaves sparsely hairy, glabrous adaxially, ± pubescent abaxially, midrib brown tomentose abaxially; *basal glands* (–0) 2 (–3), up to 1.5 mm long, ovate-oblong, flat, over the base of leaf blade margin, along the midrib, additional scarce circular or semi-circular glands on the blade near the margins, densely small pellucid dotted on the blade; *2° venation* weakly brochidodromous, 6–10 alternate on another side of the midrib, oblique, decreasing towards the base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, narrow to moderate (35–50°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 1–1.6 cm long, canaliculate in cross-section, rounded abaxially, pubescent; *petiolar glands* absent. **Stipules** medium, 6–10 mm long × 1–2.5 mm wide, oblique linear, oblong, apex acuminate, margin entire or slightly toothed near the base, with a few marginal glands, base oblong-truncate, sparsely to densely hairy, not early caducous. **Inflorescences** compound, solitary raceme, dense-flowered, (mainly) in axils of leaves, occasionally on the branches with fallen leaves, 1–2.5 cm long, (2–)5–15-flowered, pubescent, peduncle erect; *involucral bracts* 5–8, up to 4 mm long, size and shape variable, ovate to subglobose, apex acute to slightly lobed, hairy outside, sub(glabrous) inside, margin ciliate, persistent at anthesis. **Flowers** bisexual, opening with mature leaves, white to yellowish-brown, sessile or short pedicellate, stout, 0–2 mm long, densely short brown hairs; *bracteoles* ovate, circular or fan shape, apex emarginate or lobed, up to 3.5 mm long, greenish-brown, tomentose, brown hairy outside, sparsely hairy inside, not early caducous; *hypanthium* funnel-shaped, 3–4 mm long, densely pubescent; *perianth* petals slightly different from calyx lobes; *calyx* lobes 5, triangular, minute, ca. 1.3 mm long × 0.8–1.2 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, tomentose brown hairy outside, densely hairy inside; *corolla* petals slightly different to or indistinguishable from sepals, white, spreading to upright, 5, medium, ca. 2.5 mm long × 2–2.5 mm wide, subequal to calyx lobes, ovate-oblong, sessile, apex rounded, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 40–46 in 3 to many series, exserted; filament filiform, white, 4–4.5 mm long, glabrous or sparsely hairy; anthers globose, 0.3–0.4 mm long; *ovary* densely hairy, 1 locular; *style* filiform, 4–6 mm long, slightly longer than, or as long as stamens, glabrous; stigma discoid. *Infructescence* 2–3 cm long, tomentose, few, 1–6 fruited. **Fruits** fleshy, stipitate, 1.5–3 mm long, young fruit green, red to reddish-purple when mature or ripe, transverse ellipsoid, subreniform to didymous, 0.8–1.2 cm long, 1.2–2.5 cm wide, apex acute to obtuse; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal or ridged, canaliculate; calyx deciduous; style present, peaked or apiculate up to 1.5 mm long. **Seeds** usually transversely globose laterally, thin, with glabrous testa, reticulate (**Figures 4.18 & 4.19**).

Additional specimens examined.— **VIETNAM**. **Annam, Gia Lai**: Mang Yang, Kon Ka Kinh, 14°15'31.7” N, 103°53'47.6” E, alt. 1,274 m, 24 April 2019, fl., *T. Yahara*, *S. Tagane*, *A. Nagahama*, *N. Komada*, *H.V. Thanh*, *N.C. Thinh V10956* (**FU**!);– **Khanh Hoa**: Hon Ba, 12°07'11.42” N, 108°57'25.76” E, alt. 1,366 m, 27 November 2014, lvs., *H. Toyama*, *S. Tagane*, *V.S. Dang*, *H. Nagamasu*, *A. Naiki*, *H. Tran*, *C.J. Yang*, *N.Q. Cuong*, *H.N.P. Hieu V2299* (**BKF**!, **FU**!);– *ibid.*, 12°06'46.88” N, 108°58'14.43” E, alt. 919 m, 20 February 2014, lvs., *H. Toyama*, *S. Tagane*, *V.S. Dang*, *H. Nagamasu*, *A. Naiki*, *H. Tran*, *C.J. Yang*, *N.Q. Cuong*, *H.N.P. Hieu V937* (**FU**!);– **Kon Tum**: Ngoc Linh, Ngoc Linh Nature Reserve, 15°10'07.4" N, 107°45'43.4" E, alt. 1,376 m, 13 February 2017, lvs., *S. Tagane*, *H. Nagamasu*, *N.V. Ngoc*, *H.T. Binh*, *H.T. Son*, *C.J. Yang & A. Kawakubo V6461* (**FU**!);– *ibid.*, alt. 1,076 m, 11 February 2017, lvs., *S. Tagane*, *H. Nagamasu*, *N.V. Ngoc*, *H.T. Binh*, *H.T. Son*, *C.J. Yang & A. Kawakubo V6128* (**FU**!);– **Lam Dong**: Cong Troi, Bi Doup Nui Ba NP., 12°06'06.85" N, 108°23'00.32" E, alt. 1,866 m, 27 June 2018, fl., *A. Nagahama*, *S. Tagane*, *K. Tsuchiya*, *V.N. Ngoc*, *H.T. Binh*, *T.Q. Cuong*, *V.S. Dang V9121* (**FU**!);– *ibid.*, alt. 1,845 m, 27 June 2018, fl., *S. Tagane*, *V.N. Ngoc & T.Q. Cuong V9174* (**FU**!);– *ibid.*, alt. 1,669 m, 14 June 2018, fl., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8177* (**FU**!);– *ibid.*, 12º09'36.61" N, 108º32'11.16" E, alt. 1,669 m, 14 June 2018, fl., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8198* (**FU**!);– **Dinh Gia Rieng**, Giang Ly, Bi Doup Nui Ba NP., 12º09'36.61" N, 108º32'11.16" E, alt. 1,656 m, 15 June 2018, fl., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8277* (**FU**!);– *ibid.*, 12°11'11.25" N, 108°42'54.17" E, alt. 1,639 m, 17 June 2018, fl., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8586* (**BKF**!, **FU**!);– *ibid.*, 12°10'34.92" N, 108°41'08.35" E, alt. 1,543 m, 22 June 2018, lvs., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya & V.N. Ngoc V8854* (**BKF**!, **FU**!);– **Hon Giao**, Bi Doup Nui Ba NP., 12º09'36.61" N, 108º32'11.16" E, alt. 1,655 m, 26 September 2018, fr., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên. V9348* (**BKF**!, **FU**!);– *ibid.*, 12°11'12.0" N, 108°42'51.0" E, alt. 1,666 m, 24 September 2018, fr., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên V9337* (**FU**!);– *ibid.*, 12°11'14.83" N, 108°42'52.20" E, alt. 1,620 m, 26 December 2018, fr., *T. Yahara*, *S. Tagane*, *A. Nagahama & K. Tsuchiya V9689* (**BKF**!, **FU**!);– *ibid.*, 12°10'34.7" N, 108°41'08.4" E, alt. 1,533 m, 21 February 2016, lvs., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *V.S. Dang*, *V.N. Ngyuen*, *T.H. Binh & J. Wai V3998* (**FU**!);– *ibid.*, 22 February 2016, lvs., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *V.S. Dang*, *V.N. Ngyuen*, *T.H. Binh & J. Wai V4152* (**FU**!);– *ibid.*, Mt. Langbian, Bi Doup Nui Ba NP., 12°09'27.6" N, 108°32'06.6" E, alt. 1,602 m, 24 March 2018, lvs., *T. Yahara*, *H. Nagamasu*, *H. Toyama*, *M. Zhang*, *N. Ai.*, *N.V. Ngoc.*, *H.T. Binh & K. Tsuchiyaojin V7826* (**FU**!);– **Cochinchine, Khanh Hoa**: Hon Ba Mt., 12°07'29.45" N, 108°57'51.11" E, alt. 1,204 m, 20 July 2013, fl., *S. Tagane*, *T. Yahara*, *H. Nagamasu*, *K. Fuse*, *H. Toyama*, *H. Tran*, *V.S. Dang*, *X.N. Loi*, *N.D. Thach*, *Q.N. Cuong*, *P.N.H. Hieu & K.N. Thach V474* (**BKF**!, **FU**!);– **Khanh Hoa**: Hon Ba Mt., 12°07'29.45" N, 108°57'51.11" E, alt. 1,204 m, 20 July 2013, lvs., *S. Tagane*, *T. Yahara*, *H. Nagamasu*, *K. Fuse*, *H. Toyama*, *H. Tran*, *V.S. Dang*, *X.N. Loi*, *N.D. Thach*, *Q.N. Cuong*, *P.N.H. Hieu & K.N. Thach V520* (**FU**!);– *ibid.*, 21 July 2013, lvs., *S. Tagane*, *T. Yahara*, *H. Nagamasu*, *K. Fuse*, *H. Toyama*, *H. Tran*, *V.S. Dang*, *X.N. Loi*, *N.D. Thach*, *Q.N. Cuong*, *P.N.H. Hieu & K.N. Thach V618* (**FU**!);– **Tonkin, Quyen Guang**: Hui Ta, 14°15'31.7" N, 103°53'47.6" E, 1 May 1918, fr., *F. Fleury 37975* (**P**03358555!).

Distribution.— Endemic to Vietnam (known only from the specimens cited) (**Maps 4.32, 4.33 & 4.35).**

Vernacular name. — Not known.

Etymology.— The epithet 'taganei' honors Dr. Shuichiro Tagane, a botanist from Japan, Kagoshima University, the collector of the type specimen.

Ecology.— Scattered in Lower Montane Forest, alt. 900–2,000 m.

Phenology.— Flowering from April to July, fruiting from May to December.

Uses.— Not known.

Conservation.—This species is known from many locations, (> 10 locations): EOO = 11,658.36 km^2; AOO = 36.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

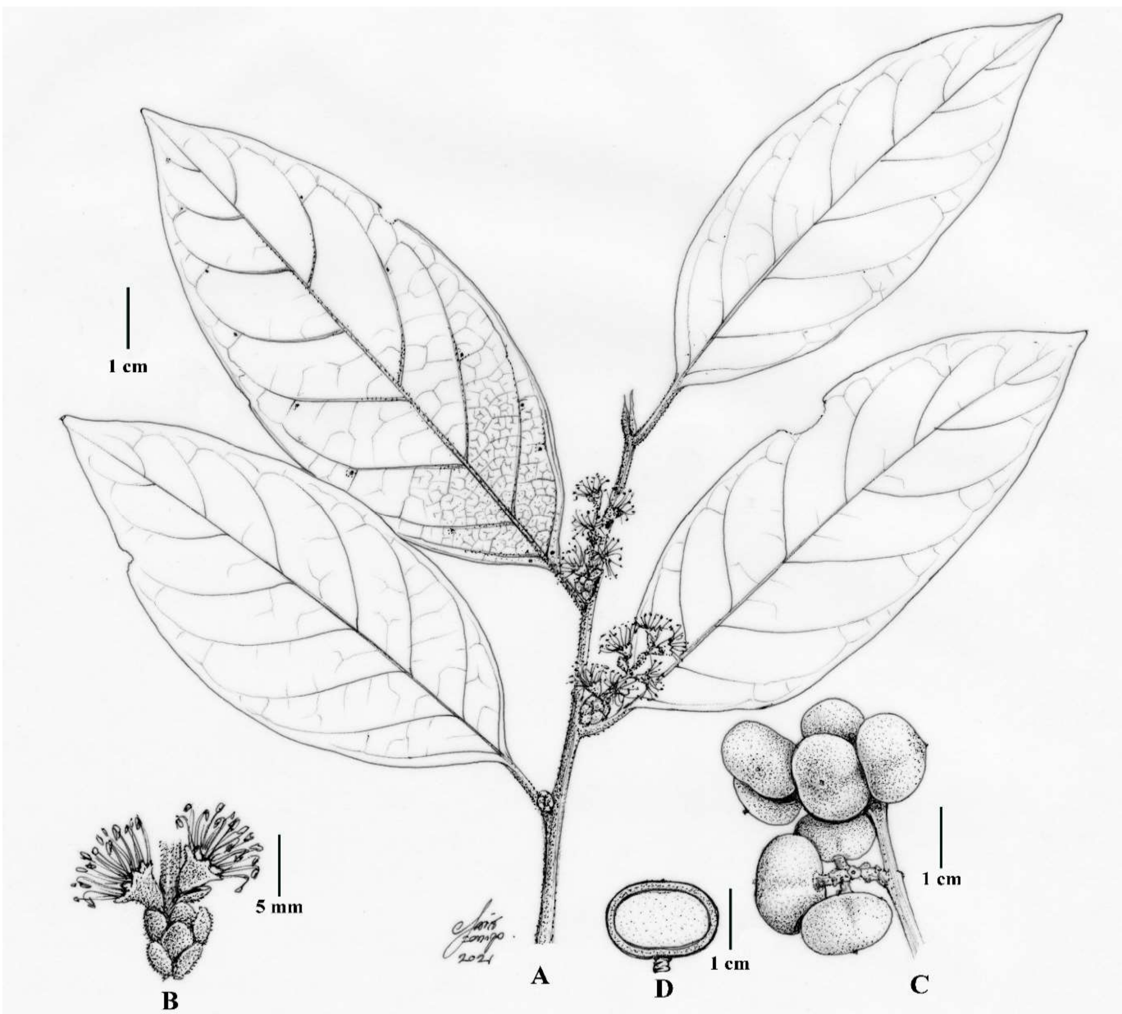


Figure 4.18. *Prunus taganei* Rueangr., J.Parn. & Hodk. **A**. inflorescence branch, short, simple raceme with dense flowers; **B**. peduncle with dense bracts, 6–10; **C**. infructescence, densely short-stalked; **D**. fruit (cross-section), inside of endocarp and seedcoat glabrous. **A** and **B** from *S. Tagane*, *V.N. Ngoc & T.Q. Cuong V9174* (**BKF**); **C** and **D**. from *S. Tagane et al. V9337* (**BKF**). Drawn by Pairuch Rayangkul.

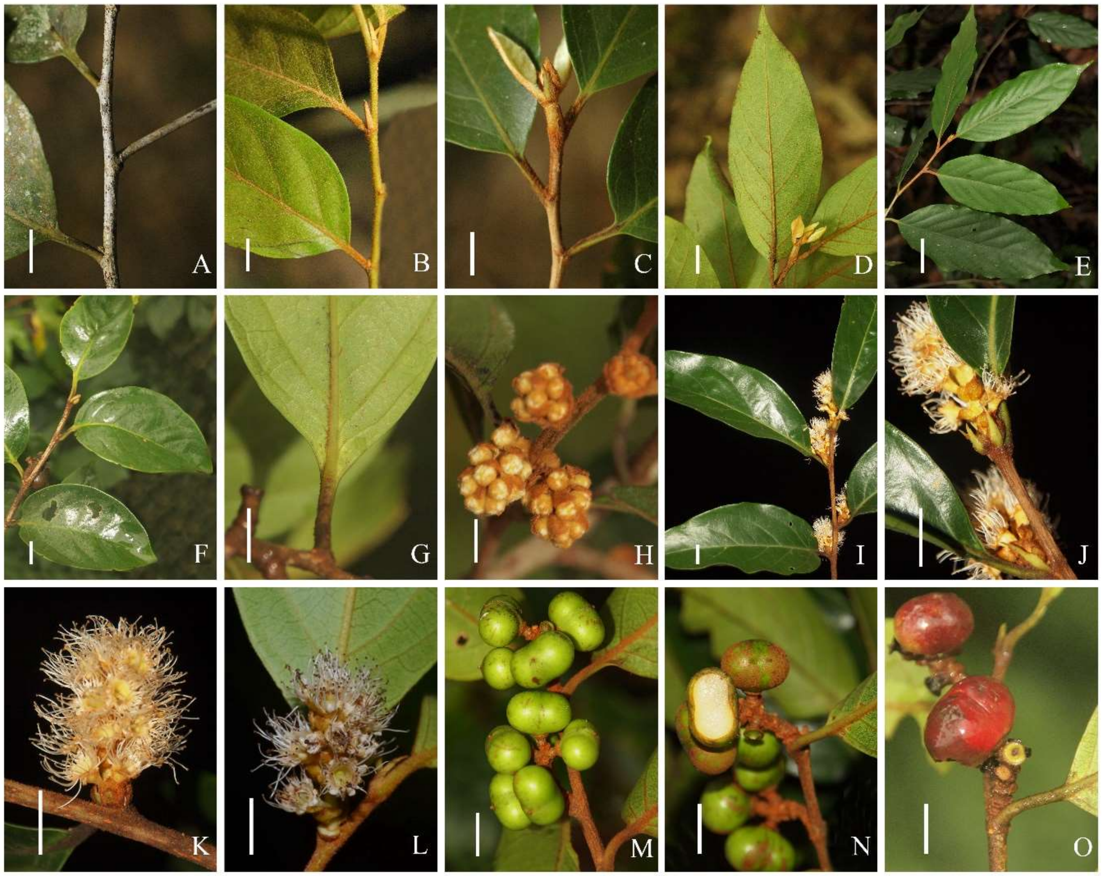
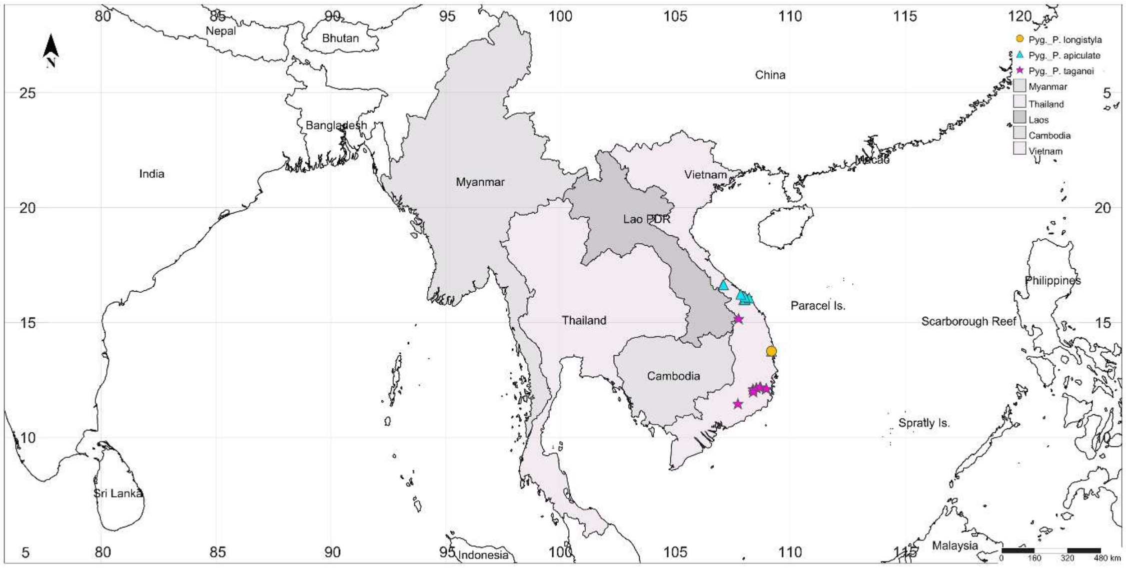


Figure 4.19. *Prunus taganei* Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters. **A--F**, twig, and leaves; **A**, twig greyish; **B**, shoot with oblong-lanceolate stipules, densely hairy; **C**, leaves alternate, twig with slight ridge; **D**, leaves elliptic-oblong, brown hairs abaxial; **E**, margin entire, undulate; **F**, variation of leaf shape (ovate) and texture (sub-coriaceous); **G**, basal glands 2–4; **H**–**L**, inflorescence; **H**, flower bud; **I**, inflorescence in the leaf axil; **J**, conspicuous stipules, and bracts at anthesis; **K**, involucral bracts at the base of inflorescence; **L**, petals slightly different from calyx lobes; **M**–**O**, infructescence; **M**, fruits transverse ellipsoid; **N**, cross-section, endocarp, and seedcoat glabrous; **O**, red to reddish-purple when mature or ripe. — Photos: A–D by Ruangruea S.; E–O by S. Tagane — Sources: all from **Vietnam**, Dalat, *S. Tagane, et al.*; E, *V9121*; F & G, *V9689*; H, *V8586*; I, K, & L, *V8177*; J, *V9174*; M & N, *V9337*; O, *V9689*. Scale bar = 1 cm.



Map 4.35. Distribution of *Prunus longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk., *P.apiculata* (Vidal) Rueangr., J.Parn. & Hodk., and *P. taganei* Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia.

31. ***Prunus lancilimba* (Merr.) Kalkman**, Blumea; Tijdschrift voor de Systematiek en de Geografie der Planten (A Journal of Plant Taxonomy and Plant Geography). 13(1): 101. 1965; *ibid.*, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to *Pygeum*: 101–102. 1965.; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 192, pl. xxv, 9. 1968. Type as for the basionym below.

≡ *Pygeum lancilimbum* Merr. in A.C.Sm. et al., Journal of the Arnold Arboretum. 19: 34. 1938; J.E.Vidal in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris 13: 296. 1949. Typification**: VIETNAM, Tonkin**: neighborhood of Sapa, Massif du Fa Tsi Pan, alt. 1,400–1,700 m., September 1930, *P.A. Pételot 4499* (holotype in **A**00032451†; isotypes **BO**, **L**0019666†, **NY**00415949-50†, **P**01819066!, **US**00107914†; paratypes:–, alt. 1,400 m., October 1930, *P.A. Pételot 4589* (**E**01020022-3!, **K**000737331!, **KYO**!, **L**1903111–3†, **P**03358255!, **P**03358261!, **US**1597384†);– alt. 1,200 m., July 1930, *P.A. Pételot 4588* (**P**03358259–60!, **US**1597362†);– route to Lo Qui Ho, alt. 2,000 m, September 1931, a tree 8–15 m tall, *P.A. Pételot 4592* (**E**01020023!, **K**000737332!, **L**1903111-2†, **P**03358256–7!, **US**1597374†).

= *Pygeum caudatum* Merr., Brittonia. 4: 87. 1941, non *Prunus caudata* Franch, Plantae Delavayanae, 196. 1890.

≡ *Prunus lancilimba* (Merr.) *sensu. auct*. Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly referred to as *Pygeum*. 101—102, 1965, *pro parte quoad*, *F. Kingdon-Ward 37* and 1*36*.

Typification**: MYANMAR,** Pyepat Ridge, alt. 1,800–2,100 m., a small to medium tree with fragrant flowers, 26 November 1938, *F. Kingdon-Ward 37* (holotype **BM**000622031!, isotype **A**00032449†); paratypes:–, alt. 2,336 m., 18 December 1938, same as no. 37, *F. Kingdon-Ward 136* (**A**†, **NY**00415947†, **NY**00415948†).

Description: Evergreen, sub-canopy, tree 8–15 m tall, canopy shape oval or globose. **Stem** clear bole, outer bark dark brown, smooth, spines absent; faint almond smell. **Branchlets** stout, blackish-brown to dark purplish-brown, with prominent lenticels; young twigs greenish-brown, densely brown hairy, cataphylls absent; old twigs glabrescent to glabrous. *Axillary winter bud* solitary, ovoid, 2–4 mm, brown pubescent, apex obtuse to acute; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, lanceolate to oblong-lanceolate, 8–16 cm long × 1.5–4.5 cm wide; *lamina apex* acuminate, tapering up to 3 cm long, with narrow point at the end, angle acute; *margin* entire, entire to sparsely hairy; *base* asymmetrical or symmetrical, acute to more or less rounded; young leaves pale green, dull dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous; sparsely tomentose on both sidie, margins slightly ciliate; old leaves sparsely tomentose on both sides, margins slightly ciliate, glabrescent to glabrous adaxially, glabrescent or sparsely hairy along abaxial midrib; *basal glands* usually 2(–4), up to 1.5 mm long, circular to ovate, flat, typically inconspicuous at the base of leaf base to slightly distant from the corner to over the second pair of nerves, sparse conspicuous small glands on leaf blade or near the margin; *2° venation* weaky brochidodromous, 6–12 alternate on either side of the midrib, oblique, ascending, spacing irregular, sunken adaxially, slightly inconspicuous abaxial when dry, very narrow angle (25–35°); *3° venation* mixed alternate and opposite percurrent; *4° venation* laticulate; *5° venation* regular polygonal reticulate; *petioles*, 0.6–1 cm long, stout, shallowly canaliculate in cross-section or terete, glabrous or sparsely pubescent; *petiolar glands* absent. **Stipules** medium to large, index 6–9, 8–12 mm long × 1–2 mm wide, linear or oblong, apex acuminate, margin entire, ciliate, with or without glands, base oblong, pubescent on both surfaces, without glands or with marginal glands, early caducous. **Inflorescences** compound, fasciculate in bundles of 2(–3), sometimes solitary, dense-flowered, mainly in axils of leaf, rarely on the branches with fallen leaves, 0.5–2.5 cm long, up to 15-flowered, densely brown tomentose; *bracts* 1–3, 1–3 mm long, size and shape variable, oblong, apex tripartite or tri-lobed, densely hairy outside, only hairy on the bottom inside, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white, pedicellate, stout, short to slender, 0.5–3 mm long, brown tomentose; *bracteoles* tripatite, 1–2 mm long, pale green, densely brown hairy, early caducous; *hypanthium* campanulate to obconic, 1.5–2 mm long, densely brown hairy outside, glabrous inside, hairy around insertion of ovary; *perianth* petals slightly different from calyx lobes, 7–12 segments, 0.8–1.2 mm long, hairy both sides and margin ciliate; *calyx* lobes perianth 7–12 segments, ovate to triangular, minute, green, 1–1.5 mm long × 0.5–0.7 mm wide, subequal, apex acute to obtuse, margin entire, ciliate, base truncate, separate in the bud, spreading when mature, deciduous, pubescent outside, pubescent inside; *corolla* petals slightly different or indistinguishable from sepals, whitish-brown, spreading to upright, 5–6 (as many as sepals), small, 1–1.5 mm long × 0.5–0.8 mm wide, equal or subequal, as long as or slightly longer than calyx lobes, oblong, ovate-lanceolate or triangular, sessile, apex acute to obtuse, margin entire, ciliate, base oblong, or truncate, alternate with calyx lobes, tomentose outside and inside; *stamens* 15–25 in 1 to 3 series, exserted, more prolonged than perianth; filament filiform, white, 2.5–6 mm long, glabrous; anthers oblong-oval, 0.3–0.6 mm long; *ovary* glabrous, with ring of hairs around the point of insertion, 1 locular; *style* filiform, slender, 2.5–5 mm long, slightly shoter or as long as stamens length, glabrous, very rarely with few hairs; stigma gland not divided, globose, green. *Infructescence* 2–3.5 cm long, sparsely to densely hairy, 1(–2) fruited. **Fruits** fleshy, 1–2 mm long, young fruit green, turning dark purple or black, via yellowish-brown when mature or ripe, ovoid-oblong, 1.5–1.7 cm long, 0.8–1.2 cm wide, apex retuse or obtuse, pointed; young and mature fruits glabrous; exocarp smooth and shiny, with a longitudinal groove, black when ripe (via yellow or red); mesocarp fleshy, thin, white, smelling of bitter almonds; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged, glabrous, more rarely hairy; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually laterally transversely globose, thin, glabrous testa, and shallowly rugose (**Figure 4.20**).

Additional specimens examined.— **VIETNAM**. **Tonkin**, **Sapa**: Fan Tsi Pan, alt. 2,000 m, September 1931, fl., *P.A. Pételot 4592* (**E**!, **K**!, **L**1903111–12†, **P**03358256–7!);– *ibid.*, September 1931, fl., *P.A. Pételot*, *s.n.* (**KYO**!);– *ibid.*, alt. 1,700 m, September 1930, fl., *P.A. Pételot 4499* (**P**01819066!);– *ibid.*, Hoang Lien NP., 4 July 1930, fl., *E. Poilane 17180* (**L**1903110†, **P**03358258!, **P**03358262!);– *ibid.*, on the way to Fanxifan peak from Ton station on Sapa pass, 22°21'03.6" N, 103°46'36" E, alt. 2,016 m, 13 September 2005, fl., *V.X. Phuon*, *N.V. Du, N.T. Coung*, *D.T. Xuye*, *N. Bramley, G. Rogier de Kok*, *Challe Gill*, *N.M. Vorontsova & A. Davis HNK227* (**K**!);– Lao Cai, Sapa, alt. 1900 m, 7 August 1926, *E. Poilane 12878* (**P**!);– *ibid.*, alt. 2400 m, 1 August 1926, *E. Poilane 12720* (**P**!);– *ibid.*, San Sa Ho, 22°21'16" N, 103°46'43" E, alt. 1,821 m, 30 November 2014, fr., *Van Du T.S. Nguyên*, *T.S. Vu Tien Chinh*, *B.H. Quang*, *N.C. Sy*, *R. Baines*, *A. Luke*, *J. Harbage*, *M. Taylor & Andy Hill 29* (**E**00670989!).

Distribution.— N. Myanmar, S. China (Yunnan), Vietnam (Tonkin, Sapa) (**Maps 4.36**).
Vernacular name. **—** Not known.
Ecology.— Scattered in Lower to Upper Montane Forest, alt. 1,200–2,800 m.
Phenology.**—** Flowering: July–September. Fruiting: October–December.
Uses.— Not known.
Conservation.—This species is known from many locations (> 10 locations): EOO = 192,394.82 km^2; AOO = 28.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— A species well characterized by its lanceolate, slenderly caudate-acuminate, obscurely reticulate leaves and dense axillary spikes equaling the petioles in length. The characteristic tripartite bracts and bracteoles fall before the flower opens. Fruits are usually ovoid-oblong.

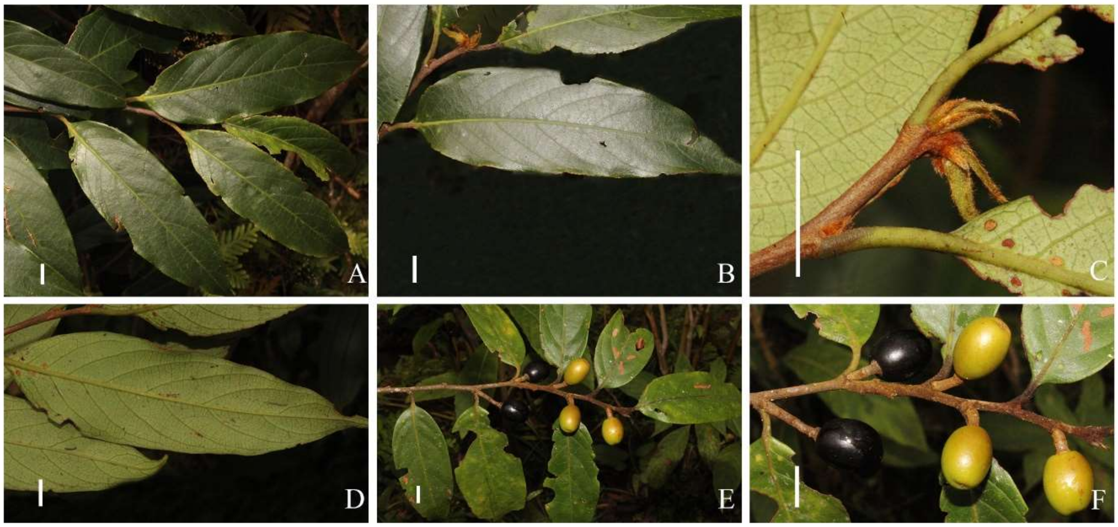
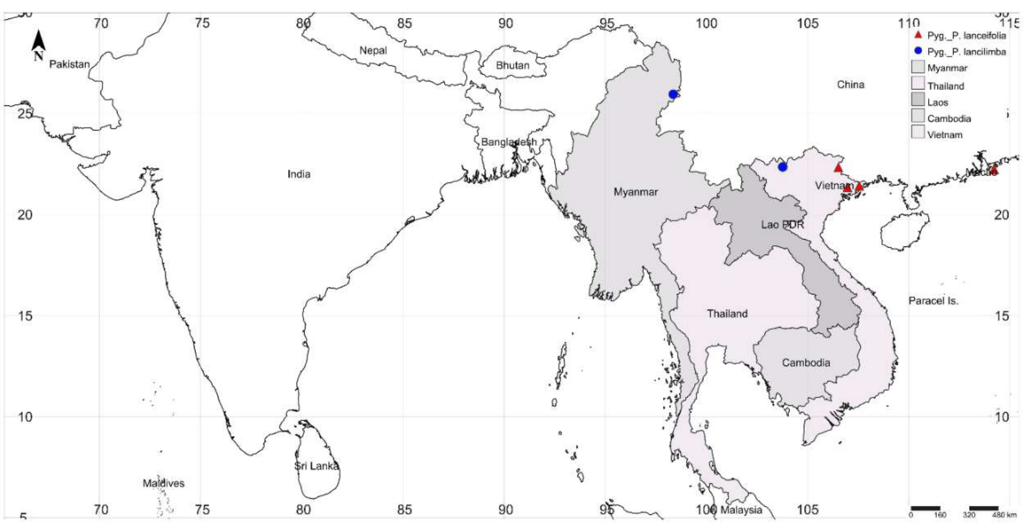
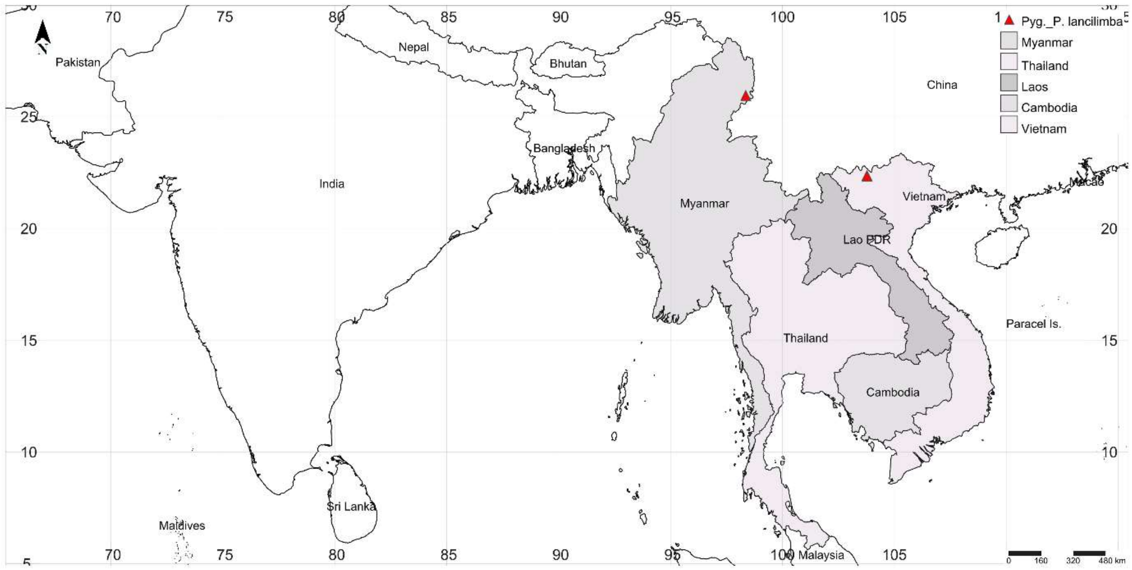


Figure 4.20. *Prunus lancilimba* (Merr.) Kalkman., vegetative and reproductive morphological characters; **A–D**, leaves; **A**, leaves alternate, oblong-lanceolate; **B**, adaxial, margin undulate, basal glands, usually 2(–4); **C**, stipules linear to oblong, margin ciliate; **D**, slightly glaucous abaxial; **E** & **F**, fruiting; **E**, fruits on the end of infructescence, ovoid-oblong; **F**, mature green, turning black when ripe. — Photos: all by Em Son. — Source: all from **Vietnam**, Fanxipan. Scale bar = 1 cm.



Map 4.36. Distribution of *Prunus lanceifolia* (Merr.) Rueangr., J.Parn. & Hodk. and *P. lancilimba* (Merr.) Kalkman of sect. *Mesopygeum* in continental Southeast Asia.



Map 4.37. Distribution of *Prunus lancilimba* (Merr.) Kalkman of sect. *Mesopygeum* in continental Southeast Asia.

32. ***Prunus santisukii* Rueangr**., **J**.**Parn**. **& Hodk**. *sp. nov.*, *ine d*.

Typification**: THAILAND, Phang Nga**, Khao Pawta Laung Kaew NP., 9°15'N, 98°20'E, alt. 1,300 m, Montane Forest, 2 May 1973, *R. Geesink & T. Santisuk 5131* (Holotype **BKF**049616!; isotypes **E**01020031!, **K**!, **KYO**!, **L**1902913†, **P**03358160!).

Description: Evergreen, understory, shrub to small tree 5 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark dark grey, smooth with brown lenticels, spines absent; strong almond smell. **Branchlets** stout, whitish-grey; young twigs green, sparsely brown hairy, then glabrous, cataphylls absent; old twigs glabrous, grey. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate-elliptic, 4–11 cm long × 2–5 cm wide; *lamina apex* obtuse to acute, angle acute to obtuse; *margin* entire, revolute, glabrous; *base* slightly oblique or symmetrical, acute or obtuse, and decurrent; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, herbaceous to subcoriaceous, glabrescent to glabrous; old leaves glabrous with sparse hairs on midrib adaxially, glabrescent abaxially; *basal glands* 2 (–3), up to 2 mm long, ovate-oblong, flat, over the base of leaf blade margin, on both surfaces, additional scarce circular glands near or along margins; *2° venation* weakly brochidodromous, 6–10 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°), sparsely hairy abaxially; *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.5 cm long, shallowly canaliculate in cross-section, glabrescent to glabrous; *petiolar glands* absent. **Stipules** small to medium, 6–10 mm long × 1–2 mm wide, linear to subulate, apex acuminate, margin entire, ciliate, base oblong, densely tomentose outside, early caducous. **Inflorescences** solitary raceme, dense-flowered, (mainly) in axils of leaves, occasionally on the branches with fallen leaves, 1–2.5 cm long, 5–15-flowered, pubescent, slightly erect; *bracts* 3–4, up to 2 mm long, size and shape variable, caducous, densely hairy both side. **Flowers** bisexual, opening with mature leaves, white to yellowish-brown, sessile or shortly pedicellate, stout, 0–1 mm long, densely short brown hairs; *bracteoles* oblong lanceolate, up to 2 mm long, greenish-brown, densely brown hairy, early caducous; *hypanthium* campanulate or obconate, 2–3 mm long, pubescent outside, glabrous inside; *perianth* petals slightly different from calyx lobes; *calyx* lobes 5, rarely 4 or 6-merous, oblong, ovate to rounded, minute, green, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, apex rounded, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent on both sides; *corolla* petals slightly different or indistinguishable from sepals, whitish-brown, spreading to upright, (4–) 5 (–6), small, 1.5–2 mm long × 0.3–0.5 mm wide, subequal to calyx lobes, elliptic, ovate to orbicular, sessile, apex rounded, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, densely pubescent outside, pubescent to sparsely hairy inside; *stamens* 45–55 in 3 to many series, exserted; filament filiform, white, 1.5–3 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers oblong to globose, ca. 0.3 mm long; *ovary* uually glabrous sometimes with a few hairs, 1 locular; *style* filiform, 1.5–2.5 mm long, slightly longer than, or as long as stamens or a male flower with minute pistillode, glabrous; stigma gland not divided, globose to peltate. *Infructescence* 1–3 cm long, glabrescent. **Fruits** and **Seeds** are unknown (**Figure 4.21**).

Additional specimens examined.**—** Not known.

Distribution.— Endemic (known only from the specimens cited) (**Map 4.35**).

Vernacular name. **—** Not known.

Etymology.— The specific epithet ‘santisukii’ honors Prof. Dr. Thawatchai Santisuk, the collector of the type specimen.

Ecology.**—** Lower Montane Forest, alt. 1,300 m.

Phenology.**—** Flowering specimens were collected from April to June.

Uses.— Not known.

Conservation.— This species is currently known from only one locality, restricted to the Lower Montane Forest, Southern Thailand. The type locality is near the top of Khao Pawta Laung Kaew NP. However, only a few individual trees are known. I consider the conservation status of the species currently to be DD (Data Deficient- (IUCN, 2019).

Figure 4.21. *Prunus santisukii* Rueangr., J.Parn. & Hodk. **A**. fruiting branch with significantly short simple raceme with dense flowers; leaves small, glabrous, coriaceous, basal glands 2–4, leaf base decurrent. All from *R. Geesink & T. Santisuk 5131* (**BKF**). Drawn by Pairuch Rayangkul.

33. ***Prunus apiculata* (J.E.Vidal) Rueangr., J.Parn. & Hodk. *comb. nov.*, *ined.***

≡ *Pygeum apiculatum* J.E.Vidal, p.p. 8791 in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 294. 1949.

Typification: **VIETNAM, Annam**: Bana pres Tourane, 1200 m., 14 July 1923, fl., *E. Poilane 7152* (lectotype **P**01819074!, designated by Kalkman, 1965; isolectotypes **L**0019625†, **P**01819073!, **P**01819075; lectoparatypes: Lien Chien pres Tourane, 600 m., *E. Poilane 7530* (**K**000737342!, **L**0019571–3†, **P**01818991–2!, **VNM**00013178-9!), designated by Kalkman, 1965.

Description: Evergreen understory, small tree 4–10 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark blackish-brown, smooth or shallowly longitudinal furrowed with brown lenticels, spines absent; *inner bark* reddish-brown; strong almond smell. **Branchlets** sparsely brown hairy; young twigs terete, brown to dark brown, with sparse hairs, cataphylls absent; old twigs glabrescent, blackish-brown. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic, obovate to elliptic oblong, 6–12 cm long × 2–4.5 cm wide; *lamina apex* acute to obtuse, angle acute; *margin* entire, slightly revolute, glabrous; *base* asymmetrical to slightly oblique or symmetrical, acute and decurrent; young leaves dull green adaxially, pale green to slightly glaucous abaxially, turning yellow before falling, chartaceous to subcoriaceous, glabrescent to glabrous; old leaves glabrous adaxially, glabrescent abaxial; *basal glands* 2 (–3), up to 1 mm long, circular to oblong, flat, over the base margin of leaf blade, additional scarce circular glands on the nerves near or along margins; *2° venation* brochidodromous or weakly brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, narrow to moderate (35–50°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.2 cm long, shallowly canaliculate in cross-section, pubescent when young, then glabrescent to glabrous; *petiolar glands* absent. **Stipules** medium, 3–6 mm long × 1–2 mm wide, linear to subulate, apex acuminate, margin entire, ciliate, base oblong, sparsely hairy outside, hairy at the base, otherwise glabrous inside, early caducous. **Inflorescences** compound, solitary raceme, dense-flowered, (mainly) in axils of leaves, occasionally on the branches with fallen leaves, 2.5–6 cm long, 5–15-flowered, pubescent, slightly erect; *bracts* 1–3, up to 2 mm long, size and shape variable, concave, caducous. **Flowers** bisexual, opening with mature leaves, white to yellowish-brown; pedicel absent or short pedicellate, slender, 0–2 mm long, densely short brown hairs; *bracteoles* ovate to oblong, up to 2 mm long, greenish-brown, densely brown hairy, early caducous; *hypanthium* campanulate or obconate, 1.5–2.5 mm long, pubescent outside, otherwise glabrous, inside; *perianth* petals slightly different from calyx lobes; *calyx* lobes 5, rarely 4 or 6-merous, oblong, ovate to rounded, minute, green, 0.3–1 mm long × 0.3–1 mm wide, subequal, apex rounded, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, pubescent inside; *corolla* petals slightly different or indistinguishable from sepals, white, spreading to upright, (4–) 5 (–6), small, 0.3–1 mm long × 0.3–1 mm wide, subequal to calyx lobes, elliptic, ovate to orbicular, sessile, apex rounded, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 25–35, in 3 to many series, exserted; filament filiform, white, 2.5–4 mm long, usuallly glabrous, sometimes sparsely hairy at base; anthers oblong to globose, ca. 0.3 mm long; *ovary* usually glabrous, sometimes sparsely hairy, with a ring of hairs around point of insertion, 1 locular; *style* filiform, 3–4 mm long, usually glabrous or sometimes sparsely hairy on the lower half, slightly longer than, or as long as stamens, or male flower with minute pistillode, glabrous; stigma gland not divided, globose, peltate to sub-bilobed. *Infructescence* 2–6 cm long, glabrescent to hairy, few, 1–5 fruited. **Fruits** fleshy, stipitate, 3–6 mm long, densely hairy, young fruit green, dark purple when mature or ripe, transverse ellipsoid, sub-reniform to didymous, very variable in dimensions, 0.8–1.4 cm long, 1.3–2 cm wide, apex obtuse, tipped by a remnant apiculum of the style, about 1 mm long; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal or ridged, canaliculate; calyx deciduous; style present, peaked or apiculate up to 1.5 mm long. **Seeds** are usually transversely globose laterally, thin, with glabrous testa, reticulate, endocarp, and seedcoat glabrous (**Figure 4.22 & 4.23**).

Additional specimens examined.— **VIETNAM**. **Annam, Da Nang**: Hoa Vang, Tourane, Ba Na, Ba Na Nature Reserve, 16°00'04.79" N, 108°02'13.67" E, alt. 351 m, 29 May 2015, fr., *S. Tagane*, *H. Toyama*, *N. Nguyên*, *C. Nguyên V3071* (**BKF**!, **FU**!);– **Dong Co Pat**: Quang Tri, Dong Tri, alt. 600 m, 16 August 1924, fr., *E. Poilane 10992* (**BKF**049709!, **L**1902585†, **P**03358367!, **VNM**00023515!);– *ibid.*, 25 May 1924, fr., *E. Poilane s.n.* (**L**4192368-9†);– *ibid.*, alt. 500 m, 3 July 1924, fr., *E. Poilane 11108* (**E**00991966!, **K**!, **L**1892630†, **P**03358461!, **P**03358466-7!);– **Qui Nhon**: Col de Mangiang, alt. 1,200 m, 22 August 1930, fl. & fr., *E. Poilane 18062* (**L**0019627†, **P**01819076-7!);– *ibid.*, Tanam, 21 November 1923, fr., *E. Poilane 7340* (**K**!, **P**03358465!);– *ibid.*, Thua Thien Hue: Bach Ma, Bach Ma NP., 16°13'41.60" N, 107°51'09.35" E, alt. 485 m, 22 May 2015, fr., *T. Yahara*, *S. Tagane*, *H. Toyama*, *N. Nguyên*, *C. Nguyên & N. Okabe V2441* (**BKF**!, **FU**!).

Distribution.— Vietnam (Annam) (**Map 4.35**).

Vernacular name. **—** Not known.

Ecology.**—** Dry Evergreen to Lower Montane Forest, in open areas, along trails, by streams, or in valleys, alt 300–1,200 m.

Phenology.**—** Flowering, April to July; fruiting, May to August.

Uses.— Not known.

Conservation.— This species is known from more than five but ≤ 10 locations: EOO = 12,392.56 km^2; AOO = 32.00 km^2. The number of individuals in each subpopulation is ≤ 1,000. I consider the conservation status of the species currently to be VU (Vulnerable); B1B2aC2a(i)D2 (IUCN, 2019).

Note.— This species is closely related to *P. maingayi* (Hook.f.) J.Wen. from which it is distinguished by its racemes 2.5–6 cm long and ovary or fruits glabrous (vs. racemes shorter than 2 cm and ovary and hairy fruits).

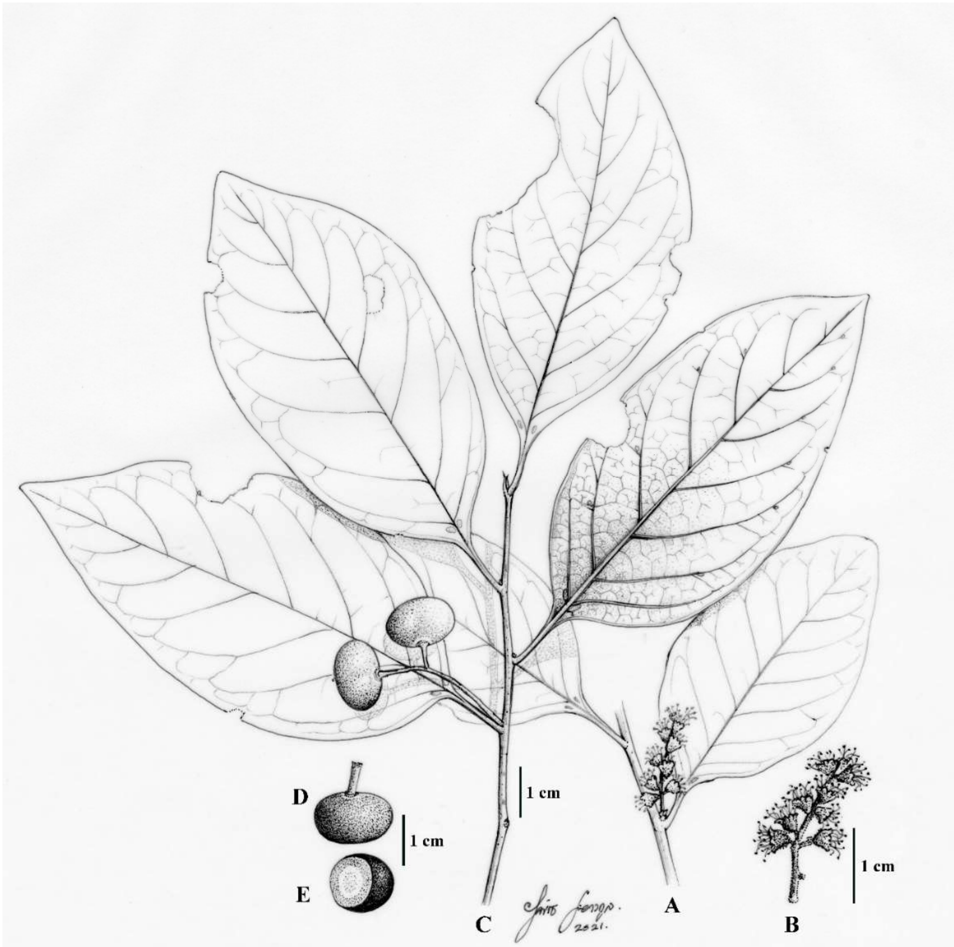


Figure 4.22. *Prunus apiculata* (J.E.Vidal) Rueangr., J.Parn. & Hodk. **A**. inflorescence branch, simple raceme with lax flowers, basal glands, 2–4; **B**. inflorescence; **C**. infructescence; **D**. fruit sub-globose to ellipsoid, glabrous; **E**. fruit (cross-seection), inside of endosperm and seedcoat glabrous. **A** and **B** from. *E. Poilane 7152* (**K**); **C–E** from *E. Poilane 11108* (**K**). Drawn by Pairuch Rayangkul.

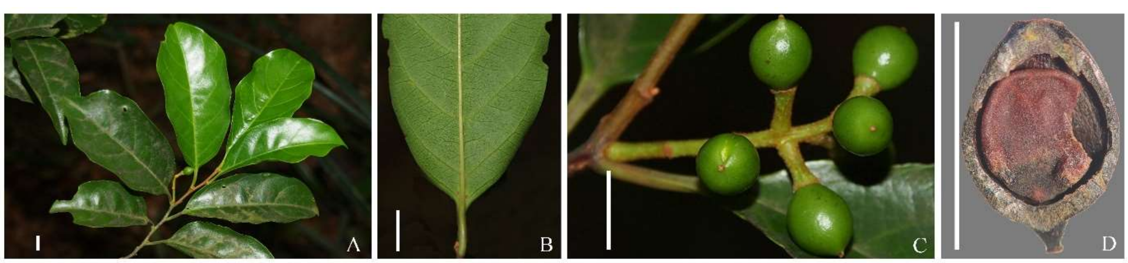


Figure 4.23. *Prunus apiculata* (J.E.Vidal) Rueangr., J.Parn. & Hodk, vegetative and reproductive morphological characters; **A**, leaves elliptic to obovate, alternate; **B**, basal glands 2; **C**, infructescence solitary, in the axil of a leaf; **D**, longitudinal fruit section, endocarp and seedcoat glabrous. — Photos: all by S. Tagane. — Source: all from **Vietnam**, Annam, Thua Thien Hue, Bach Ma, *T. Yahara et al. V2411*. Scale bar = 1 cm.

34. ***Prunus longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk., *comb. nov., ined.***

≡ *Pygeum longistylum* J.E.Vidal, in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 294. 1949.

Typification: **VIETNAM**. **Annam**, De Quin Hon: Col de Mangiang, alt. 1,200 m, 22 August 1930, fl. & fr., *E. Poilane 18062* (holotype **P**01819076!; isotypes **P**01819077!, **L**0019627–8†).

Description: Evergreen understory, small tree 8–12 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish, smooth with brown lenticels, spines absent; *inner bark* reddish-brown; strong almond smell. **Branchlets** sparsely brown hairy; young twigs greyish-white, with conspicuous ridges, with sparse brown hairs, cataphylls absent; old twigs glabrescent, blackish-brown. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic, obovate to elliptic oblong, 4.5–8 cm long × 1.2–3 cm wide; *lamina apex* acute to obtuse, angle acute; *margin* entire, slightly revolute, glabrous; *base* asymmetrical to slightly oblique or symmetrical, acute and decurrent; young leaves dull green adaxially, pale green to slightly glaucous abaxially, turning yellow before falling, herbaceous to subcoriaceous, glabrescent to glabrous; old leaves glabrous adaxially, glabrescent abaxially; *basal glands* 2 (–4), up to 1 mm long, circular to oblong, flat, over the basal margin of leaf blade, additional scarce circular glands on the nerves near or along margins; *2° venation* brochidodromous or weakly brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, narrow to moderate(35–50°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.2 cm long, shallowly canaliculate in cross-section, pubescent when young, then glabrescent to glabrous; *petiolar glands* absent. **Stipules** medium, 1.5–3 mm long × 1–2 mm wide, subulate, lanceolate to linear, apex acuminate, margin entire, ciliate, base oblong, sparsely hairy, early caducous. **Inflorescences** compound, solitary raceme, dense-flowered, (mainly) in axils of leaves, occasionally on the branches with fallen leaves, 1–2 cm long, 5–15-flowered, pubescent, slightly erect; *bracts* 1–3, up to 2 mm long, size and shape variable, hairy, caducous. **Flowers** bisexual, opening with mature leaves, white to yellowish-brown; pedicel sessile or short pedicellate, slender, 0–2 mm long, densely short brown hairy; *bracteoles* ovate to oblong, up to 2 mm long, greenish-brown, densely brown hairy, early caducous; *hypanthium* campanulate or obconate, 1–1.5 mm long, brown pubescent outside, with a ring of hairs around point of insertion, otherwise glabrous or with a few hairs inside; *perianth* petals slightly different from calyx lobes; *calyx* lobes 5, rarely 4 or 6-merous, oblong, ovate to rounded, minute, green, 0.3–0.6 mm long × 0.3–0.5 mm wide, subequal, apex rounded, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, pubescent inside; *corolla* petals slightly different or indistinguishable from sepals, white, spreading to upright, (4–) 5 (–6), small, 0.3–0.5 mm long × 0.3–0.5 mm wide, subequal to calyx lobes, elliptic, ovate to orbicular, sessile, apex rounded, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 20–25, in 3 to many series, exserted; filament filiform, white, 1–4 mm long, usually glabrous or sometimes sparsely hairy; anthers oblong to globose, ca. 0.3 mm long; *ovary* densely hairy, 1 locular; *style* filiform, 4–6 mm long, slightly longer than, or as long as stamens, or male flower with minute pistillode, glabrous; stigma slightly divided, 3-lobed, globose to peltate. *Infructescence* 1–2 cm long, hairy, few, 1–5 fruited. **Fruits** fleshy, stipitate, 3–6 mm long, young fruit green, dark purple when mature or ripe, transverse ellipsoid, sub-reniform to didymous, very variable in dimensions, 0.6–0.8 cm long, 0.8–1 cm wide, apex obtuse, tipped by a remnant apiculum of style, about 1 mm long; young fruits covered with dense hairs; mature fruits glabrescent; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal or ridged, canaliculate; calyx deciduous; style present, peaked or apiculate up to 1.5 mm long. **Seeds** are usually transversely globose laterally, thin, with glabrous testa, reticulate, endocarp, and seedcoat glabrous.

Additional specimens examined.— Endemic (known only from the specimens cited) (**Map 4.35**).

Distribution.— Vietnam (Annam).

Vernacular name. **—** Not known.

Ecology.**—** Lower Montane Forest, in open areas, along trails, by streams in the valley, 1,200 m alt.

Phenology.**—** Flowering, April to July; fruiting, July to September.

Uses.— Not known.

Conservation.— This species is currently known from only one location, and is, therefore, restricted to the Lower Montane Forest, Central Vietnam, **Annam**, De Quin Hon: Col de Mangiang. I consider the conservation status of the species currently to be DD (Data Deficient- (IUCN, 2019).

Note.— *Prunus longistyla* is morphologically similar to *P. apiculate* (J.E.Vidal) Rueangr., J.Parn. & Hodk. It is distinguished from *P. apiculata* by its greyish (vs. dark brown) twigs and its ovary, which is always densely brown tomentose (vs. ovary with a ring of hairs around the point of insertion, otherwise glabrous or with a few hairs) and by the number of stamens: 20–25 compared to 25–35.

35. ***Prunus maingayi*** **(Hook.f.) J.Wen,** *ined.* (in press).

≡ *Pygeum maingayi* Hook.f., Hook.f., Flora of British-India. 2(5): 319. 1878; Kurz, Forest Flora of British-Burma 1: 436. 1877; King, Materials for a Flora of the Malayan Peninsula. Singapore 9: 291. 1897; *op. cit.* 12: 293. 189.

Typification: **MALAYSIA**: *Maingay 625* (lectotype **K**000737271!, on the same sheet with Maingay 2569, designated by Kalkman, 1965; isolectotypes **BM**000622050!, **BM**000906028!, **CAL**, **K**000737273-4!, **L**0019630†).

≡ *Pygeum lanceolatum* var. *maingayi* (Hook.f.) Ridl., The flora of the Malay Peninsula. 1(2): 674. 1922.

≡ *Prunus grisea* (Blume ex Müll.Berol.) Kalkman var. *tomentosa* (Hook.f.) Kalkman, Blumea; Tijdschrift voor de Systematiek en de Geografie der Planten (A Journal of Plant Taxonomy and Plant Geography). 13(1): 56. 1965; J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 186–188, pl. xxv, 3. 1968; *ibid.*, in Flora of Thailand 2 (1): 70–71. 1970; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 339. 1993.

= *Pygeum lanceolatum* Hook.f., Flora of British-India. 2(5): 319. 1878.

Typification: **SINGAPORE**, 1846, *T. Lobb 328* (lectotype **K**000737272!, designated by Kalkman, 1965; isolectotypes **BM**000906028!, **BM**000622050!, **E**00991955!, **K**000737273–4!, **TCD**!).

= *Pygeum hookerianum* King, Journal of the Asiatic Society of Bengal. Part 2. Natural History. 66: 239. 1897; King, Materials for a Flora of the Malayan Peninsula. Singapore 12: 293. 1897.

Typification: **MALAYSIA**, Perak, Larut & Matang, Larut, Blanda Mabok, April 1890, *L. Wray 3969* (lectotype **CAL**, *non vidi*., designated by Kalkman, 1965; isolectotypes **BM**000622049!, **K**!, **SING**0068705–6†; lectoparatypes, same locality; *King 1970* (**CAL**, **US**),–Perak, Luzul, 300 m alt., July 1881, *2083* (**CAL**†, **E**00010505!), *2735* (**CAL**†),–Perak, Larut, August 1883, *4789* (**BO**, **CAL**, **U**0226245!),–Perak Larut, low ground, 100 ft alt, August 1884, fr., *King 6425* (**A**, **CAL**, **HBG**511157†, **P**01819085!, **U**0226246†);– Peninsula Malaya, *Scortechini 1234* (**BM**000622046!, **CAL**, **K**000737275!).

= *Pygeum havilandii* Ridl., Kew Bulletin. 281. 1938.

Typification: **MALAYSIA,** Sarawak, Kuching Mt., 30 February 1892, *G.D. Haviland 2063*, (lectotype **K**000737316!, designated by Kalkman, 1965; isolectotypes **A**00032462†, **L**†, **SAR**†, **SING**0068707–8†).

= *Pygeum hookerianum* var. *borneense* Ridl., Kew Bulletin. 281. 1938.

Typification: **MALAYSIA,** Sarawak, Baram, Long Lama, October 1894, *Charles Hose 186* (lectotype **K**!, designated by Kalkman, 1965; isolectotypes **BM**000622048!, **P**01819072!).

= *Pygeum latifolium* var. *tomentosum* Koord. & Valeton, Mededeelingen uit 's Lands Plantentuin. 33: 359. 1900, not cited. From the text, it can be inferred that the authors saw at least: *Koorders 6407* (**BO**), *6409* (**BO**, **L**†, **K**000737311!), *13344* (**BO**), *22486* (**BO**), *36937* (**BO**), the latter three from the same tree, *20077* (**BO**, **L**†), *20230ft* (**BO**, **L**†), *22233* (**BO**, **CAL**, **L**†), the latter three also from one tree, Kalkmam, 1965.

Typification**: INDONESIA,** Java, Jawa Tengah, Vindplaats, Noesa Kambangan, 7 February 1894, *S.H. Koorders 22255B* (lectotype **BO**, designated by Kalkman, 1965, *non vidi*; isolectotypes **K**000737312-3!, **WAG**0002935!).

= *Pygeum latifolium* f. *lanceolatum* Koord. & Valeton, Bijdrage tot de kennis der boomsoorten van Java. 5: 359. 1900. Type, *non vidi*.

= *Pygeum koordersianum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 194. 1913.

Typification: *Koorders 22233B* (lectotype **BO**†, designated by Kalkman, 1965; isolectotypes **CAL**†, **L**†; lectosyntypes, From the same tree collected: *Koorders 20077ft* (**BO**†, **L**†) and *20230ft* (**BO**†, **L**†).

= *Pygeum membranaceum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 195. 1913.

Typification: **MALAYSIA**, *Junghuhn Pl. Ined. 3*11 (lectotype **L**†, designated by Kalkman. lectosyntypes *Junghuhn 310 (249)* (**L**†), and 1*87* (**L**†),

= *Pygeum velutinosum* Ridl., Flora of the Malay Peninsula. 5: 306–307. 1925.

Typification: **MALAYSIA**, Malay Peninsula, Pahang, *c.* 500 ft alt., 12 November 1924, *H.M. Burkill & Haniff SFN 16947* (lectotype **K**000737278!, designated by Kalkman, 1965; isolectotypes **BO**†, **KEP**†, **SING**0068735†; lectoparatypes:–Peninsular Malaysia Lilu Chineas, Kualahifis, 17 November 1924, *H.M. Burkill & Haniff SFN 17092* (**BM**000622047!, **K**000737277!) (not *17902* as cited by Ridley).

= *Pygeum kingianum* Craib, Bulletin of Miscellaneous Information, Royal Gardens, Kew. 1930(4): 161. 1930.

Typification: **THAILAND, Phang-Nga**, Khao Bang To, 1100 m alt., 21 February 1929, *A.F.G. Kerr 17167* (lectotype **K**000737334!, designated by Kalkman, 1965; isolectotypes **BK**!, **BM**000622037!, **L†, SING**0096237†, **TCD**0016633!).

Description: Evergreen, sub-canopy, small tree or up to 25 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 35 cm in diameter; outer bark blackish-brown, smooth with brown lenticels forming a longitudinal line, spines absent; *inner bark* pinkish-brown; strong almond smell. **Branchlets** dark brown with densely prominent brown lenticels; young twigs brown, pubescent when very young, rapidly glabrescent, cataphylls absent; old twigs glabrescent. *Axillary winter bud* solitary, 1.5–4 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate, elliptic to oblong or lanceolate, 4–14 cm long × 1.5–6 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* entire, sometimes undulate, glabrous or sparsely ciliate; *base* symmetric to slightly asymmetric, rounded to acute; young leaves dull green to glossy green adaxially, pale green to slightly glaucous abaxially, turning yellow before falling, chartaceous; young leaves glabrescent to sparsely hairy on midrib abaxially; old leaves glabrous adaxially, ± glabrescent to sparsely hairy on midrib abaxially; *basal glands* 2 (0–6), up to 1 mm long, oblong to circular, flat, often not entire base, but higher up, additional scarce circular glands near the loop of lateral vein and along margins, and small pellucid dotted, not turning black when drying; *2° venation* brochidodromous or weaky brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* reticulate, inconspicuous on both surfaces; *petioles* 0.5–1 cm long, shallowly canaliculate in cross-section, glabrous to sparsely hairy; *petiolar glands* absent. **Stipules** small to medium, 5–10 mm long × 1–2 mm wide, linear to triangular, apex acuminate, margin entire, ciliate, base oblong, densely hairy, and early caducous. **Inflorescences** compound, solitary raceme, dense-flowered, both in axils of leaves and the scars of falling leaves, 1–3 cm long, 5–15-flowered, pubescent, erect to horizontal; *involucral bracts* 3–6, up to 1.5 mm long, size and shape variable, lowermost ones sometimes with deeply tripartite lobed apex, hairy outside, sub(glabrous) inside, margin ciliate, usually soon caducous, occasionally present at anthesis. **Flowers** bisexual, opening with mature leaves, white, sessile or shortly pedicellate, stout, 1–2 mm long, densely short brown hairy; *bracteoles* ovate-triangular, up to 2 mm long, whitish-green, densely brown hairy outside, glabrescent inside, early caducous; *hypanthium* campanulate, 1.5–2(–3) mm long, pubescent; *perianth* petals slightly different from calyx lobes; *calyx* lobes 7–10, triangular to ovate-oblong, minute, white, 0.6–1.5 mm long × 0.5–1 mm wide, subequal, apex acute to sub-obtuse, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, glabrous inside or with hairs on bottom inside; *corolla* petals slightly different or indistinguishable from sepals, white, spreading to upright, (4–) 5, small, 0.8–1.5 mm long × 0.5–0.8 mm wide, subequal, petals not distinct from calyx lobes, elliptic, ovate to triangular, sessile, apex rounded to sub-acute, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 18–32 in 3 to many series, exserted; filament filiform, white, 2–3.5 mm long, glabrous; anthers globose, 0.3–0.5 mm long; *ovary* usually glabrous, sometimes sparsely hairy, rarely more densely so, glabrescent to densely hairy around point of insertion, 1 locular; *style* filiform, 3.5–5 mm long, as long as stamens or male flower with minute pistillode, glabrous; stigma gland not divided, globose to peltate. *Infructescence* 1–2(–3) cm long, densely to sparsely hairy, 1–5 fruited. **Fruits** fleshy, stipitate, 2.5–3.5 mm long, stout, densely hairy with whitish-brown lenticels, young fruit greenish to whitish-green, dark purple when ripe, globose or transversely ellipsoid to didymous, 0.6–1 cm long, 0.8–1.2 cm wide, apex retuse to obtuse, sometimes tipped with remnants of style; young fruits glabrous to sparsely hairy; mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone, pitted and furrowed, very hard; calyx deciduous; style absent or a minute at the end of the fruit. **Seeds** usually transversely globose laterally, thin, with glabrous testa, reticulate, endocarp, and seedcoat glabrous (**Figure 4.24**).

Additional specimens examined.— **INDONESIA**. **Bogor**: Seram, Manusela NP., 03°10'S, 129°33'E, alt. 2,050 m, 5 January 1985, fl., *K. Ueda, M. Okamoto & U.W. Mahjar C-3107* (**KYO**!);– Borneo: 30 December 1892, fl., *Kuching 2063* (**K**000737316!);– **Celebes**: Sulawesi, Taipa, 2°29'S, 121°17'E, alt. 505 m, 20 June 1979, fr., *E.F. de Vogel 5895* (**KYO**!);– *ibid.*, Soroako and Wawondula, alt. 500 m, 17 June 1979, fl., *M. Van Balgooy 4051* (**KYO**!);– *ibid.*, Soroako, alt. 400 m, 16 May 1979, fl., *M. Van Balgooy 4036* (**KYO**!);– *ibid.*, Taipa, alt. 400 m, 20 June 1979, fl., *E.F. de Vogel 5886* (**KYO**!);– *ibid.*, NW. shore of lake Towuti, 2°40'S, 121°26'E, alt. 380 m, 17 July 1979, fl., *E.F. de Vogel 6312*

(**KYO**!);– **Java**: Bangoemas, June 1868, fl., *Teysmann*, *s.n.* (**P**01819078!);– **Java West**, Gede Pangorango NP., 06°45'13.00"S, 106°59'16.33” E, alt. 1,760 m, 30 September 2011, lvs., *T. Yahara*, *H. Nagamasu*, *A. Naiki*, *H. Toyama*, *R. Ichihashi*, *A. Hidayat*, *A. Sadili*, *M. Ardiyani & D. Darnaedi IJ605* (**BKF**!, **FU**!);– *ibid.*, Halimun Natonal Park, 06°44'35.9"S, 106°31'39.1” E, alt. 1,280 m, 18 October 2011, lvs., *S. Tagane & A. Salidi IJ1187* (**FU**!);– **Sulawesi**: Selatan, Soroako, S. Matano lake, 2°31'52.9"S, 121°17'41.9” E, alt. 400 m, 14 June 1979, fl., *E.F. de Vogel 5778* (**KYO**!). **MALAYSIA**. 6°00'25.62” N, 116°32'40.53” E, alt. 1,553 m, 18 August 2018, fr., *T. Yahara*, *S. Tagane*, *M. Zhang & A. Nagahama SB344* (**FU**!);– alt. 100 m, July 1881, fl., *King 2083* (**E**00010505!);– October 1882, fl., *King 3524* (**K**!);– Blanda Mabok, 15 April 1967, fr., *L. Jr. Wray 3969* (**K**!);– **Gadeh**: 1 October 1959, fr., *A.H. Millard 1806* (**K**!);– **Johor**: Gunong Pulai, Sungei Ayer Hitam Basar, 14 May 1953, lvs., *J. Sinclair 7427* (**E**00991956!);– *ibid.*, Kluang, 2°30'23.4” N, 103°08'34.8” E, 20 November 1922, fl., *Houtum 9470* (**K**!);– *ibid.*, Mawai, 28 November 1961, fr., *J. Sinclair 10677* (**E**00991957!, **E**00991959!);– *ibid.*, Gunning Pulai, Sungei Ayer Hitam Basar, 14 May 1953, lvs., *J. Sinclair 39625* (**P**03144237!);– *ibid.*, *Chew & Kueh H.L. 58951* (**K**!);– *ibid.*, Labis, 15 May 1967, fr., *T. Suppiah 104979* (**K**!);– *ibid.*, Selangor, Buloh, 13 March 1967, fr., *K.M. Kochummen FRI2261* (**K**!);– **Kedah**: Gurun, Gunung Jerai, 26 July 1994, fr., *Zainudin A. 5124* (**K**!);– **Kelantan**: Gunong Rabong, 15 March 1972, fr., *E. Soepadmo 1171* (**K**!);– *ibid.*, Bukit Bata, 22 March 1990, fl., *H. Schaller & L.E. Teo KL3887* (**P**04163619-20!);– *ibid.*, 11 November 1969, fr., *B. Everest FRI13640* (**K**!);– **Kepong**: Selangor, Buloh, 13 August 1969, fl., *K.M. Kochummen FRI2738* (**K**!);– *ibid.*, 2 November 1979, fl., *K.M. Kochummen FRI29004* (**K**!);– **Langkawi**: Kedah, 26 February 1961, fl., *K.M. Kochummen 94402* (**L**1902931†);– Malacca, 9 October 1868, fl., *A.C. Maingay 625* (**K**!);– *ibid.*, *A.C. Maingay 2659* (**K**!);– **Pahang**: Bentong Komanshul, Sabai, 5 June 1958, fr., *Mohd Shah 195* (**K**!);– *ibid.*, *Mohd Shah 206* (**K**!);– *ibid.*, Balok, 3 September 1966, fr., *Ding Hu 760* (**K**!);– *ibid.*, Jerantut, June *s.n.*, fr., *F. Remy & L.E. Teo 3993* (**K**!, **P**03358161!);– *ibid.*, Semangko, August 1904, fr., *H.N. Ridley 12107* (**K**!);– *ibid.*, April 1924, fl., *H.M. Burkill & Haniff 16947* (**K**000737278!);– *ibid.*, Gunong Tahan, 22 July 1936, fl., *Kiah 31761* (**K**!);– *ibid.*, 28 June 1969, fl., *T.C. Whitmore FRI12259* (**K**!);– *ibid.*, Fraser's Hill, 15 October 1966, fr., *K.M. Kochummen FRI2153* (**K**!);– *ibid.*, Teku, 20 February 1968, fr., *T.C. Whitmore FRI4763* (**K**!);– *ibid.*, Selangor, Fraser's Hill, 26 August 1959, fl., *H.M. Burkill HMB2043* (**K**!);– **Penang**: Pulua, March 1901, fl., *B. Burtis 735* (**K**!);– *ibid.*, November 1885, fl., *B. Burtis 216* (**K**!);– *ibid.*, Pulua, Government hill, January 1995, fl., *B. Burtis 3472* (**K**!);– *ibid.*, March 1915, fl., *H.N. Ridley*, *s.n.* (**K**!);– **Perak**: Hula Perak, Belum, Temanggor dam, 5°25'42.6” N, 101°16'52.5” E, 6 June 1998, fr., *S. Kamarudin*, *L.S.L. Chula*, *S. Damahuri*, *Baya & Temangnor FRI4070* (**K**!);– *ibid.*, June *s.n.*, fr., *Scortechini 217 (***K**!*)*;– *ibid.*, May 1884, fr., *King 6032* (**P**03358153!);– *ibid.*, 6 July 1966, fr., *T.C. Whitmore FRI0517* (**K**!);– *ibid.*, April *s.n.*, fl., *King*, *s.n.* (**P**03358154!);– *ibid.*, alt. 200 m, December 1883, fl., *King 5336* (**P**03358151-2!);– **Sabah**: Ulu Kimanis, Papar, 5°34'00.0” N, 115°57'00.0” E, 25 March 1976, fr., *D. Sundaling & B. Talib 80506* (**L**0576279†);– **Sarawak**: Bario, Aruv, alt. 1,157 m, 26 January 2016, fr., *H. Kurokawa*, *M. Aiba*, *M. Oguro*, *S. Tagane*, *Y. Keldi & D.*

Eudi SWK1320 (**FU**!);– *ibid.*, Baram, October 1894, fl., *C. Hose 186* (**BM**000622048!, **K**000737314!, **P**01819072!);– *ibid.*, Taau, swamp forest, 03°15'10.25" N, 113°47'26.53" E, alt. 43 m, 10 February 2016, lvs., *H. Toyama*, *S. Tagane*, *Y. Takeuchi SWK1879* (**FU**!);– **Slangor**: Klang Gateson, 31 December 1920, fr., *H.N. Ridley*, *s.n.* (**K**!);– **Ulu Selangor**: Sugai Buloh, 19 January 1966, fr., *Hardial & Sidek 440* (**K**!). **MYANMAR**. **Lower Burma, Taninthayi**: Maliwan, 19 April 1928, fl., *Suluos 7754* (**K**!);– **North Eastern Burma**, Tenasserim and Andamans, February 1861, fl., *Helfer 2056* (**P**03358157!). **PAPUA NEW GUINEA**. **Kaiser-Wilhelmsland**: Augustafluss, April 1887, fl., *M. Hollrung 660* (**P**01819080!);– **Ijivitari**: Goropu Mountain, 9°34'S, 148°56'E, alt. 2,500 m, 12 July 1972, fr., *J.F. Veldkamp & P.F. Stevens 5883* (**KYO**!);– **Capiz**: Sibuyan island, May 1910, fr., *A.D.E. Elmer12137* (**P**01819079!);– **Luzon**: Batana, Lamao rivers, Mt. Mariveles, 14°31'59.0" N, 120°28'00.0" E, September 1904, fl., *T.E. Borden 1806* (**P**01819084!);– **Todaya**: Davao, Mindanao, July 1909, lvs., *Elmer A.D.E. 11828* (**P**01819083!). **SINGAPORE**, MacRitchie Nature Reserve, 1°21'32" N, 103°48'40" E, 19 August 2007, lvs., *P. Wilkie*, *A.T. Gwee*, *J. Skornickova*, *A. Samsuri & S.K. Ganesan PW523* (**E**00304467!);– No. 2 Rifle range, Seletar Reservoir, 1 May 1954, lvs., *J. Sinclair 8057* (**E**00991958!);– Rifle range, Seletar forest, 1 May 1954, fl., *J. Sinclair 40272* (**K**!). **THAILAND**. **Peninsular, Chumphon**: Phato, 9°41'43.7" N, 98°45'34.2" E, 11 April 1969, fl., *C. Chermsirivathana & Kasem 1293* (B**K**213995!);– **Phetchaburi**: Kaeng Krachan, 12°48'55" N, 99°23'25" E, alt. 750 m, 22 April 2019, lvs., *S. Rueangruea, S. Kaithongsuk P. Uea-Ary, T. Chaowasku, A. Danthongdee, N. Hathai & W. Kaewmongkul SR210* (**BKF**229939-40!, **TCD**!);– *ibid.*, 12°49'56.8"N, 99°21'32.6"E, alt. 826 m, 2 January 2020, *S. Rueangruea, A. Rueangruea & Sirichai & Sutuch. SR251* (**BKF**!, **TCD**!);– *ibid.*, 12°47'52"N, 99°22'7.1"E, alt. 300 m, 10 May 2005, *David J. Middleton, S. Suddee, C. Hemrat, S. Linsay & S. Suwanachat 3358* (**BKF**157833!, **E**00219245!, **L**4193712†);– **Nakhon Si Thammarat**: Thung Song, 8°5'N, 99°45'E, alt. 100 m, 13 May 1973, fl., *R. Geesink & T. Santisuk 5366* (**BKF**049630!, **E**01020033!, **KYO**!, **L**1902912†, **P**03358155!);– *ibid.*, Kiri Wong, Khao Laung NP., 8°28'54.7" N, 99°45'01.5" E, alt. 884 m, 14 February 2015, fl., *S. Tagane*, *H. Toyama*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *H. Kanemitsu*, *W. Kiewbang & C. Hemrat T4091* (**FU**!);– *ibid.*, Lansaka, Karom waterfall, Khao Laung NP., alt. 150 m, 17 May 1985, fr., *J.F. Maxwell 85-480* (**BKF**049735!, **E**01020037!, **L**1902903†);– *ibid.*, Ron Phiboon, Khao Ram Rom, 8°14'11" N, 99°48'12" E, alt. 944 m, 1 May 2019, fr., *S. Rueangruea*, *P. Puttarak & C. Suddoo SR216* (**BKF**229948!, **BKF**229950!, **TCD**!);– **Narathiwat**: Bacho, 6°31'52" N, 101°39'10" E, 18 April 1961, fl., *B. Sangkhachand 71* (**BKF**049618!, **L**1902909!†);– **Phang Nga**: Khao Bang To, 8°01'11" N, 98°19'00" E, alt. 90 m, 30 April 2007, fl., *C. Phengklai 1552* (**BKF**!);– *ibid.*, Khura Buri, Khlong Nang Yon, 9°15'N, 98°20'E, alt. 100 m, 29 April 1973, fl., *R. Geesink & T. Santisuk 5025* (**BKF**049637!, **E**01020032!, **K**!, **KYO**!, **L**1902914†, **P**03358156!);– *ibid.*, Kura Buri, Sri Phang Nga NP., 9°00'N, 98°12'8" E, alt. 100 m, 10 May 2002, fr., *R. Pooma*, *V. Chaemchumroon*, *N. Koonkunthod & P. Chantaboon 3713* (**BKF**177971!);– *ibid.*, Takuapa, Sri Phang Nga NP., 8°59'7.6" N, 98°27'9.5" E, alt. 100 m, 24 April 2005, fl., *R. Pooma*, *K. Phattarahirankanok*, *S. Sirimongkol & M. Phoopath 5216* (**BKF**163406!,

L4193759†);– **Phatthalung**: Bang Kram, 7°55'25.8” N, 99°15'37.2” E, alt. 100 m, 18 April 1928, fl., *A.F.G. Kerr 15301* (**BK**213993!, **K**!);– *ibid.*, Si Ban Phot, near Mat Cha Cave, Khao Pu-Khao Ya NP., 7°43'20” N, 99°44'41” E, alt. 50 m, 13 June 1986, fr., *J.F. Maxwell 86-355* (**BKF**049638!, **P**03358148!);– **Ranong**: Kra Buri, Nikom Pakchan, 10°32'21.6” N, 98°53'00.5” E, alt. 150 m, 24 April 1974, fl., *S. Gardner & P. Sidisunthorn 515* (**BKF**049615!);– *ibid.*, Suk Samran, Khlong Nakha WS., 9°27'38” N, 98°30'25” E, alt. 50 m, 7 September 1984, fr., *W. Nanakorn 663* (**BKF**!);– **Satun**: Tarutao, 6°37'17.0” N, 99°30'28.6” E, alt. 50 m, 8 April 2008, fl., *C. Phengklai 15721* (**BKF**172507!);– **Songkhla**: Chana, Chanong, 7°32'38” N, 99°47'33” E, alt. 80 m, 20 April 1949, fl., *Sa-Ard Boonkerd 3300* (**P**03358158!);– *ibid.*, Wang Sai, 6°34'46.9” N, 100°40'18.6” E, alt. 50 m, 25 March 1928, lvs., *A.F.G. Kerr 14771* (**BK**213991!, **E**01020034!, **K**!, **TCD**0016632!);– Hat Yai, Koh Hing hill, west slope, 15 March 1986, fl., *J.F. Maxwell 86-174* (**L**1902905†);– *ibid.*, Kho Hong, 8°04'45” N, 98°40'49” E, alt. 375 m, 13 October 1984, fr., *J.F. Maxwell 84-316* (**BKF**049628!);– *ibid.*, Koh Hing hill, west slope, alt. 175 m, 27 April 1986, fr., *J.F. Maxwell 86-256* (**BKF**049629!, **L**1902904†);– *ibid.*, 6°53'26” N, 100°53'42” E, alt. 25 m, 5 September 1984, fl., *J.F. Maxwell 84-188* (**BKF**049626!);– *ibid.*, Ton Nga Chang WS., 06°56’N, 100°14’E, 14 May 2004, fl., *S. Gardner & P. Sidisunthorn ST0512* (**BKF**184149!, **K**!);– *ibid.*, Ton Nga Chang WS., 06°56’N, 100°14’E, alt. 130 m, 27 March 2004, fl. & fr., *P. Sidisunthorn ST0338* (**BK**!, **BKF**184151!, **BKF**217790!, **K**!);– *ibid.*, *ibid.*, Ton Nga Chang WS., 7°00'0” N, 100°10'2.6” E, alt. 125 m, 7 June 1972, fr., *K. Larsen*, *S.S. Larsen, S.S. Renner*, *C. Niyomdham*, *W. Ueachirakan & P. Sirirugsa 42731* (**BKF**120350!).;– **Surat Thani**: 9°18'29” N, 98°51'58” E, 1 March 1974, fl., *B. Sangkhachand 2* (**BKF**!);– **Trang**: Yan Takhao, Peninsular Botanic Garden (Thung Khai), 7°27'52” N, 99°38'26” E, alt. 47 m, 30 April 2019, fr., *S. Rueangruea*, *P. Puttarak & C. Suddoo SR214* (**BKF**229944!, **TCD**!);– *ibid.*, 07°28’N, 99°38’E, alt. 25 m, 3 June 2004, fr., *S. Gardner & P. Sidisunthorn ST0650* (**BKF**184159!, **K**!);– *ibid.*, 23 April 1988, lvs., *C. Niyomdham 1861* (**BKF**049627!);– Na Yong, Khao Chong, 7°32'38” N, 99°47'33” E, alt. 82 m, 5 April 1969, fl., *S. Phusomsaeng 109* (**BKF**049619!, **K**000577040!, **L**1902915†);– *ibid.*, alt. 82 m, 7 April 1969, fl., *P. Sangkhachand 1845* (**KYO**!);– *ibid.*, alt. 82 m, 17 June 1969, fl., *P. Sangkhachand 1880* (B**K**213996!);– *ibid.*, alt. 80 m, 10 July 2000, fr., *D.J. Middleton, T. Boonthavikoon*, *S.J. Davies*, *C. Hemrat & M.F. Newman 377* (**BKF**129109!, **E**00148013!, **K**000229928!, **L**4208032†);– *ibid.*, alt. 80 m, 21 July 1969, fr., *P.Sangkhachand2008* (**K**!);– *ibid.*, alt. 56 m, 15 April 1969, fr., *S. Phusomsaeng 147* (**BKF**049620!, **E**00991998!, **E**00992000!, **K**000577039!, **L**1902916†);– *ibid.*, alt. 900 m, 13 April 1969, fl., *S. Phusomsaeng 138* (**BKF**!);– *ibid.*, alt. 140 m, 7 April 2004, fr., *S. Gardner & P. Sidisunthorn ST0419* (**BKF**161691!, **K**!, **QBG**44272!);– Khao Banthat WS., 7°34'43” N, 99°47'19” E, alt. 109 m, 4 May 2019, fr., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR223* (**BKF**!, **TCD**!);– Palian, Khao Soi dao WS., alt. 500 m, 27 April 1928, fl., *A.F.G. Kerr 19150* (**BK**213992!, **E**01020035!, **K**!, **TCD**0016631!);– **Yala**: Betong, Winter Flower Garden, 5°53'39” N, 101°01'27” E, alt. 975 m, 14 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR235* (229809!, **TCD**!);– *ibid.*, 5°53'19” N, 101°01'21” E, alt. 865 m, 14 May 2019, fl. & fr., *S. Rueangruea*, *M.*

Poopath, *S. Yuprasert & S. Jirakorn SR234* (**BKF**229967!, **TCD**!);– Bannang Sata, Yala, 6°19'51” N, 101°23'26” E, alt. 798 m, 15 May 2019, fr., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR238* (**BKF**229813!, **TCD**!);– *ibid.*, 6°17'06.9” N, 101°18'46.2” E, alt. 200 m, 6 August 2000, fr., *C. Niyomdham*, *P. Puudja & S. Chonkujana 6347* (**BKF**201656!);– **Southern, Phetchaburi**: Kaeng Krachan, phanoen Thung ranger substation, Kaeng Krachan NP, 12°49'03.5” N, 99°22'53.5” E, alt. 860 m, 28 October 2013, fr., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T2358* (**BKF**206946!, **FU**!);– *ibid.*, 12°50'N, 99°18'E, 10 May 2005, fr., *D.J. Middleton, S. Suddee*, *C. Hemrat*, *Lindsay S. & S. Suwanachat*, *1793* (**BKF**144514!, **E**00320973!);– *ibid.*, 12°47'52” N, 99°22'7.1” E, alt. 300 m, 10 May 2005, fr., *D.J. Middleton, C. Hemrat*, *Lindsay S.*, *S. Suddee & S. Suwanachat 3358* (**BKF**157833!, **E**00219245!, **L**4193712†);– *ibid.*, 12°49'31"N, 99°21'46"E, alt. 951 m, 22 April 2019, *S. Rueangruea, S. Kaithongsuk P. Uea-Ary, T. Chaowasku, A. Danthongdee, N. Hathai & W. Kaewmongkul SR207* (**BKF**229805!, **TCD**!).

Distribution.— Myanmar (Northeastern and Lower). Thailand (Eastern, Southern, and Peninsula), Malaysia, Singapore, Indonesia (Borneo Java, Sumatra), and Papua New Guinea (**Maps 4.35 & 4.38**).

Vernacular name.— **Malaysia**: Poko mandong (Negeri Sembilan); Kayu tulang daeng (Temuan, Selangor); Pepijat (Selangor); Kayu marapit (Malacca); Togoba. **Thailand**: นูดต้นใบเล็ก Nuut bai lek (Trang), นูดต้น Nuut ton (Phatthalung). **Indonesia:** Iuimp (Papua New Guinea).

Ecology.— Evergreen Forest to Hill Evergreen Forest, from sea level to alt. 2,600 m.

Phenology.— Flowering March–June. Fruiting April–August.

Uses.— Occasionally mentioned as timber.

Conservation.—This species is known from many locations (> 10 locations): EOO = 18,617,670.20 km^2; AOO = 308.00 km^2.. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman (1965, 1993) treated this taxon as *Prunus grisea* var. *tomentosa* (Koord. & Valeton) Kalkman. *Prunus grisea* was originally described based on type material from Java. The main difference between *Prunus maingayi* and *Prunus grisea* is the thinner, papyraceous leaf (vs. thicker, subcoriaceous) and inflorescence with short raceme, 1–2 cm long (vs. long raceme, 2–6 cm long).

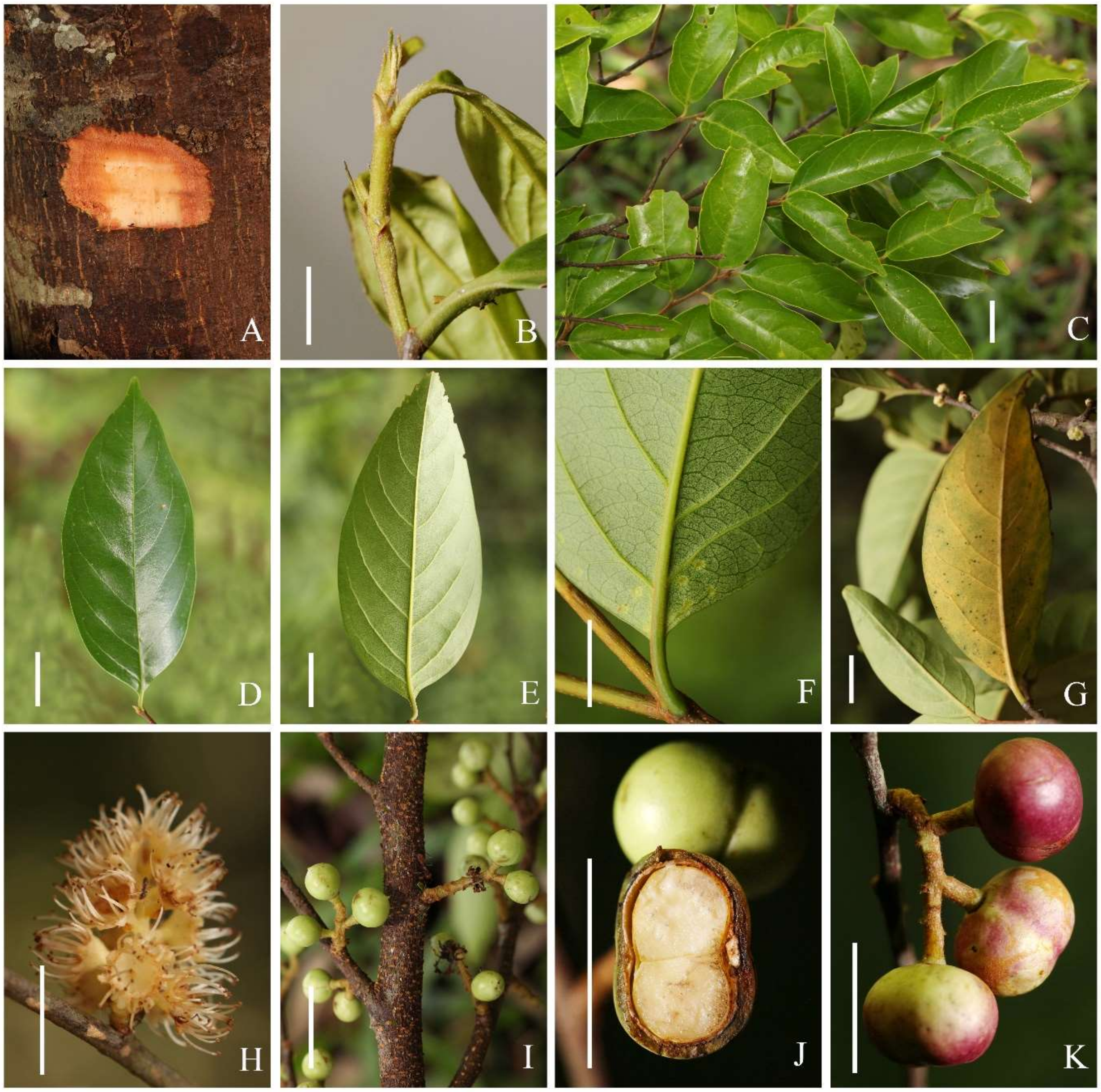
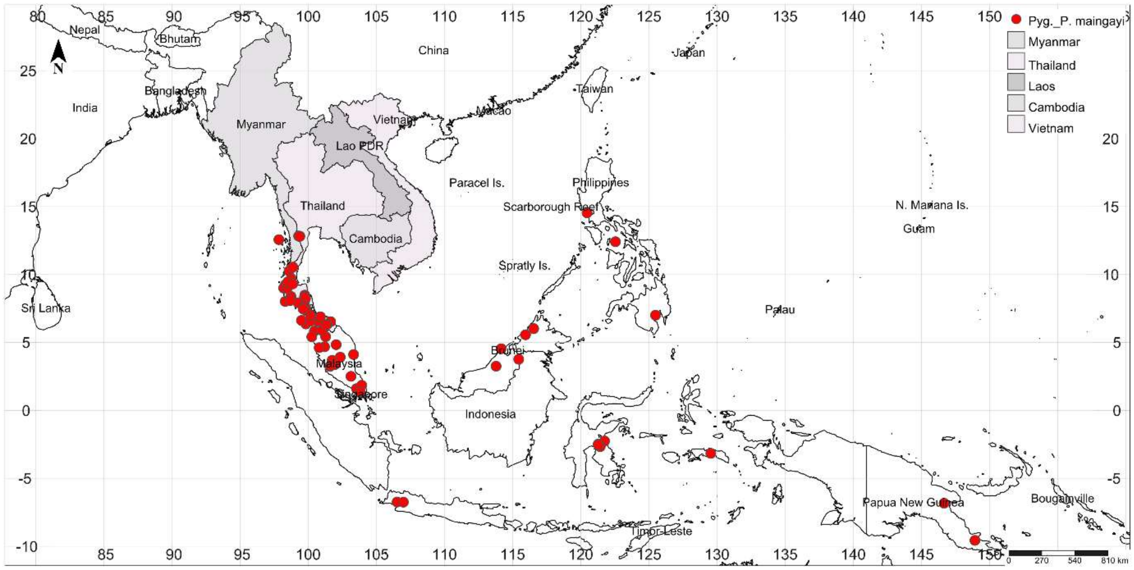


Figure 4.24. *Prunus maingayi* (Hook.f.) J.Wen, vegetative and reproductive morphological characters; **A**, outer and inner bark; **B**–**G**, leaves; **B**, young shoot, stipule linear; **C**, mature leaves, alternate; **D**, ovate-elliptic, glossy green adaxial; **E**, pale green to slightly glaucous abaxial; **F**, basal glands 2 (0–6); **G**, leaves from high altitude smaller and slightly thicker; **H**, inflorescence solitary, short on the fallen leaves branch; **I–K**, infructescence; **I**, young fruits, globose; **J**, mature cross-section, mesocarp and seedcoat glabrous; **K**, mature fruits transversely ellipsoid to didymous, turning reddish purple to black when ripe. — Photos: all by S. Rueangruea — Sources: all from **Thailand**, Southern, *S. Rueangruea et al.*: Nakhon Si Thammarat, C, E, J, from *SR216*: Trang, A, G, H from *SR214*; B, K from SR223: Yala, D, F, I, from *SR238*. Scale bar = 1 cm.



Map 4.38. Distribution of *Prunus maingayi* (Hook. f.) J.Wen of subg. *Laurocerasus* in continental Southeast Asia and nearby.

36. ***Prunus bokorensis*** **Rueangr., J.Parn. & Hodk.** ***sp. nov., ined.***

Typification**: CAMBODIA**, Cambodge, Kaoh Touch, Elephant Mountain, Bokor NP., 10°39'19.53” N, 104°3'36.61” E, alt. 928 m, line 5, sphagnum bog, 8 December 2013, *S. Tagane*, *P. Chhang*, *S. Rueangruea*, *S. Suddee & M. Zhang 6138* (holotype **BKF**200746!, isotype **FU**!).

Description: Evergreen, understory, shrub to small tree 2–5(–8) m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 6 cm in diameter; outer bark blackish-brown, smooth with brown lenticels, spines absent; *inner bark* yellowish-white; strong almond smell. **Branchlets** dark brown with dense prominent brown lenticels; young twigs reddish-brown with sparse long lenticels, sparsely brown tomentose, cataphylls absent; old twigs glabrescent. *Axillary winter bud* solitary, 1.5–4 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic, elliptic-oblong, narrow elliptic to ovate, 6–14 cm long × 1.5–4.5 cm wide; *lamina apex* usually acute to acuminate, sometimes obtuse, angle acute; *margin* entire, revolute, glabrous; *base* asymmetric sometimes slightly so, acute, slightly decurrent; young leaves pale green, dull dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous; young leaves glabrescent to glabrous; old leaves usually glabrous adaxially, glabrescent to glabrous abaxially; *basal glands* (–0) 2, up to 2 mm long, oblong to circular, flat, base often not entire, additional scarce circular glands near and along the margins; *2° venation* brochidodromous or weaky brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent;

4° venation reticulate, inconspicuous when dry; *5° venation* reticulate, inconspicious on both surfaces; *petioles* 0.5–1 cm long, grooved to shallowly canaliculate in cross-section, usually glabrous, sparsely hairy when young; *petiolar glands* absent. **Stipules** small to medium, 3–8 mm long × 1–2 mm wide, linear to oblong-triangular, apex acute to acuminate, margin entire, slightly serrated at the base, glabrous to sparsely ciliate, base oblong, glabrescent, caducous. **Inflorescences** solitary raceme, dense-flowered, in axils of leaves in the upper half of twigs or sometimes terminal, 1–2(–3) cm long, 5–12-flowered, tomentose, erect to horizontal along a branch; *involucral bracts* 3–5, up to 3 mm long, size and shape variable, ovate to oblong sometimes with shallowly tripartite lobed apex, densely whitish-brown hairy outside, sparsely hairy inside, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white, sessile or short pedicellate, stout, 0–1 mm long, densely short brown hairs; *bracteoles* ovate-oblong, to boat shaped, up to 4 mm long, up to 2 mm wide, whitish-green, densely whitish-brown hairs, early caducous; *hypanthium* campanulate to obconic, 1.5–2(–3) mm long, pubescent; *perianth* 5-merous, petals slightly different from calyx lobes; *calyx* lobes 7–10, triangular to ovate, minute, white, 0.6–1.5 mm long × 0.5–1 mm wide, subequal, apex acute to sub-obtuse, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, glabrous inside or with hairs on bottom inside; *corolla* petals slightly different or indistinguishable from sepals, white, spreading to upright, (4–)5, small, 0.8–1.5 mm long × 0.5–0.8 mm wide, subequal, petals not distinct from calyx lobes, elliptic, ovate to triangular, sessile, apex rounded to sub-acute, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 30–36 in 3 to many series, exserted; filament filiform, white, 2–3.5 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers globose, 0.3–0.5 mm long; *ovary* typically glabrous, sometimes sparsely hairy at bottom, rarely more densely so, 1 locular; *style* filiform, 2.5–5.5 mm long, usually more longer or at least as long as stamens, glabrous; stigma gland not divided, globose to peltate. *Infructescence* 1–3 cm long, densely to sparsely hairy, 1–9 fruited. **Fruits** fleshy, stipitate, stout, densely brown hairy, young fruit greenish to whitish-green, red to reddish-purple when mature or ripe, transverse ellipsoid, sub-reniform to didymous, 0.7–1 cm long, 0.6–0.8 cm wide, apex retuse to obtuse, sometimes tipped with the remnant of style, beak-like up to 1 mm long; young fruits not seen; mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-red; endocarp stone, pitted and furrowed, hard, glabrous; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually transversely globose laterally, thin, with glabrous reticulate testa seedcoat glabrous (**Figure 4.25**).

Additional specimens examined.— **CAMBODIA**. **Cambodge**: Kaoh Touch, Elephant Mountain, Bokor NP, 13 November 2012, fr., *Wu Su-Gong*, *X. Gong*, *Ting Shuang Yi*, *C. Liu & Xin-Yu Wang WH-30167* (**MO**100630167†);– *ibid.*, *WH-4173* (**MO**6448380†);– *ibid.*, 10°37'16.77" N, 104°01'52.32" E, alt. 1,043 m, 10 December 2013, lvs., *H. Toyama*, *K. Fuse*, *F. Iwanaga*, *S. Rueangruea*, *S. Suddee*, *W. Kim*, *M. Loth 6268* (**FU**!);– *ibid.*, 10°38'12.59" N, 104°02'06.37"E: alt. 1,014 m, 4 December 2011, lvs., *H. Toyama*, *S. Tagane*, *T. Kajisa*, *K. Sakata*, *M. Nobayashi*, *N. Mihara*, *T. Ide*, *P. Chhang*, *H. Nagamasu 1495* (**BKF**!, **FU**!);– *ibid.*, alt. 1,014 m, 5 December 2011, lvs., *H. Toyama*, *S. Tagane*, *T. Kajisa*, *K. Sakata*, *M. Nobayashi*, *N. Mihara*, *T. Ide*, *P. Chhang*, *H. Nagamasu 1616* (**FU**!);– *ibid.*, alt. 1,014 m, 5 December 2011, fl. & fr., *H. Toyama*, *S. Tagane*, *T. Kajisa*, *K. Sakata*, *M. Nobayashi*, *N. Mihara*, *T. Ide*, *P. Chhang*, *H. Nagamasu 1629* (**FU**!);– *ibid.*, alt. 1,014 m, 16 July 2012, fl., *S. Tagane*, *K. Fuse & P. Chhang 3995* (**FU**!);– *ibid.*, alt. 1,000 m, 2 November 1933, fl., *E. Poilane 23038* (**L**1902911†, **P**03358146-7!, **VNM**!);– *ibid.*, alt. 970 m, 23 October 2012, lvs., *T. Yahara*, *S. Tagane*, *K. Fuse*, *A. Naiki*, *T. Yamaoto*, *M. Zhu*, *P. Chhang & H.N. Choeung 4464* (**FU**!);– *ibid.*, 10°37'35.2” N, 104°03'57.3” E, alt. 970 m, 23 October 2012, fr., *T. Yahara*, *S. Tagane*, *K. Fuse*, *A. Naiki*, *T. Yamaoto*, *M. Zhu*, *P. Chhang & H.N. Choeung 4467* (**FU**!);– *ibid.*, 10°39'19.53” N, 104°03'36.61"E: alt. 933 m, 16 February 2013, fr., *S. Tagane*, *H. Toyama*, *N. Wachi*, *R. Ichihashi*, *K. Mase*, *M. Zhu & P. Chhang 5479* (**FU**!);– *ibid.*, alt. 928 m, 8 December 2013, fl. & fr., *S. Tagane*, *P. Chhang*, *S. Rueangruea*, *S. Suddee & M. Zhang 6138* (**FU**!);– *ibid.*, 10°37'35.2” N, 104°03'57.3” E, alt. 800 m, 5 February 1928, fr., *E. Poilane 14678* (**L**1902910†, **P**03358149-50!);– **Koh Kong**: Thma Baing, Ruessei Chrum, 11°39'39.2” N, 103°23'58.7” E, alt. 342 m, 22 December 2008, fr., *M. Newman*, *J.-N. Labat*, *O. Insisiengmay*, *L. Ecilio & L. Viboth 2180* (**L**4182724†, **P**00695534!); – *ibid*, Koh Kong, 11°13'00"N, 104°10'00"E, alt. 400 m, 30 October 2002, fr., *A.M. Huq, Phourin, Pungley H10967* (**L**0808739†). **THAILAND**. **Eastern, Trat**: Khao Kuap, 11°38'49.9” N, 102°33'07.2” E, alt. 700 m, 25 December 1929, fl. & fr., *A.F.G. Kerr 17769* (**BM**!, **K**!, **L**1902917†).

Distribution.— Endemic to W. Cambodia and E. Thailand (known only from the specimens cited) (**Maps 4.35 & 4.39**).

Vernacular name. **—** Not known.

Etymology.— The epithet ‘bokorensis’ refers to the type specimen collection locality, Bokor National Park.

Ecology.**—** Dry Evergreen to Lower Montane Forest, in opening areas, along trails, streams, or in valleys, alt. 300–1,200 m.

Phenology.**—** Flowering, November to January; fruiting, December to February.

Uses.— Not known.

Conservation.— This species is known from more than five but ≤ 10 locations: EOO = 5,736.37 km^2; AOO = 24.00 km^2. The number of individuals in each subpopulation is ≤ 1,000. I consider the conservation status of the species currently to be VU (Vulnerable); B1B2aC2a(i)D2 (IUCN, 2019).

Note.— The new species is highly distinctive in its leaf, floral, and fruit morphology compared with most other species in continental Southeast Asia. It is somewhat similar to *Prunus maingayi* (Hook.f.) J.Wen. But, *Prunus bokorensis* can be easily distinguished from *P. maingayi* by its leaf index of 3–5 (vs. 1.5–3), basal leaf glands, 0.8–2 mm long (vs. up to 1 mm long), bracteoles 2–4 mm long (vs. up to 2 mm long), and stamens 30–36 (vs. 20–30).

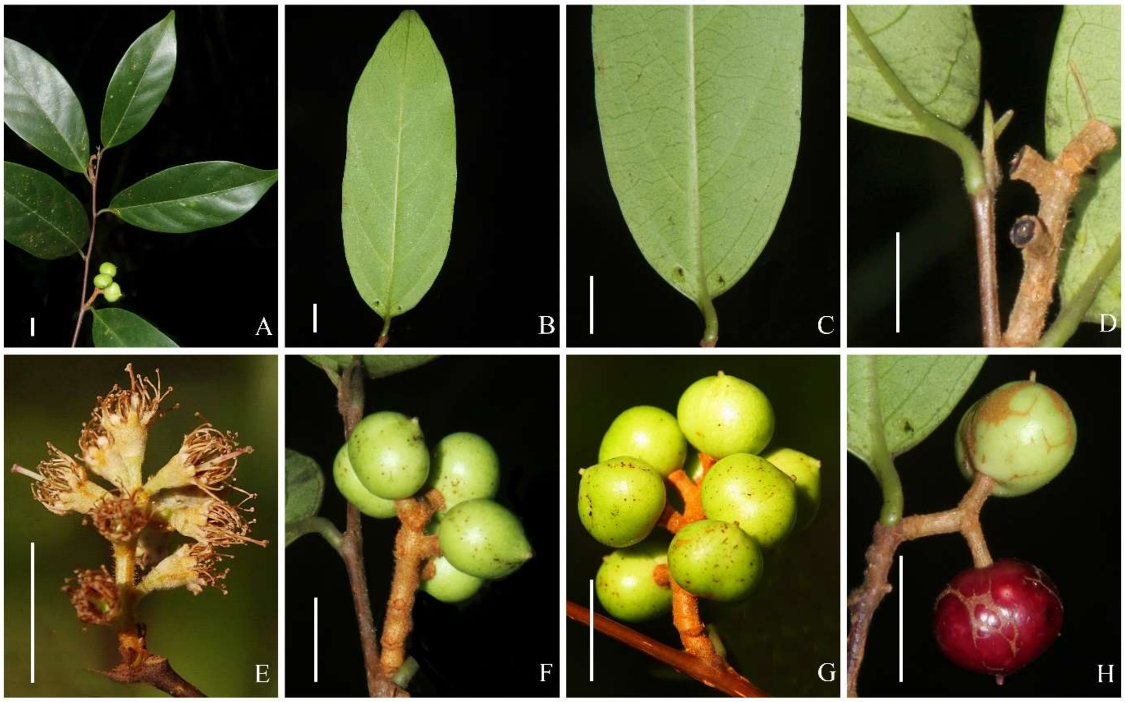
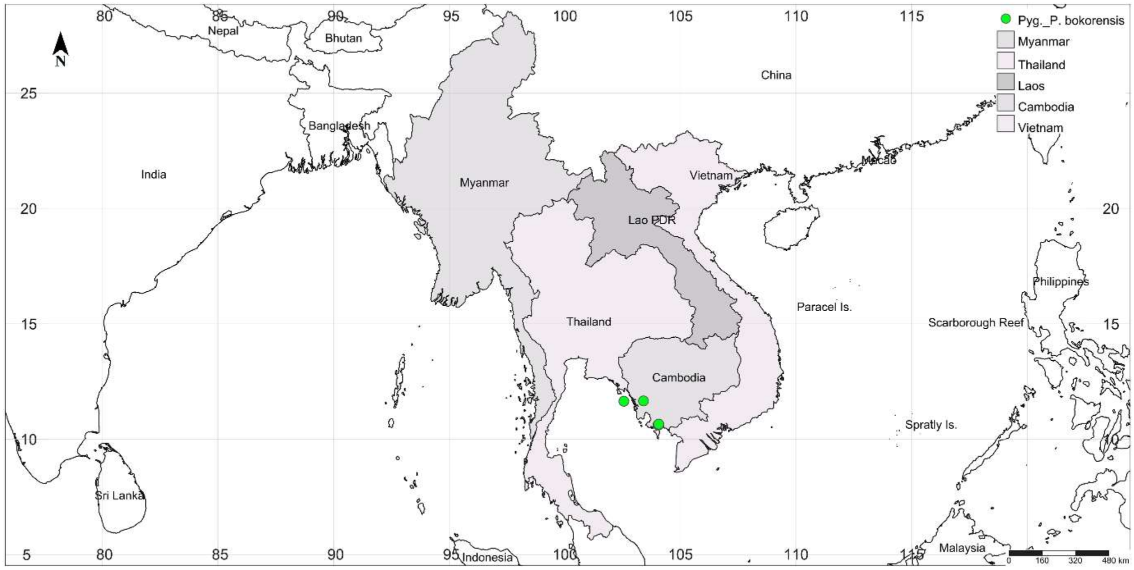


Figure 4.25. *Prunus bokorensis* Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters. **A**–**D**, leaves; **A**, leaves elliptic; **B**, elliptic-oblong, abaxial; **C**, basal glands 2; **D**, fallen fruits infructescence with linear stipules; **E**, inflorescence solitary, petals slightly different from calyx lobes; **F**–**H**, fruiting; **F**, young infructescence in axillary leaf; **G**, mature fruits, transverse ellipsoid, sub-reniform to didymous**;** **H**, turning reddish purple to black when ripe, tipped with the remnant of style, beak-like. — Photos: all by S. Tagane. — Sources: all from **Cambodia**, Cambodge, Bokor NP, *S. Tagane, et al.*; A – E & H, from *1629*; F, G from *6138*. Scale bar = 1 cm.



Map 4.39. Distribution of *Prunus bokorensis* Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia and nearby.

37. ***Prunus hongiaoensis*** **Tagane & Yahara**, in Tagane et al. Acta Phytotaxonomica et Geobotanica. 71 (3): 219–221. *f.* 10: 219. 2020.

Typification: **VIETNAM**. **Lam Dong** Province. Bidoup-Nui Ba National Park: Hon Giao, Montane forest, 1,639 m, 12°11′11.25″N, 108°42′54.17″E, 19 June 2018, fl., *S. Tagane*, *T. Yahara*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc*, *H.T. Binh V8691* (holotype **KYO**!, isotypes **BKF**!, **DLU**†, **FU**!).

Description: Evergreen, understory, small tree up to 8 m tall, canopy shape oval, or globose. **Stem** clear bole, erect, dbh 4–20 cm in diameter; outer bark blackish-grey, smooth with distinct lenticels, spines absent; *inner bark* yellowish-brown; strong almond smell. **Branchlets** stout, blackish-brown or whitish-brown lenticels; young twigs green to greenish-brown, reddish-brown when dry, glabrous, cataphylls absent; old twigs glabrous, greyish-brown. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate-elliptic, elliptic or elliptic-oblong, 5–10 cm long × 2–4 cm wide; *lamina apex* acute to obtuse, angle acute; *margin* entire, revolute, glabrous; *base* slightly oblique or symmetrical, cuneate to obtuse, decurrent; young leaves dull green adaxially, grey when dry, pale green abaxially, greyish-brown when dry, turning yellow before falling, coriaceous, glabrescent to glabrous; old leaves glabrous adaxially, glabrescent to glabrous abaxially; *basal glands* 2–4 (–6), up to 2.5 mm long, oblong to ovate-oblong, flat or shallowly swollen adaxially, over the base of leaf blade margin, along the midrib, additional scarce circular glands on blade; *2° venation* weakly brochidodromous, 8–10 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, flat, slightly impressed adaxially or prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 1–1.5 cm long, canaliculate in cross-section, rounded abaxially, glabrescent to glabrous; *petiolar glands* absent. **Stipules** medium, 7–16 mm long × 1–2.5 mm wide, oblique linear, oblong, apex acute, margin entire or slightly a few teeth near the base, with a few marginal glands, base oblong, glabrous, not early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, both in axils of leaves and the scars of fallen leaves, mainly at the base of young shoots, 2–10 cm long, 2–84-flowered, pubescent, erect or slightly pendulous; *bracts* 1–3, up to 2 mm long, size and shape variable, hairy outside, sub(glabrous) inside, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white to yellowish-brown, pedicellate, slender, 2–4(–5) mm long, densely short brown hairy; *bracteoles* ovate-triangular, ca 2.5 mm long, greenish-brown, adpressed, brown hairy outside, glabrous inside, early caducous; *hypanthium* funnel-shaped, 3.5–5 mm long, pubescent; corolla distinctly different from calyx lobes; *calyx* lobes 5, triangular, minute, ca. 1.3 mm long × 0.8–1.2 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, adpressed brown hairy outside, glabrous inside; *petals* white, spreading, 5, medium, ca. 3 mm long × 2.5–3 mm wide, subequal, petals 2.5–3 times calyx lobes length, orbicular, sessile, apex rounded, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, glabrous inside; *stamens* 40–46 in 3 to many series, exserted; filament filiform, white, 4–4.5 mm long, glabrous; anthers oblong to globose, ca. 0.7 mm long; *ovary* glabrous, 1 locular; *style* filiform, 4–5 mm long, slightly longer than to as long as stamens, glabrous; stigma discoid. *Infructescence* 2–5 cm long, glabrous, few, 1–5 fruited. **Fruits** fleshy, stipitate, 3–5 mm long, young fruit green, dark purple, via reddish-purple when ripe, transverse ellipsoid, subreniform to didymous, 1–1.2 cm long, 1.4–1.6 cm wide, apex acute to obtuse; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal or ridged, canaliculate; calyx deciduous; style present, peaked or apiculate up to 1.5 mm long. **Seeds** are usually transversely globose laterally, thin, with glabrous reticulate testa (**Figure 4.26**).

Additional specimens examined.— **VIETNAM**. **Annam, Lam Dong**: Bao Loc, Blao, Phnom Sapoun, alt. 1,100 m, 10 January 1935, levs., *E. Poilane 23799* (**L**4184914†); – *ibid*.: Chu Yang Sinh, alt. 2400 m, 24 April 1941, *E. Poilane 32569* (**P**!);– *ibid.*, Hon Giao, Bi Doup Nui Ba NP., 12°11'11.25” N, 108°42'54.17” E, alt. 1,639 m, 24 September 2018, lvs., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya*, *T. Nguyên & C.T. Nguyên. V9338* (**BKF**!, **FU**!);– *ibid.*, Dinh Gia Rieng, Giang Ly, Bi Doup Nui Ba NP., 12°11'12.0” N, 108°42'51.0” E, alt. 1,666 m, 17 June 2018, lvs., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8540* (**FU**!);– *ibid.*, 12°11'11.25” N, 108°42'54.17” E, alt. 1,639 m, 17 June 2018, fl., *op. cit.*, *V8583* (**BKF**!, **FU**!);– *ibid.*, 19 June 2018, fl., *op. cit.*, *V8691* (**FU**!);– **Cochinchine, Khanh Hoa**: Hon Ba Mt., 12°07'8.64” N, 108°56'51.99” E, alt. 1,498 m, 18 July

2013, fr., *S. Tagane*, *T. Yahara*, *H. Nagamasu*, *K. Fuse*, *H. Toyama*, *H. Tran*, *V.S. Dang*, *X.N. Loi*, *N.D. Thach*, *Q.N. Cuong*, *P.N.H. Hieu & K.N. Thach V306* (**FU**!);– **Tonkin, Da Nang**: Ba Na Nui Chua, 12°07'8.64" N, 108°56'51.99" E, 22 October 2008, fr., *N.V. Du, B.H. Quang*, *Chinh V.T.*, *The P.V.*, *Kok R. de*, *M.D. Xanthos*, *A. Moore*, *C. J. A.M. Sinou*, *R.P. Clael & P.I. Little*, *HNK3267* (**K**!).

Distribution.**—** Endemic to Vietnam (known only from the Hon Giao area in Bidoup-Nui Ba National Park) (**Map 4.40**).

Vernacular name. **—** Not known.

Ecology.— Scattered in open areas or the shade, Lower Montane Forest, alt. 1,400–1,800 m.

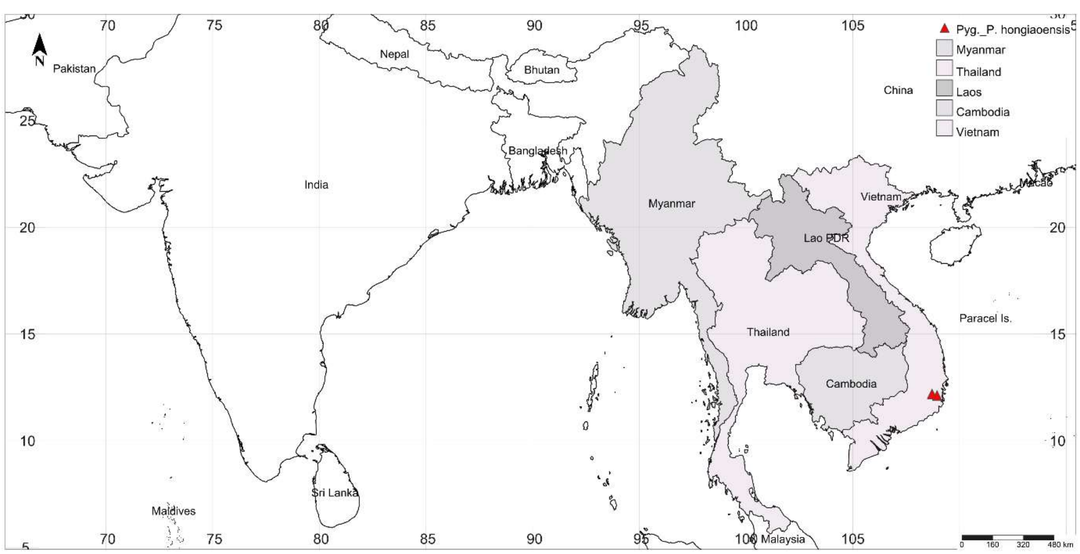
Phenology.**—** Flowering specimens were collected from May to June, fruiting from July to October.

Uses.— Not known.

Conservation.— This species is known from not more than five locations: EOO = 736.37 km2; AOO = 14.00 km2. The species is endemic to Southern Vietnam, known only for one location. The number of individuals in the population is small. The number of mature individuals < 50. I consider the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1 (IUCN, 2019).

Note.— Tagane (2020) states that *Prunus hongiaoensis* belongs to the subgenus *Laurocerasus*. According to the revision of *Laurocerasus* by Kalkman (1965), it is also similar to *Prunus spinulosa* Siebold & Zucc. of Japan and southern China in having leaves without dark spots abaxially, flat or only slightly hollowed basal glands not on the petiole but on the leaf blade, solitary and simple racemes, petals distinct from the sepals, a glabrous ovary, and glabrous seedcoat. *Prunus hongiaoensis*, however, is distinguished from *P. spinulosa* by its entire leaf margin (vs. undulate, with a few acicular teeth apically from middle to near apex), lamina with 6 or 7 pairs of secondary veins (vs. 8–14 pairs), and 40–46 stamens (vs. 25–35).

Figure 4.26. *Prunus hongiaoensis* Tagane & Yahara, vegetative and reproductive morphological characters; **A**, outer bark and inner bark, **B–D**, leaves; **B**, young shoot, spiral; **C**, elliptic-oblong, coriaceous; **D**, basal glands, 2–4 (–6), and linear stipules; **E** & **F**, inflorescence; **E**, solitary raceme with flower bud; **F**, opening flowers, corolla distinctly different from calyx lobes; **G**–**H**, infructescence; **G**, mature, transverse ellipsoid; **H**, cross-section, endocarp and seedcoat glabrous. — Photos: A–D by S. Rueangruea; E–H by S. Tagane — Sources: all from **Vietnam**, Annam, Lam Dong, Bi Doup Nui Ba NP, *S. Tagane, et al.*; A–E from *V8583*; F from *V8691*; G & H from *V9338*. Scale bar = 1 cm.



Map 4.40. Distribution of *Prunus hongiaoensis* Tagane & Yahara of sect. *Mesopygeum* in continental Southeast Asia.

38. *Prunus ceylanica* (Wight) Miq., Flora van Nederlandsch Indie. 1(1): 366. 1855; Kurz, Forest Flora of British-Burma 1: 435. 1877; Hook.f., Flora of British-India, London. 2 (5): 318–321. 1878; King, Materials for a Flora of the Malayan Peninsula. Singapore 6: 289. 1897; Kalkman, Blumea; Tijdschrift voor de Systematiek en de Geografie der Planten (A Journal of Plant Taxonomy and Plant Geography). 13(1): 52–55. 1965; *ibid*, The Old World species of *Prunus* subgen. *Laurocerasus,* including those formerly referred to *Pygeum*: 56–56, fig, 22: 62. 1965. J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 184–185, pl. xxv, 1–2. 1968; in Flora of Thailand 2 (1): 70. 1970; Tirvenggadum, in F.R. Fosberg. A Revised Handbook of the Flora of Ceylon. 3: 376–378. 1981. Type as for the basionym below.

≡ *Polydontia ceylanica* Wight, Illustrations of Indian Botany. 1: 203. 1840.

Typification: Sri Lanka, Ceylon, Westerly Peninsula, Anamallay, Shevarry, Pulney and Tinevelly ranges, Beddome *s.n.*, *non vidi*; Ceylon, Central Province, alt. 4,000–8,000 ft. Wight, *s.n.*

≡ *Pygeum wightianum* Blume, in Ser. Mélanges Botaniques. 12: 361. 1855.

= *Pygeum zeylanicum* Gaertn., De Fructibus et Seminibus Plantarum. 1: 218. t. 46. f. 4. 1788.

Lectoypification: fr. *Koening 6404* (lectotype **L**†, designated by Kalkman 1965; isolectotype, *non vidi*).

= *Pygeum plagiocarpum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 180. 1913; Alston in Trimen, Hand. Fl. Ceylon 6: 101. 1931.

Typification: Sri Lanka, Ceylon, alt. 4–8000 ft., June 1854, fl. *G.H.K. Thwaites 638* (holotype **K**000030980!; isotypes, **BM**000622029!, **BR**0000005294602†, **GH**00032452†, **K**000030978!, **K**000030979!, **L**00013644†, **P**01819054!, **P**01819055!, **P**01819056!).

Description: Evergreen, sub-canopy, tree up to 25 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown, smooth to slightly fissured with brown lenticels, spines absent; *inner bark* pinkish-white; strong almond smell. **Branchlets** stout, greyish-brown prominent brown lenticels; young twigs greenish-brown, pubescent when very young, rapidly glabrescent, cataphylls absent; old twigs glabrescent with prominent whitish-brown lenticels. *Axillary winter bud* solitary, 5–8 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate; *lamina apex* usually acuminate, rarely obtuse, angle acute; *margin* entire, revolute, glabrescent to glabrous; *base* asymmetrical to slightly oblique or symmetrical, acute, rounded, usually decurrent; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, texture generally relatively thin and chartaceous, sometimes more coriaceous; young leaves sparsely hairy; old leaves glabrous adaxially, ± sparsely pubescent abaxial; *basal glands* (–0) 2 (–3), up to 2 mm long, circular to oblong, flat or shallowly swollen adaxially, over the base of leaf blade margin, additional scarce oblong glands near the nerves or along margins; *2° venation* brochidodromous or weaky brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 1–1.5 cm long, stout, shallowly canaliculate in cross-section, pubescent when young, then glabrescent to glabrous; *petiolar glands* absent. **Stipules** medium, 3–4 mm long × 1–2 mm wide, linear, apex acuminate, margin entire, ciliate, sometimes with marginal glands, base oblong, densely hairy, margins sometimes glandular, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, both in axils of leaves and the scars of fallen leaves, 3–7(–11) cm long, many-flowered, pubescent, pendulous; bracts 1–3, up to 1.5 mm long, size and shape variable, hairy outside, sub(glabrous) inside, margin ciliate, caducous. **Flowers** bisexual or functionally male and then with a small to minute pistillodium, opening with mature leaves, white, pedicellate, slender, 1–4(–5) mm long, pubescent; *bracteoles* scale-like to minute linear, up to 0.5 mm long, pale green, pubescent, early caducous; *hypanthium* campanulate or obconate, 1.5–2 mm long, pubescent; corolla distinctly different from calyx lobes; *calyx* lobes 5, rarely 4 or 6-merous, very rarely the perianth segments more equal, triangular or subulate, minute, green, 0.6–1 mm long × 0.5–1 mm wide, apex acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, glabrescent except on the bottom inside; *petals* white, spreading to upright, 5, small, 0.8–1.5 mm long × 0.5–0.8 mm wide, subequal, petals 1–1.5 times calyx lobes length, elliptic, ovate to orbicular, sessile, apex acute to obtuse, margin entire, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 10–22 in 3 to many series, exserted; filament filiform, white, 3.5–4 mm long, glabrous; anthers oblong to globose, 0.3–0.5 mm long; *ovary* with a ring of hairs around point of insertion, otherwise glabrous or with a few hairs, 1 locular; *style* filiform or pistilode stout, 2–5 mm long, slightly longer than, or as long as stamens or male flower with minute pistillode, glabrescent to sparsely pilose; stigma gland not divided, globose, green. *Infructescence* 2–12 cm long, glabrescent to glabrous, few, 1–3 fruited. **Fruits** fleshy, stipitate, 3–5 mm long, young fruit green, reddish-green, dark purple or ultimately black, powerful almond smell, bitter testing when mature or ripe, transversely ellipsoid to didymous, very variable in dimensions, 0.6–1.2 cm long, 1.2–1.8 cm wide, apex retuse to obtuse, sometimes tipped with remnants of style; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal furrowed or ridged, canaliculate; calyx deciduous. **Seeds** are usually transversely globose laterally with thick, glabrous, and reticulate testa.

Additional specimens examined.— **SRI LANKA**., October *s.n.*, fr., *S. Gardner*, *s.n.* (**K**000030968!);– October 1855, fr., *G.T. 393* (**P**03358370!);– **Central, Ceylon**: March 1836, fl., *R. Wight 293* (**E**!);– *ibid.*, June *s.n.*, fl., *G.H.K. Thwaites CP1596* (**P**01819057!);– *ibid.*, October *s.n.*, fr., *D.D. Tirvengadum & L.H. Cramer, s.n.* (**P**03358477!);– *ibid.*, Elk Plains near Ambevela, alt. 1,700 m, 9 April 1969, fr., *Kostermans 23097* (**L**1902581†);– *ibid.*, Hackgalle, fl., s.n., *R.H. Beddome 2694* (**BM**!);– *ibid.*, Kandy, Dotulugala, 1 February 1975, fr., *S. Waas 1031* (**L**1892637†);– *ibid.*, Adisham forest near Haputale, alt. 1,500 m, 9 May 1969, *Kostermans 23424* (**L**1902587†);– *ibid.*, Madulkele, near the summit of Gomliya Ridge, 5 May 1980, fr., *Kostermans 28524* (**L**†);– *ibid.*, Nuwara Eliya: 24 January 1973, lvs., *D.D. Tirvengadum & L.H. Cramer 269* (**L**1902589†, **P**03358408!);– *ibid.*, 24 January 1973, fr., *D.D. Tirvengadum & L.H. Cramer 270* (**P**03358404!);– *ibid.*, 15 July 1978, fl., *W. Meijer 1974* (**L**1892638†);– *ibid.*, 7 December 1972, fr., *D.D. Tirvengadum & L.H. Cramer 111* (**P**03358369!);– *ibid.*, Ram Boda, 17 June 1946, lvs., *T.B. Worthington 1926* (**K**!);– *ibid.*, Maskeliya, 14 November 1978, fl., *A. Kostermans 27066* (**K**!).

Distribution.**—** Srilanka (Ceylon), (**Maps 4.41 &4.42**).

Vernacular name.**—** Not known.

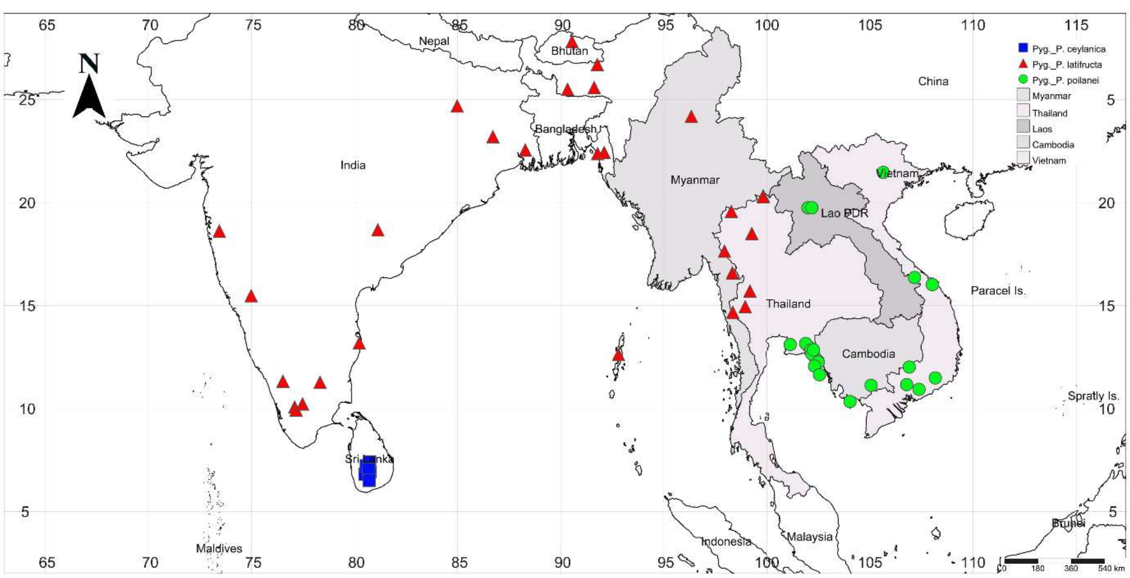
Ecology.**—** Dry Evergreen Forest to Montane forest, often in disturbed forests or jungles, alt. 600–1,700 m.

Phenology.**—** Flowering May–August, fruiting October–November.

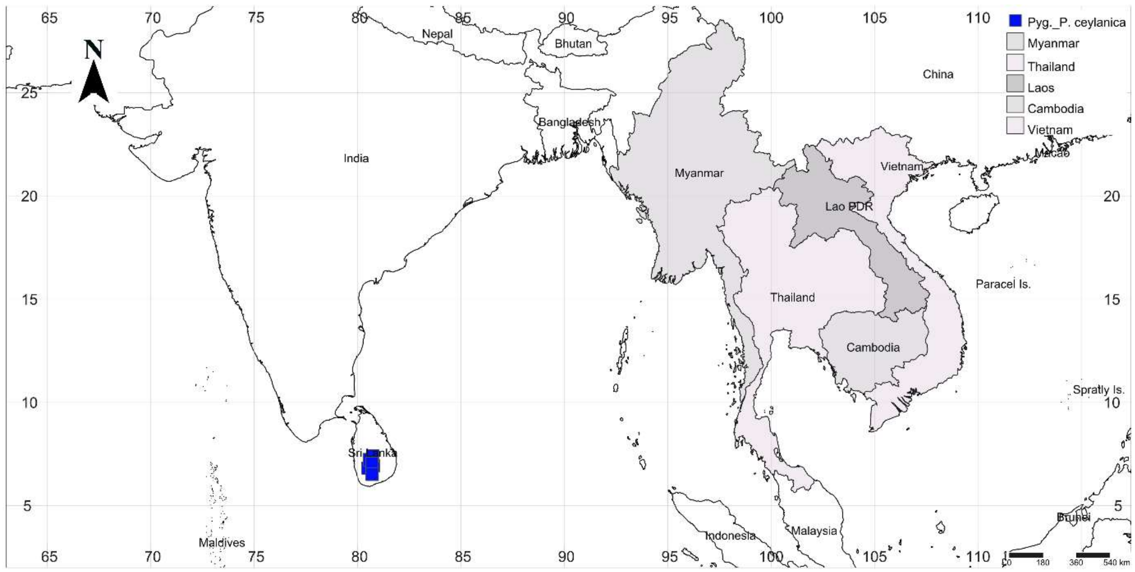
Uses.— Used for timber, light-colored, wood moderately hard.

Conservation.—This species is known from many locations (> 10 locations): EOO = 1,273,771.58 km^2; AOO = 128.00 km^2.. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— *Prunus ceylanica* (Wight) Miq. is outside of the study area but was included because this name has previously been applied in the study area. *Pygeum tenuinerve sensu auct.* Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 180. 1913. Typification: Sri Lanka, Ceylon, Einheim, *pro parte, quoad Moore*, *s.n.*, (holotype **L**0019573†). Kalkman (1965) treated this species as a synonym of *Prunus ceylanica.* However, morphologically, it appears to be a close relative of the Chrysobalanaceae.



Map 4.41. Distribution of ceylanica's group of sect. *Mesopygeum*, inflorescence a solitary long raceme; *Prunus latifructa* (Colebr) Ruengr., J.Parn. & Hodk., *P. ceylanica* (Wight) Miq., and *P. poilanei* (Vidal) Rueangr., J.Parn. & Hodk., respectively, in continental Southeast Asia and nearby.



Map 4.42. Distribution of *Prunus ceylanica* (Wight) Miq. of sect. *Mesopygeum* in India and Sri Lanka.

39. ***Prunus latifructa*** **(Colebr.) Ruengr., J.Parn. & Hodk.,** comb. nov., nom. nov., ined.

≡ *Pygeum acuminatum* Colebr., Transactions of the Linnean Society of London. London. 12(2): 360. t. 18. 1818; Hook.f., Flora of British-India. 2(5): 318. 1878. Typification. Bangladesh, Bengal, at Silhet, Ghorma, *non vidi*, non *Prunus acuminata* Wall.

Typification. India, Patgong, 25 March 1809. fr., (*Pygeum denudatum*), *s.coll., cat. no. 7190* (lectotype **K**001126855!), designated here.

= *Pygeum glaberrimum* Hook.f., Flora of British-India. 2(5): 319. 1878.

Typification. Bangladesh, Chittagong, alt 3,000–5,000 ft., *J.D. Hooker & T. Thomson, s.n.* (lectotype **K**000030965!; isolectotypes **BM**000622028!, **E**00317635!, **L**0019568!, **M**0214824†, **P**01818993!, **U**1551794! (exclude the flowering sample); India, Sikkim,1,000-3,0000 ft., fr., *J.D. Hooker, s.n.* (lectoparatypes **A**00032450!, **BM**000946951!, **E**00010504!, **GH**00032450†, **K**000030965!, **K**000030966!, **M**0214828†, **P**01818994!), designated by Kalkman.

= *Pygeum gardneri* Hook.f., Flora of British-India. 2(5): 321. 1878.

Typification**: INDIA,** Tamil Nadu, Neelgherry (Nilghiri) Hills, January 1845. Stamens *ca* 12(-30), *Wight 908* (lectotype **K**000030967!), designated by Kalkman.

= *Pygeum sisparense* Gamble, Bulletin of Miscellaneous Information, Royal Gardens, Kew. (7): 238. 1918. Typification: **INDIA,** Kerala, above Sispara, May 1884, fl., *J.S. Gamble 14339* (holotype

K000030971!), paratypes: June 1884, 700 ft., *J.S. Gamble 11472* **K**000030972! (on the same sheet as type); Tamil Nadu, Kundah, *Gamble 20582*, **K**000030970!; *Gamble 1409*, **K**000030973!; **Madras**: Hilgiris, Sispara, June 1918, *Gamble 20637*, **K**000030969!).

Description: Evergreen, sub-canopy, tree up to 25 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown, smooth or shallowly fissured with dense prominent brown lenticels, rough, vertically fissured, and shallowly horizontally cracked, spines absent; *inner bark* whitish-brown with longitudinal brown stripes, 6–10 mm thick; strong almond smell. **Branchlets** stout, greyish-brown with prominent brown lenticels; young twigs green, pubescent when very young, rapidly glabrescent, cataphylls absent; old twigs glabrescent, prominent whitish-brown lenticels. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, various shapes and sizes, alternate, ovate, ovate-lanceolate, oblong-lanceolate, elliptic-ovate, ovate-oblong to broad lanceolate, 9–20 cm long × 3–8.5 cm wide; *lamina apex* acuminate to acute, angle acute; *margin* entire, slightly revolute, glabrous; *base* asymmetrical to slightly oblique or symmetrical, obtuse to subacute; young leaves pale green, glossy green adaxially, pale green abaxially, turning yellow before falling, usually herbaceous to sub-coriaceous, glabrescent to glabrous; old leaves glabrous adaxially, glabrescent to glabrous abaxially; *basal glands* flat or shallowly pitted, 2 (–3), up to 1.5 mm long, circular to oblong, usually flat or shallow swollen adaxially, over the base of leaf blade margin, additional scarce oblong glands on the nerves, near or along the margins; *2° venation* brochidodromous or weaky brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles* 0.8–2.2 cm long, stout, shallowly canaliculate in cross-section, pubescent when young, then glabrescent to glabrous; *petiolar glands* absent. **Stipules** medium, 3–6.5 mm long × 1–2 mm wide, linear, apex acuminate to acute, margin glandular, entire, ciliate, base oblong, sparsely hairy, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, (mainly) in axils of leaves, occasionally on the branches with fallen leaves, 5–12 cm long, peduncle and rachis stout, many-flowered, pubescent, pendulous; *bracts* 1–3, up to 1.5 mm long, size and shape variable, lowermost ones sometimes tripartite, hairy outside, sub(glabrous) inside, margin ciliate, caducous. **Flowers** bisexual, sometimes with a slight to minute pistillodium, opening with mature leaves, white, pedicellate, slender, 2–4(–5) mm long, 5–6 mm across, pubescent to sparsely hairy; *bracteoles* scale-like to minute linear, up to 0.5 mm long, pale green, pubescent, early caducous; *hypanthium* campanulate, obconic or turbinate, 1.5–2 mm long, white, sparsely pubescent outside, yellow to orange glabrescent and spasely hairy at the base inside; corolla distinctly different from calyx lobes; *calyx* lobes 5, rarely 4 or 6-merous, very rarely the perianth segments more equal, triangular, minute, green, 0.6–1 mm long × 0.5–1 mm wide, apex acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, glabrescent except on the bottom inside; *petals* white, spreading to upright, (4–) 5 (–6), small, 0.8–1.5 mm long × 0.5–0.8 mm wide, subequal, petals 1–1.5 times calyx lobes length, oblong, elliptic, ovate to orbicular, sessile, apex rounded or obtuse, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* (20–)25–42 in 3 to many series, exserted; filament filiform, white, 3–5 mm long, glabrous; anthers oblong to globose, 0.3–0.5 mm long; *ovary* with a ring of hairs around point of insertion, otherwise glabrous or with a few hairs, 1 locular; *style* stout, 2–5 mm long, slightly longer than, as long as stamens, glabrescent to sparsely hairy at the basal half, or male flower with minute pistillode, glabrous; stigma gland not divided, globose, green. *Infructescence* (2) 6–12 cm long, glabrescent to glabrous with large lenticels, few, 1–4 fruited. **Fruits** fleshy, stipitate, very stout, glabrous with prominent brown lenticels, young fruit green, dark purple when mature or ripe, transverse ellipsoid, subreniform to didymous, very variable in dimensions, 1–2.5 cm long, 1.8–3.5 cm wide, apex retuse to obtuse, sometimes tipped with remnants of style; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal furrowed or ridged, canaliculate; calyx deciduous; style absent or a minute at the end of the fruit. **Seeds** usually transversely globose laterally, thick 0.5–1 mm, with glabrous reticulate testa, endocarp, and seedcoat glabrous (**Figures 4.27 & 4.28**).

Additional specimens examined. —**BANGLADESH**. **Chittagong**: 1886, *King 157* (**K**!);– alt. 900 m, March 1886, *King 95* (**P**03358456!);– alt. 900 m, 1886, *King 233* (**BM**!), alt. 900 m, October 1886, *King 510* (**BM**!, **L**1892644†, **P**03358455-6!);– Chusal, alt. 900 m, 20 February 1966, *Mades 24491* (**K**!, **L**1892641†);– Kodala hill, alt. 900 m, September 1885, *King 102* (**BM**!, **L**1892643†). **BHUTAN**. alt. 900 m, 23 March 1982, *A.J.C. Grierson & D.G. Long 3968* (**K**!). **INDIA**, alt. 780 m, June 1884, *J.S. Gamble 14472* (**K**000030972!);– alt. 935 m, December s.d., *Griseb. 2417* (**BM**!, **P**03358372-3!);– alt. 1000 m, October s.d., *J.D. Hooker s.n.* (**E**!);– alt. 900 m, May 1889, *J.S. Gamble 20582* (**K**!);– alt. 789 m, October s.n., *Hook.f. s.n.* (**BM**!, **P**03358372-3!);– alt. 600 m, October s.n., *J.D. Hooker s.n.* (**K**!);– **Andaman Islands**, alt. 600 m, 1884, *King 81* (**L**1892645†, **P**03358458!);– *ibid*., 22 August 1991, *King s.n.* (**P**03358459!);– *ibid*., 1884, *King 379* (**P**03358457!);– **Assam**, Cherrapunjee, Khasia, alt. 900 m, October s.n., *J.D. Hooker & T. Thomson 397* (**P**03358371!);– *ibid*., alt. 1330 m, 3 August 1952, *Thakur Rup Chand 6271* (**L**1892634†);– *ibid.,* alt. 1330 m, 29 July 1952, *Thakur Rup Chand 6315A* (**L**1892635†);– *ibid*., alt. 1330 m, 30 July 1952, *Thakur Rup Chand 6331A* (**L**†);– *ibid*., Simons, Drahuece, *s.d., s.coll 139* (**K**!);– **Attur**, Salem, alt. 935 m, 28 June 1978*, K.M. Matthew 15087* (**K**!, **L**1892636†);– **Baster**, Bailadila, alt. 935 m, 17 December 1938, *H.F. Mooney 918* (**K**!);– **Bengal**, Mal forest, alt. 789 m, January 1905, *H.H. Haines 1052* (**K**!);– ibid., West Bengal, Shalimar, Botanic garden of Calcutta, *s.n., E.D. Merrill 62* (**BKF**040263!);– *ibid*., Kanara, 23 November 1884, *W.A. Talbot 275* (**K**!);– *ibid*., Anshi, Ghas. October 1980, fl., *L.J. Sedgwick & T.R.D. Bell 7716* (**K**!);– *ibid*., Shahableshurar, alt. 1,500 m, November 1918, *L.J. Sedgwick & T.R.D. Bell 4798* (**K**!); **Kerala**, Chemmannar, Cardamom hill, 19 June 1976, fl., *C.E. Ridsale 185* (**K**!, **KYO**!, **L**1902583†);– *ibid.*, Hekadi, alt. 1,000 m, 18 June 1986, fl., *A. Kostermans 26159* (K!, **KYO**!, **L**1902584†);– *ibid.*, Thekadi to Devicolam: alt. 1,500 m, 16 June 1976, fr., *A. Kostermans 26132* (**K**!, **L**†);– *ibid.*,Thekadi to Devicolam, alt. 1,000 m, 17 June 1986, fl., *A. Kostermans 26335* (**L**1892647†);– **Madras**: 17 June 1897, *Bowne 474* (**K**!);– *ibid*., Hilgiris, Sispara, Godavari, July 1885, fr, *J.S. Gamble 15941* (**K**!);– *ibid.*, Nilgiris, June 1883, lvs., *J.S. Gamble 11803* (**K**!);– **Maharashtra**: Shilimb, 15 April 1994, fl. & fr., *A. Godbole*, *A. Watave 45171* (**K**!);– **Meghalaya**, Goro Hills, alt. 789 m, 15 February 1886, *C.B Clarke 43128* (**BM**!);– Sylhet Station, 24 November 1872, *C.B Clarke 17983* (**K**!);– Mysore, Hassan, alt. 935 m, 19 October 1969, *C. Saldanha 15583* (**K**!);– **Sikkim,** alt. 1,000 m, October s.n., *J.D. Hooker & T. Thomson 395* (**P**01818994!); *– ibid.,* alt. 1,000 m, s.d., *J.D. Hooker & T. Thomson s.n.* (**TCD**!);– **Tamil Nadu**, Kollimalai, Salur, 27 June 1916, *S.Coll. 12994* (**K**!). **MYANMAR**. **Katha**, alt. 935 m, December 1927, *Haines 5* (**K**!);– **Lower Burma**, **Tenasserim**, Tenasserim and Andaman, alt. 750 m, April 1861, *s.coll. 2053* (**K**!);– *ibid*., **Myawadee to Kawkereik** hills, alt. 900 m, 21 December 1930, *J.F. Rock 679* (**P**03358460!, **US**†);– **Tamil Nadu:** Kodaikanal, 16 June 1987, fl., *Fieldmen 49779* (**K**!). **THAILAND**. **Northern: Chiang Rai**, Mae Sai, 20°19'33” N, 99°49'27” E, alt. 1294 m, 22 March 2019, *S. Rueangruea, M. Poopath & S. Jirakorn SR140* (**BKF**229742!, **BKF**2297461, **TCD**!);– ibid., 20°19'32.8” N, 99°49'25.8” E, alt. 1266 m, 5 December 2019, *S. Rueangruea, T. Thananthaisong & P. Uea-Ari SR244* (**BKF**229822, **TCD**!);– ibid., 20°17'18.6” N, 99°48'37.0” E, alt. 985 m, 5 December 2019, *S. Rueangruea, T. Thananthaisong & P. Uea-Ari SR242* (**BKF**229818!, **TCD**!);– **Lampang**, 18°29'44.5” N, 99°16'08.0” E, alt. 790 m, 25 November 1982, *Winit 1456* (**K**!);– **Lamphoon**, Mae Tah, Doi Khun Tan NP., 18°29'51” N, 99°16'17” E, alt. 525 m, 31 July 1994, *J.F. Maxwell 94-847* (**BKF**049565!, **CMUB**!, **L**4195170†);– **Mae Hong Son**, Pang Mapha, Tham Nam Lot, 19°34'05.8” N, 98°16'39.1” E, alt. 708 m, 17 February 2000, *Sawat Santijan 45* (**CMUB**†, **L**4207604†);– **Tak**, Mae Ramat, 17°38'35” N, 97°56'38” E, alt. 621 m, 6 March 2019, *S. Suddee, S. Rueangruea, S. Kaithongsuk, C. Hemrat, W. Kiewbang 5480* (**BKF**229773!, **TCD**!);– *ibid*.,17 August 2020, *N. Tetsana, P. Puudjaa & C. Hemrat 1818* (**BKF**221556!, TCD!);– **Western: Kanchanaburi**, Thong Phaphum, Chalae, 14°57'00.0"N, 98°57'00.0"E, alt. 700 m, 6 March 2019, fr., *P.C. van Welzen 60* (**L**4207451†);–**Uthai Thani**, Lansak, Huai Kha Khaeng WS., 15°42'32.8” N, 99°10'44.8” E, alt. 620 m, 9 February 2020, *K. Chowtiwuttakorn, T. Thanathaisong 9* (**BKF**229776!). **SRI LANKA**. **Ceylon**, Gilimale Forest Reserve, 6°49'12.6"N, 80°30'29.3"E, alt. 935 m, 24 July 1790, *W. Meijer 488* (**K**!, **L**18926271†);– *ibid.*, 29 July 1947, lvs., *T.B. Worthington 2907* (**BM**!, **K**!).

Distribution.— India, Bangladesh, Myanmar (Bago, Magway, Taninthayi, Yangon), China (Yunnan), and W. & N. Thailand (**Maps 4.1 &4.43**).

Vernacular name. **—** Not known.

Etymology.— The specific epithet 'latifructa' refers to the mature big fruit that is conspicuously wide and transversely ellipsoid.

Ecology.**—** Occasional by stream banks, sometimes found in the opening area of the Mixed Deciduous forest, usually in Dry Seasonal Evergreen forest to Lower Montane forest, alt. 600–2,100 m.

Phenology.**—** Flowering September–December. Fruiting December–April.

Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 689,771.58 km^2; AOO = 88.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman (1965) and Tirvenggadum (1981) treated *Pygeum acuminatum* Colebr. as *Prunus ceylanica* var. *ceylanica*. However, *Prunus ceylanica* and *Pygeum acuminatum* Colebr. (AKA *P. latifructa)* have different and discrete distributions. The former's distribution is restricted in Sri Lanka (Ceylon) (vs. The latter is found over a large area, including Sri Lanka, India, Myanmar, Nepal, S. China, and W. and N. Thailand (**Map 4.41 and 4.42**). Though *Prunus latifructa* is morphologically very similar to *P. ceylanica* it is distinguished from *P. ceylanica* by its thinner leaves (chartaceous to sub-coriaceous vs. coriaceous), finely reticulate (vs. obscured reticulate), leaf margin entire and smooth when dried (vs. margin usually revolute abaxially), young twigs that are typically small, terete (vs. thicker with slightly to conspicuous ridge), the number of stamens (20–)25–42 (vs. 10–20(–25)), and infructescence and fruit stalk with conspicuous densely distributed lenticels (vs. usually without lenticel). We herein elevated it to the species level. Because the name "*Prunus acuminata*" was already occupied, we used *Prunus latifructa* as the new name.

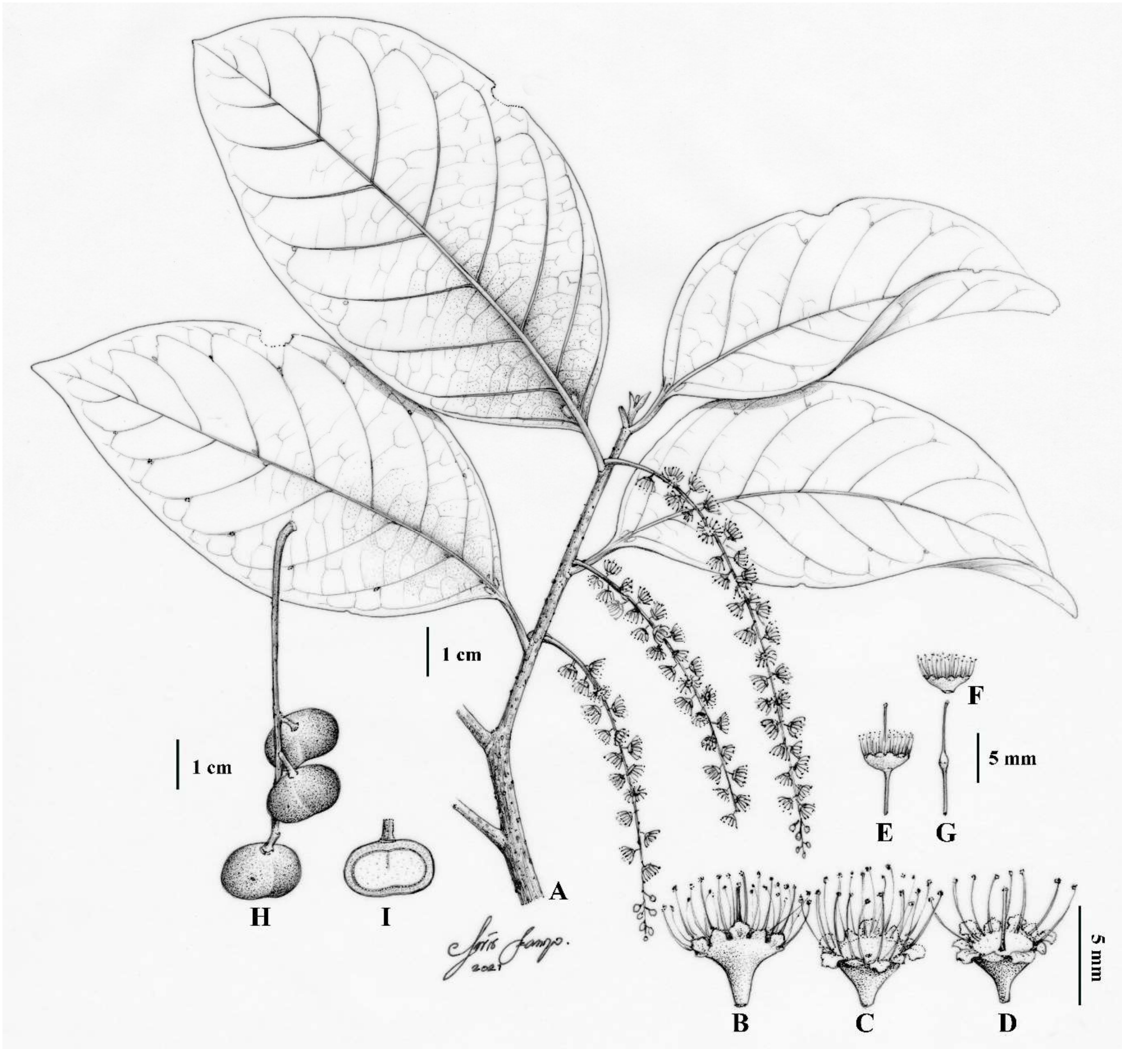


Figure 4.27. *Prunus latifructa* (Colebr.) Ruengr., J.Parn. & Hodk. **A**. flowering branch, lenticellate with terminal stipules, leaves with basal and additional glands; **B**, **D–F**. perfect flowers; **C**. imperfect flower (male flower) with rudimentary hair-like style; **G**. flower with ovary, style, and stigma; **H**. infructescence; **I**. fruit (cross-section); **A–F**. from *N. Tetsana et al.1818* (**BKF**); **H** and **I**. from *S. Suddee et al*. *SS5480* (**BKF**). Drawn by Pairuch Rayangkul.

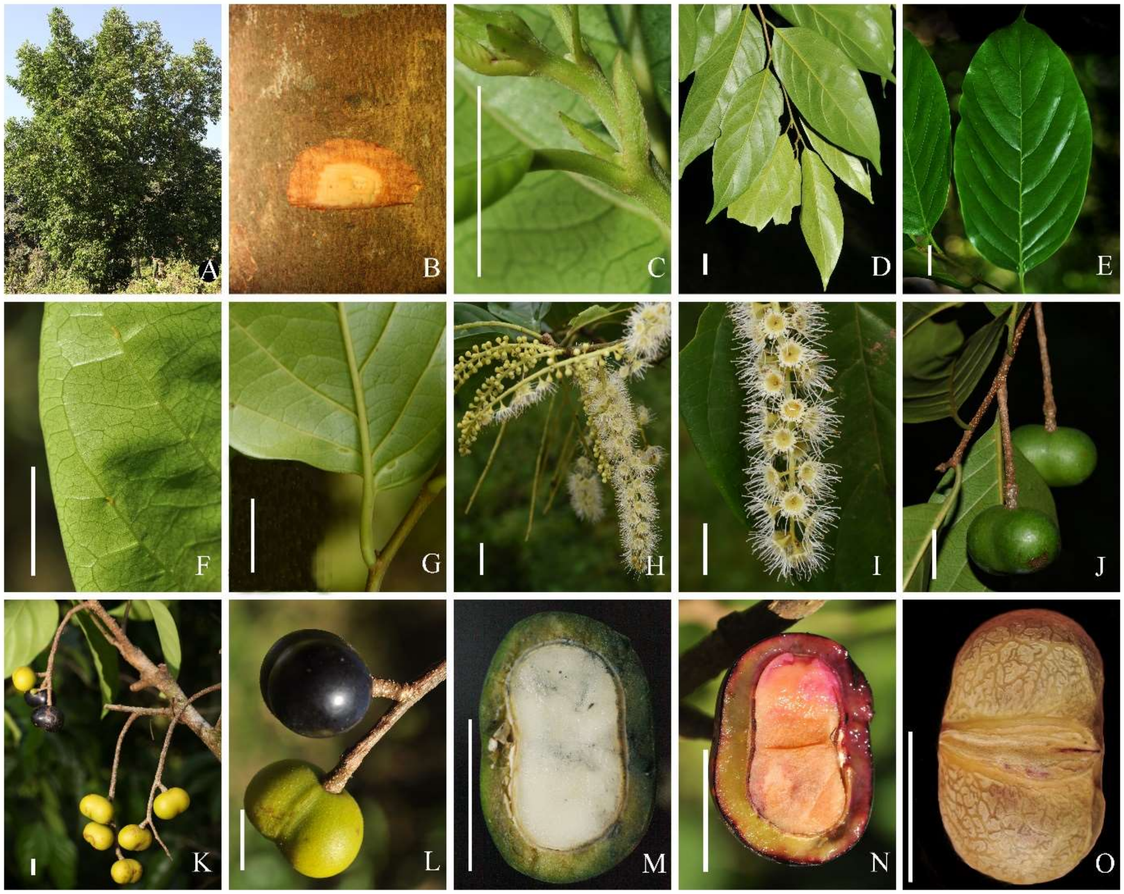
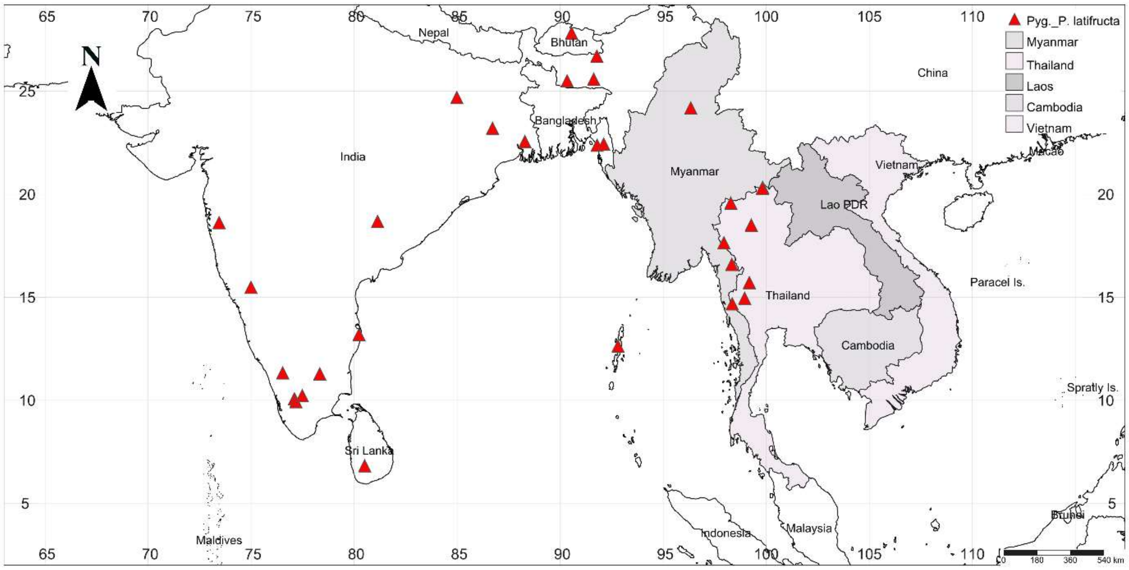


Figure 4.28. *Prunus latifructa* (Colebr.) Ruengr., J.Parn. & Hodk., habitat, vegetative, and reproductive morphological characters; **A**, habit; **B**, outer bark and inner bark; **C–**G, leaves; **C**, young shoot with oblong-linear stipules; **D**, leaves abaxial, alternate; **E**, adaxial, margin undulate; **F**, additional glands on the lateral vein, along margin; **G**, basal glands, 2; **H–I**, inflorescence; **H**, solitary pendulous racemes in the axil of leaves and fallen leaves branch; **I**, corolla distinctly different from calyx lobes; **J**–**L**, infructescence; **J**, young fruits; **K**, mature fruits yellow turning black when ripe; **L**, transverse ellipsoid, subreniform to didymous; **M–N**, fruit; **M**, cross-section, endocarp, and seedcoat glabrous; **N**, ripe fruit, cross-section; **O**, endocarp with shallow reticulate sculpture, conspicuous longitudinal or ridged, canaliculate. — Photos: A–D, F, G, J–M by S. Rueangruea; E, G, N & O by W. Kaewbang; H & I by N. Tetsana. — Sources from **Thailand**: Chiang Rai, D from, *S. Rueangruea et al. SR242*: J & M from *SR244*: Tak, A–C, E, F, G K L N & O from *S. Suddee et al. SS5480*; H & I from *N. Tetsana et al. 6611*. Scale bar = 1 cm.



Map 4.43. Distribution of *Prunus latifructa* (Colebr) Ruengr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia and nearby.

40. ***Prunus poilanei* (J.E.Vidal) Rueangr., J.Parn. & Hodk**. *comb. nov.* & *nom. nov.*, *ined.*

≡ *Pygeum cochinchinense* J.E.Vidal, in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 295. 1949; *sensu auct*. Kalkman, Blumea. The Old World species of *Prunus* subgen. *Laurocerasus,* including those formerly referred to *Pygeum*: 52–55, fig 22: 62. 1965.

Typification: **VIETNAM, Cochinchine**, Thudaumot, Budop, 22 November 1939, *E. Poilane 803* (holotype **P**01818989!; isotypes **L**0019569†, **L**0019570†, **K**000737343!, exclude serrate leaved specimen on the same sheet, **P**01818990!), non *Prunus cochinchinensis* Koehne, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 300.1915.

Description: Evergreen, sub-canopy, tree up to 20 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 50 cm in diameter; outer bark blackish-grey to brown, smooth to shallowly cracked with brown lenticels, spines absent; *inner bark* brown; strong almond smell. **Branchlets** dark brown with prominent brown lenticels; young twigs pubescent, rapidly glabrescent, cataphylls absent; old twigs glabrescent or glabrous with prominent whitish-brown lenticels. *Axillary winter bud* solitary, 3.5–5 mm long, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic oblong, oblong to ovate or ovate-lanceolate, 6–12 cm long × 3–5 cm wide; *lamina apex* acute to acuminate, sometimes obtuse, angle acute; *margin* entire, slightly revolute, glabrescent to glabrous; *base* asymmetrical to slightly oblique, acute, subacute to obtuse; young leaves dull green adaxially, pale green to slightly glaucous abaxially, turning yellow before falling, chartaceous to subcoriaceous, sparsely hairy; old leaves glabrous adaxially, ± sparsely glabrescent abaxially; *basal glands* (1–) 2–3 (–

5), up to 2.5 mm long, oblong, swollen, shallowly swollen to flat adaxially, over the base of leaf blade margin, additional scarce oblong glands near the nerves or along margins; *2° venation* brochidodromous or weaky brochidodromous, 5–9 alternate on either side of the midrib, oblique, decreasing in frequency of occurrence towards base, spacing irregular, sunken adaxially, prominent abaxially, narrow angle (< 45°), sometimes with compound agrophic veins; *3° venation* mixed alternate and opposite percurrent; *4° venation* reticulate; *5° venation* regular polygonal reticulate; *petioles*, 0.6–1 cm long, shallowly canaliculate in cross-section, pubescent when young, then glabrescent to glabrous; *petiolar glands* absent. **Stipules** medium, 3–6 mm long × 1–2 mm wide, linear to subulate, apex obtuse to acute, margin entire, ciliate, base oblong, densely hairy, early caducous. **Inflorescences** compound, solitary raceme, lax-flowered, mainly on the branches with fallen leaves, occasionally in axils of leaves, (1)4–7 cm long, peduncle and rachis slender, many-flowered, pubescent, pendulous or slightly erect; *bracts* 1–3, up to 1.5 mm long, size and shape variable, hairy outside, sub(glabrous) inside, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white to yellowish-brown, pedicellate, slender, 2–4(–5) mm long, dense short brown hairs; *bracteoles* ovate to oblong, up to 1.5 mm long, pale green, densely brown hairy, early caducous; *hypanthium* campanulate or obconate, 3.5–4 mm long, pubescent outside, glabrous with hairs at base inside; corolla distinctly different from calyx lobes; *calyx* lobes 5, rarely 4 or 6-merous, triangular, minute, green, 0.6–1 mm long × 0.5–0.8 mm wide, very rarely the perianth segments more or less equal, apex acute, margin entire, ciliate, base truncate, separate or valvate in bud, spreading when mature, deciduous, pubescent outside, glabrescent except on the bottom inside; *petals* white, spreading to upright, (4–) 5 (–6), small, 0.8–1.5 mm long × 0.5–0.8 mm wide, subequal, petals 1–1.5 times calyx lobe length, elliptic, ovate to orbicular, sessile, apex rounded, margin softly tomentose, ciliate, base oblong, alternate with calyx lobes, pubescent outside, pubescent to sparsely hairy inside; *stamens* 50–58(–60) in 3 to many series, exserted; filament filiform, white, 2–5 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers oblong to globose, 0.3–0.5 mm long; *ovary* glabrous, densely hairy at point of insertion, 1 locular; *style* filiform, 4–6 mm long, slightly longer than, as long as stamens or male flower with minute pistillode, glabrous with a ring of hairs around point of insertion; stigma gland not divided, globose to peltate. *Infructescence* 2–7 cm long, densely hairy, 3–12 fruited. **Fruits** fleshy, stipitate, *c.* 4 mm long, stout, glabrous with whitish-brown lenticels, young fruit green, dark purple when ripe, transverse ellipsoid, subreniform to didymous, very variable in dimensions, 0.8–1.4 cm long × 1.2–1.8 cm wide, apex retuse to obtuse, sometimes tipped with remnants of style; young and mature fruits glabrous; exocarp smooth and shiny, without a longitudinal groove; mesocarp fleshy, succulent, whitish-dark purple; endocarp stone bony, with shallow reticulate sculpture, with conspicuous longitudinal or ridged, canaliculate; calyx deciduous; style absent or a minute at the end of the fruit. **Seeds** are usually transversely globose laterally, thin, testa glabrous, shallowly reticulate, endocarp, and seedcoat glabrous (**Figures 4.29 & 4.30**).

Additional specimens examined.— **CAMBODIA**. Hg Thom, 10 November 1919, fl., Pras Ta Hung *261* (**P**03358593!). **LAOS**. **Northern, Laung Prabang**: Nguen, Long Nai, alt. 500 m, 15 May 1936, fr., *E. Poilane 26152* (**L**1892632†, **K**!, **P**03358468-9!);– *ibid.*, Kuang Si, Cha Tan, alt. 100 m, 20 October 1928, fr., *E. Poilane 16031* (**K**!, **L**1892628†, **P**03358470-1!). **THAILAND**. **Eastern, Chantaburi**: Pong Nam Ron, Khao Kluea, 210 m, 30 April 1956, fl., *T. Smitinand 3322* (**BKF**011582!, **L**1892639†);– *ibid.*, Kaeng Hang Maew, Klong Roi, 13 July 1999, fl., *P. Puudja & S. Cholkulchana 587* (**BKF**125975!);– *ibid.*, Ma-kham, alt. 120 m, 25 October 1954, fl. & fr., *B. Sangkhachan 288* (**P**03358159!);– *ibid.*, Bara Arag, 12°60'N, 102°2'E, 19 November 1945, fr., *Chitr 81* (**BKF**049606!, **L**1892642†, **P**!);– *ibid.*, Khao Saming, 25 November 1981, fr., *A.F.G. Kerr 9403* (**K**!);– *ibid.*, Khao Kit Chakut, Krating waterfall, Khao Khitchakut NP., 12°50'14" N, 102°07'13" E, alt. 73 m, 10 April 2019, lvs., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari*, *S. Chatrupamai*, *& S. Anannat*, *SR200* (**BKF**224929!, **TCD**!);– *ibid.*, (same tree as *SR200*), 3 January 2020, fr., *S. Rueangruea*, *A. Rueangruea & S. Anannat SR253* (**BKF**229840-1!, **TCD**;– **Chonburi**: Hoop Bon, Nong Khao, 20 November 1916, fr., *D.J. Collins 466* (**K**!);– **Trat**: Dong Ma Kluea, 12°03'54" N, 102°18'48" E, alt. 50 m, 19 June 1952, lvs., *T. Smitinand 1306* (**BKF**049604!);– *ibid.*, Bo Rai, Khao Kuap, 27 May 1980, fl., *N. Put 3043* (**BM**!, **K**!, **L**1892640†, **P**03358450!);– *ibid.*, Boyscout Camp, alt. 20 m, 13 June 1972, fl., *T. Smitinand 11606* (**BKF**049605!). **VIETNAM**. **Annam, Haut Donai**: Djiring, alt. 200 m, 20 October 1931, fr., *E. Poilane 19801* (**K**!, **L**1892626†, **P**03358462-3!);– *ibid.*, alt. 1200 m, 5 June 1933, fl., *E. Poilane 22607* (**L**4183662†, **P**04170095!);– *ibid.*, Broian, alt. 1800 m, 20 February 1935, fl., *E. Poilane 24442* (**P**!);– **Thua Thien-Hue**: A Luoi, Hong Van, Talo village, 16°21'52.0" N, 107°09'36.0" E, 29 April 2005, fr., *L.V. Averyanov*, *P.K. Lôc*, *T.V. Thao*, *N.T. Vinh*, *T.M. Duc & N.T. Dung 7660* (**MO**†);– **Tourang**: December *s.n.*, fr., *E. Poilane*, *s.n.* (**K**!);– **Cochinchine, Bien Hoa**: Dinh Quan, 13 October 1931, lvs., *E. Poilane 19650* (**E**00991965!, **L**1892625†, **L**1892629†, **P**03358472-3!);– **Bu Dop**: Thudaumot, 12°01'06.9" N, 106°54'28.7" E, alt. 139 m, 22 November 1919, fl., *E. Poilane 803* (**K**000737343!, **L**0019569†, **P**01818989-90!);– **Suzonneh**: June 1918, fr., *A.J.B. Chevalier 36641* (**P**03358474!);– **Tonkin, Baobang**: Piahouac, 19 February 1931, fr., *E. Poilane 19120* (**P**04461743!);– **Vinh Phuc**: Tam Dao, Tam Dao NP., 21°28'08.8" N, 105°38'42.0" E, 5 May 2009, fr., *J.Wen 10801* (**US**†).

Distribution.— Thailand (Eastern, Chanthaburi), Cambodia, N. Laos (Luang Prabang), and Vietnam (**Maps 4.41 & 4.44**).

Vernacular name.**—** Thailand: อบเชย Op Choei. **Vietnam**: Moi, Tom mpru.

Ecology.**—** Occasional by stream banks, in the open areas of the Dry Evergreen Forest to Lower Montane Forest, alt. 20–1,000 m.

Phenology.**—** Flowering July–November. Fruiting September–December.

Uses.— The fruit's shell has a strong odor of cyanic acid and is used as an infusion against stomach aches (Vidal, 1949). According to E. Poilane no. 803, the bark is used by many in S. Vietnam against stomachache while also providing a beverage.

Conservation.—This species is known from many locations (> 10 locations): EOO = 273,771.58 km^2; AOO = 68.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman did not make his use of morphological characters clear. I argue that *P. ceylanica* should be defined more narrowly. For example, the species distribution of the *Prunus ceylanica* group is discrete (Map 4.41 and 4.42), the inflorescence length varies from 2–15 cm long, the number of stamens varies from 10 to 45, and clusters of associated morphological characters can be distinguished.

Vidal (1949) accepted *Pygeum cochinchinensis* as a new taxon, while Kalkman (1965, 1993) treated it as a synonym of *Pygeum cohinchiense* and as a synonym of *Prunus ceylanica* var. *ceylanica*. However, the morphological characteristics of this taxon are distinct from typical *P. ceylanica*: herein, I recognize it at the species level. Because the name "*Prunus cochinchinensis*" is already occupied, I use *Prunus poilanei* as the new name in honor of Mr. Eugène Poilane, from France. He became a botanist for the Forest Service of Indochina in Vietnam and is the collector of the type specimen.

Prunus poilanei is most similar to *P. ceylanica* and *P. latifructa* in having herbaceous to subcoriaceous leaves of different shapes, a solitary raceme, and glabrous fruit. *P. poilanei* is distinguished from these species by glaucous abaxially leaves (vs. pale green abaxially), midrib or lateral veins tomentose abaxially (vs. glabrous abaxially), lateral veins narrowly angled, less than 45° (vs. lateral veins moderately angled, 45°–60°), basal leaf blade having oblong protruding glands, (1–) 2–3 (–5) adaxially (vs. ovate and flat, 2 (–3) glands).

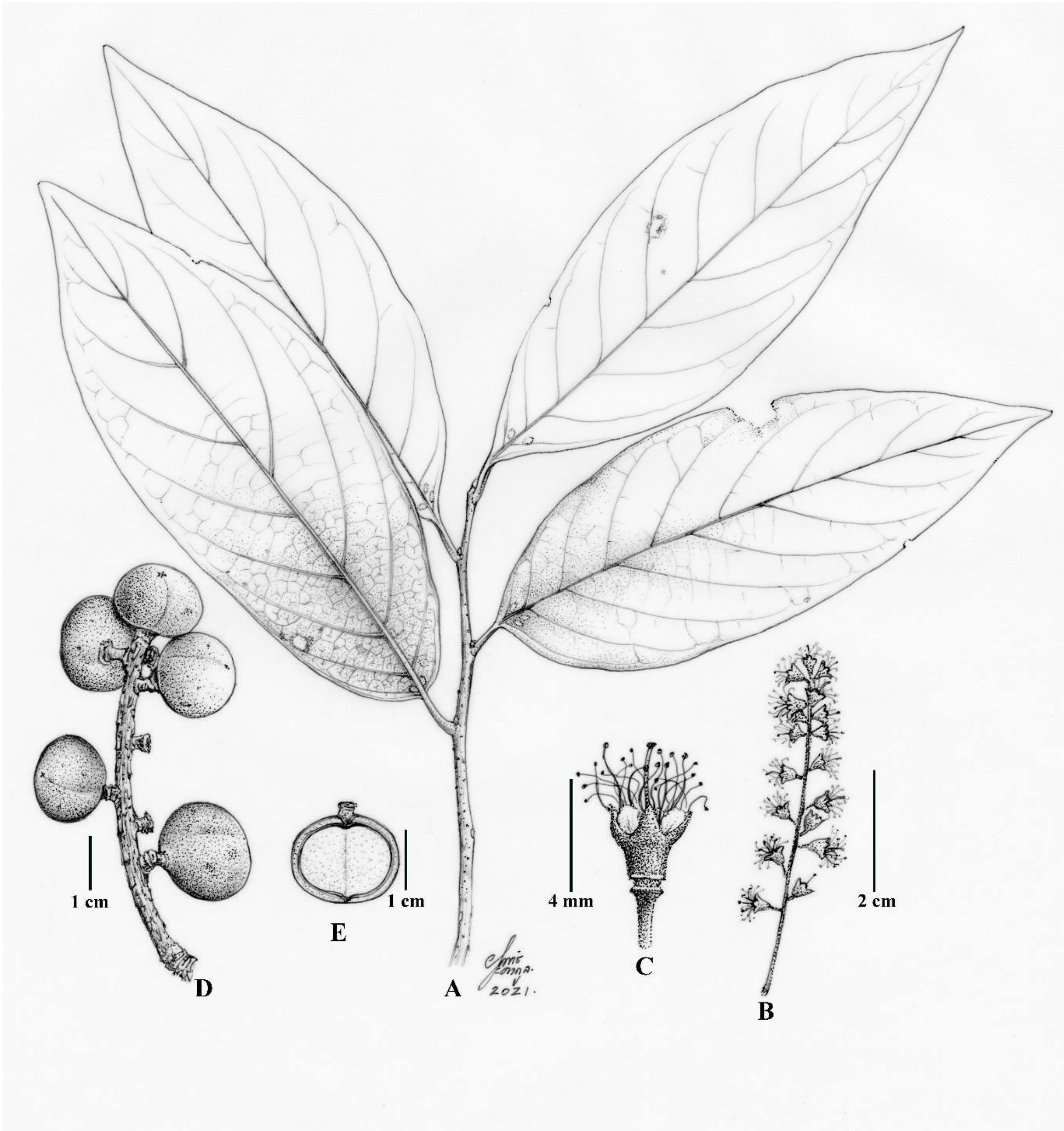


Figure 4.29. *Prunus poilanei* (J.E.Vidal) Rueangr., J.Parn. & Hodk. **A**. fruiting branch, oblong-lanceolate leaves, basal glands, 2–6; **B**. single raceme inflorescence; **C**. flower, with different sepals and petals, densely hairy around insertion; **D**. infructescence, glabrous fruits; **E.** fruit (cross-section); **A**, **D** & **E**. from *S. Rueangruea et al. SR200* (**BKF**); **B** & **C**. from *Put 3043* (**K**). Drawn by Pairuch Rayangkul.

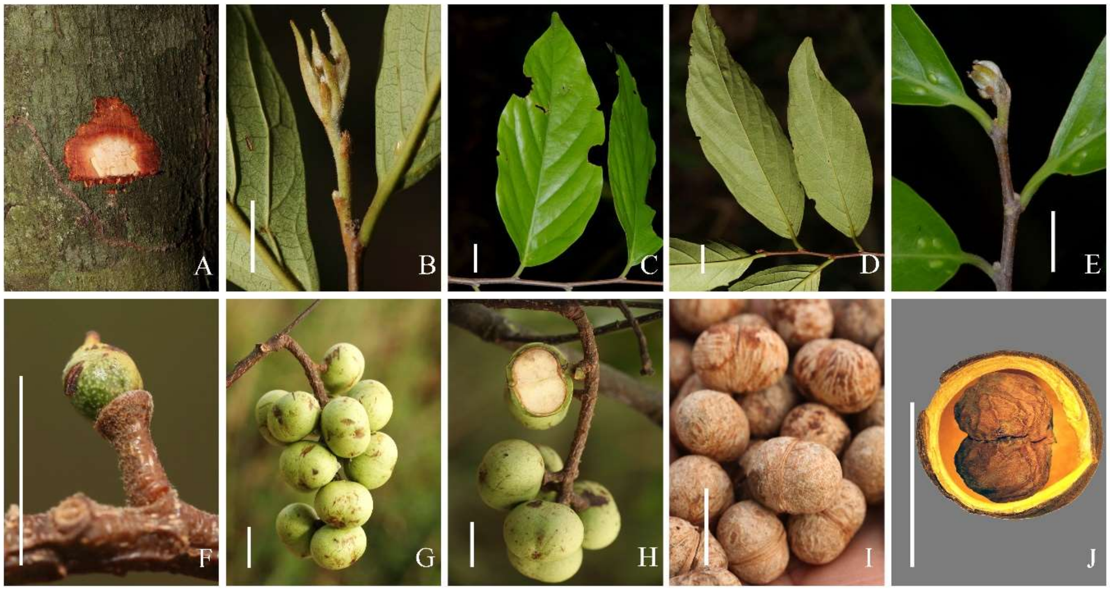
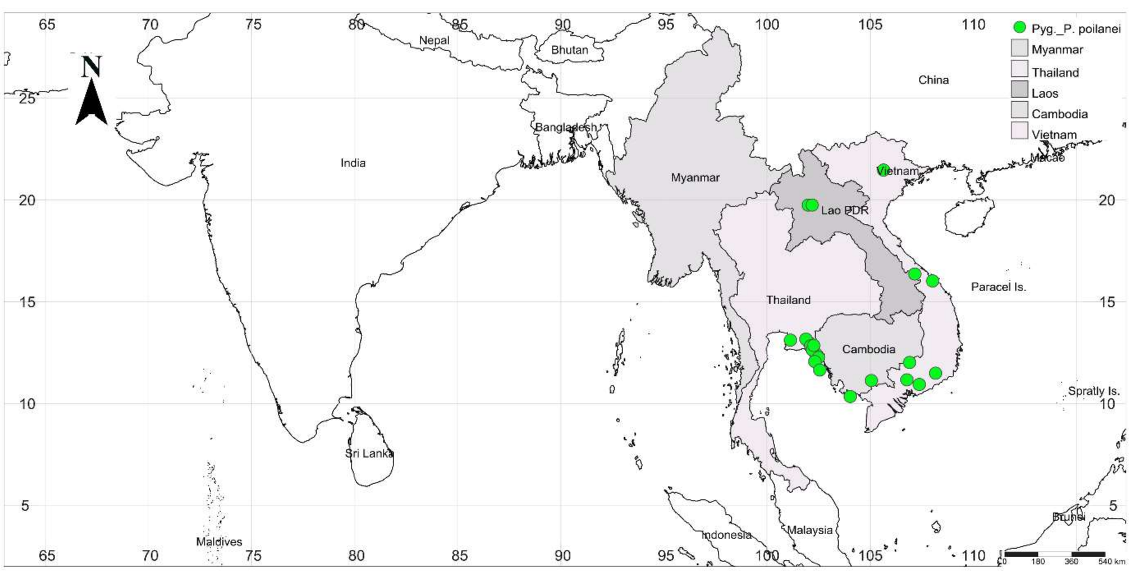


Figure 4.30. *Prunus poilanei* (J.E.Vidal) Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters; **A**, outer bark dark brown, inner bark brown; **B–E**, leaves; B, young shoot, tomentose; **C**, leaves abaxial; **D**, slightly glaucous abaxial; **E**, leaf base oblique, basal glands 3–4, slightly protruding; **F–J**, fruit; **F**, young fruit, ovary glabrous; **G**, mature fruits; **H**, cross-section; **I**, endocarp testa glabrous, shallowly reticulate; **J**, cross-section, endocarp inside and seedcoat glabrous. — Photos: all by S. Rueangruea. — Sources: all from **Thailand**, Trat, *S. Rueangruea et al. SR200*. Scale bar = 1 cm.



Map 4.44. Distribution of *Prunus poilanei* (Vidal) Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia and nearby.

41. ***Prunus kaengkrachanensis* Nagam., Tagane & Suddee**. Nakamasu H., S. Rueangruea, S. Suddee & S. Tagane, *Prunus kaengkrachanensis* (Rosaceae) a new species from Southeastern Thailand, in Pooma & Utteridge. Thai Forest Bulletin. 43: 43–45. 2015.

Typification**: THAILAND,** Phetchaburi, Kaeng Krachan Province, Kaeng Krachan National Park, near Phanoenthung ranger substation, 12°49'30.78” N, 99°21'54.26” E, alt. 947 m, 28 May 2014, fr., *S. Tagane*, *H. Toyama*, *S. Rueangruea*, *S. Suddee*, *H. Kanemitsu*, *W. Kiewbang*, *C. Hemrat & W. Supong T2978* (holotype **KYO**!; isotypes **BKF**190204!, **FU**!, **K**001097855!, **P**00871688!).

Description: Evergreen, sub-canopy, tree up to 20 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark greyish-brown to dark brown, smooth or with prominent brown lenticels, living bark 5–10 mm thick, spines absent; faint almond smell. **Branchlets** erect, stout; young twigs shallow longitudinal ridged, reddish-brown with white lenticels; young twigs densely finely pubescent, cataphylls absent; old twigs dark brown, soon glabrescent, with longitudinal lenticels, drying blackish-brown. *Axillary winter bud* solitary, 4–5 mm long, ovoid, usually covered with hairs; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic to elliptic-ovate, 9.5–15.5 cm long × 4–7.5 cm wide; *lamina apex* acuminate to obtuse, angle acute to obtuse; *margin* entire, revolute, glabrous; *base* symmetric to asymmetric, sometimes oblique, cuneate to attenuate, decurrent; young leaves pale green, dull dark green adaxially, pale green abaxially, turning yellow before falling, coriaceous; young leaves glabrous to glabrescent; old leaves young glabrous to glabrescent, glabrous adaxially, usually still distinctly hairy at least on midrib, nerves and petiole abaxially; *basal glands* usually with 2 (–0), large, up to 5 mm long, conspicious oblong excavated, deeply hollowed abaxially, near the leaf bas contracted, along decurrent or petiole length, sparsely small circular glands near the lateral lobes along margins from upper half to apex; *2° venation* weaky brochidodromous, 8–11 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles*, 0.9–1.6 cm long, stout, shallowly canaliculate in cross-section, glabrous; *petiolar glands* absent. **Stipules** medium, 3–10 mm long × 1–2 mm wide, linear, apex acute to obtuse, margin entire, sparsely ciliate and inconspicuous glands margin, base sessile, sparsely pubescent to glabrescent, early caducous. **Inflorescences** compound, solitary or 2–3 branched near the bottom, without terminal bud, in axils of leaves near the top of branchlets, 3–6 cm long, many-flowered, usually 12–30 flowers, lax, densely to sparsely golden-brown pubescent; *bracts* 1–3, 0.6–0.8 mm long, size and shape variable, broadly elliptic, slightly concave, apex acute or obtuse, densely hairy both side, margin ciliate, early caducous, caducous. **Flowers** bisexual, opening with mature leaves, white, pedicellate, slender, 1.5–3 mm long, densely short golden hairs; *bracteoles* scale-like, 1–2.5 mm long, pale green, densely brown hairy, early caducous; *hypanthium* shortly campanulate, 1.5–2 mm long, densely to slightly pubescent; *perianth* absent or petals not distinct from calyx lobes; *calyx* lobes 5, triangular, minute, green, 0.5–1.2 mm long × 0.5–1 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, densely to sparsely pubescent outside, glabrescent inside; *corolla* petals slightly different or indistinguishable from sepals, white, spreading to upright, 5, small, 0.5–1 mm long × 0.3–0.5 mm wide, subequal, as long as or slightly longer than calyx lobes, oblong to triangular, sessile, apex acute to obtuse, margin entire, ciliate, base oblong to truncate, alternate with calyx lobes, densely white hairs outside, densely white hairy inside; *stamens* 50–60 in 1 to 3 series, exserted, slightly longer than petals; filament filiform, white, 2–4 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* glabrous with tomentose brown hairs at base, 1 locular; *style* filiform, slender or stout, 2.5–3.5 mm long, slightly shorter to nearly than stamens, glabrescent; stigma subpeltate. *Infructescence* 2–6 cm long, sparsely pubescent to glabrous without lenticels, few, 1–5 fruited. **Fruits** fleshy, stipitate, 3–4 mm long, young fruit green, turning dark purple when mature or ripe, broad ellipsoid to obovoid-subglobose, 1.8–2 cm long × 1.8–2.5 cm wide, apex obtuse, emarginate to shortly acute; young and mature fruits glabrous; exocarp smooth and shiny, with a longitudinal groove; mesocarp fleshy, thin, up to 2.5 mm; endocarp stone bony, thick and hard, prominent coarsely and sharply reticulate especially near the apex; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually transversely globose laterally, thick, with shallow reticulate glabrous testa but endocarp densely long hairy inside, the hairs *c.* 1.3 mm long, white to cream, seedcoat densely covered with cream-coloured hairs (**Figure 4.31**).

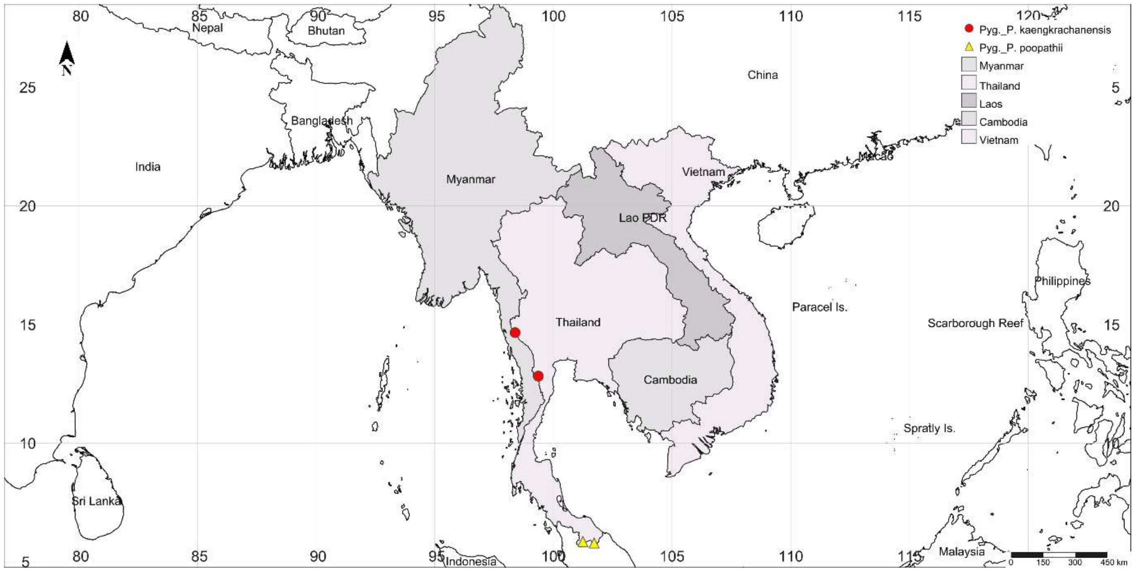
Additional specimens examined.— **THAILAND**. **Southern, Phetchaburi**, Kaeng Krachan: 12°49'19.7” N, 99°21'57.7” E, alt. 960 m, 22 October 2013, fr., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T1959* (**BKF**206425!, **FU**!);– *ibid.*, 12°49'19.7” N, 99°21'57.7” E, alt. 960 m, 23 October 2013, fr., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T2072* (**BKF**206544!, **FU**!);– *ibid.*, Phanoen Thung ranger substation: 2°49'30", 99°21'55", 11 June 1994, fr., *T. Santisuk*, *s.n.* (**BKF**089272!);– *ibid.*, 12°49'31” N, 99°21'47” E, alt. 952 m, 22 April 2019, fl. & fr., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari*, *T. Chaowasku*, *A. Danthongdee*, *N. Hathai & W. Kaewmongkul SR208* (**BKF**229807!, **TCD**!);– Western, Kanchanaburi, Thong Phaphum, E-Tong, Thong Phaphum NP.: 14°39'31.3” N, 98°23'05.0” E, alt. 889 m, 28 January 2001, fl., *A. Veesommai I-34* (**BKF**145942!);– *ibid.*, 14°39'32” N, 98°23'05” E, alt. 885 m, 12 January 2019, fr., *S. Rueangruea*, *A. Rueangruea & A. Veesommai SR254* (**BKF**!, **TCD**!);– *ibid.*, 14°39'32” N, 98°23'05” E, alt. 885 m, 19 April 2019, fr., *S. Rueangruea*, *A. Rueangruea & Y. Yujongdee SR204* (**BKF**!, **TCD**!).

Distribution.— Endemic to Thailand (known only from the specimens cited) (**Map 4.45**).

Vernacular name. — Thailand: นูดแก่งกระจาย Nuut Kaeng Krachan.

Ecology.— Upper Mixed deciduous to Lower Montane Forest, alt. 800–1,200 m.

Figure 4.31. *Prunus kaengkrachanensis* Nagam., Tagane & Suddee habitat, vegetative and reproductive morphological characters; A, habit; **B**, outer and inner bark; **C–F**, leaves; **C**, young shoot with large oblong stipules; **D**, leaf ovate adaxial; **E**, leaf abaxial, margin undulate; **F**, basal stipules 2, oblong, protruding; **G–I**, inflorescence; **G**, flower buds; **H**, compound raceme, panicle-like; **I**, inflorescence in the leaf axil; **J**, flower, lateral view of hypanthium; **K**–**M**, infructescence and fruit; **K**, young fruits, endocarp densely white hairy inside, ovule hairy; **L** & **M**, infructescence; **L**, young fruit; **M**, mature fruits; **N** & **O**, fruit cross-section; **N**, fresh mature fruit in cross-section; **O**, dried fruit cross-section, endocarp densely hairy inside, seedcoat hairy. — Photos: A–C, M–O by S. Rueangruea; H by U. Veesommai; G, K & L form S. Tagane; O by K. Daonurai. — Sources: all from **Thailand**: Kanchanaburi; A–C, M–O from *S. Rueangruea et al. SR204*; H from *U. Veesommai I-34*: Phetchaburi; D–F, I & J from *S. Ruangruea et al. SR208*; G, K & L form *S. Tagane et al. T2978*. Scale bar = 1 cm.



Map 4.45. Distribution of *Prunus kaengkrachanensis* Nagam., Tagane & Suddee and *P. polystachya* (Hook.f.) Kalkman of sect. *Mesopygeum* in continental Southeast Asia.

Phenology.**—** Flowering: January–March. Fruiting: February–July.

Uses.— Not known.

Conservation.— This species is known from only two areas, restricted to Western Thailand. The type locality is in Kaengkrachan National Park. The second area is the open Mixed Evergreen Forest near the Thai-Myanmar border: EOO = 23.58 km^2; AOO = 8.00 km^2. The number of mature individuals < 50. I consider the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1 (IUCN, 2019).

Note.— *Prunus kaengkrachanensis* and *P. polystachya* (Hook.f.) Kalkman is easily distinguished from other species of *Prunus* in Thailand by the large and thick leaves with two distinctly hollowed glands at the base. They are similar in having fruits of almost the same size. *Prunus kaengkrachanensis* and *P. polystachya* occur in Southern Thailand. The distribution is near the Thailand / Malaysia border, in Sumatra, the Malay Peninsula, Singapore, and Brunei. In addition, *P. kaengkrachanensis* is distinguishable from *P. polystachya*, particularly by the densely hairy endocarp, leaf base acute to attenuate, and distinct oblong excavate gland shape. In contrast, the glabrous inside of the endocarp characterises the latter, leaf base obtuse or slightly cordate, and distinct circular excavated glands at the bottom.

42. ***Prunus polystachya*** **(Hook.f.) Kalkman,** Blumea 13: 88. 1965. Type as for the basionym below.

≡ *Pygeum polystachyum* Hook.f., Flora of British-India. 2: 320. 1878.

Typification: **MALAYSIA**. Malacca, a tree with a very thick trunk, 27 Apr 1867, fl, *A. C. Maingay 627* (lectotype: **K**000737263!, designated by Kalkman, 1965.; isolectotypes: **K**000737264!, **L**0019678†).

= *Pygeum myriandrum* Merr., Papers of the Michigan Academy of Science, Arts and Letters. Part 1, botany and forestry. 19: 155. 1933.

Typification: **INDONESIA**, Sumatra, East Coast), old jungle near the Aek Kanopan, Loendoet Concession, Koealoe, 12 Mar 1927, *Bartlett 6871* (holotype: **NY**00415886†; isotypes: **K**!, **L**0019679†, **MICH**1111291†, **MIN**1002839†).

Description: Evergreen, sub-canopy, tree up to 10–28 m tall, canopy shape oval or globose. **Stem** clear bole, erect, dbh *c.* 20 cm in diameter; outer bark greyish-brown, smooth, finely lenticellate, living bark c.10 mm thick, slash inner bark red to reddish-brown; faint almond smell. **Branchlets** erect or slightly drooping, stout, reddish-brown to greyish-brown with sparse brown lenticels; young twigs terete, greenish-with whitish-brown lenticels, with young twig densely to sparsely finely pubescent, cataphylls absent; old twigs becoming glabrescent to glabrous. With conspicuous lenticels. *Axillary winter bud* solitary, *c.* 5 mm long, ovoid, usually covered with hairs to glabrescent; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate-oblong, obovate, oblong to broadly elliptic, (8–)12–25 cm long × 8–15.5 cm wide; *lamina apex* acuminate, bluntly acute to obtuse, angle acute to obtuse; *margin* entire, revolute, glabrous; *base* symmetric to slightly asymmetric, broadly acute, rounded to slightly cordate; young leaves pale green, dull dark green adaxially, pale green abaxially, turning yellow before falling, subcoriaceous to coriaceous; young leaves shortly pubescent to glabrescent; mature leaves glabrescent adaxially, glabrescent to sparsely hairy on midrib, usually with finely dots on abaxial visible with a magnifier or under a dissecting microscope, nerves and petiole abaxially; *basal glands* usually with 2 (–0), medium, 3–3.5 mm long × 1.8–2.5 mm wide, slightly oblong excavated adaxially, usually deeply large hollowed abaxially, at the base of leaf, close to the petiole, along the basal midrib, additional glands typically present and often numerous, much smaller, flat, circular glands near the lateral lobed along margins from upper half to apex or small glands between the middle of lateral veins; *2° venation* weaky brochidodromous, (10)14–18 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, flat to slightly impressed adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent, inconspicuous adaxially; *5° venation* regular polygonal reticulate; *petioles* 0.5–1.8 cm long, stout, shallowly canaliculate in cross-section, pubescent to glabrescent; *petiolar glands* absent. **Stipules** medium, index 2–6, 5–15 mm long × 2–3 mm wide, linear to narrow triangular, apex obtuse to slightly acute, margin entire, ciliate, glandular, base sessile, pubescent outside, pubescent to glabrescent inside, usually with small marginal glands, caducous. **Inflorescence** is a solitary raceme or an aggregated loose panicle consisting of 3–7 racemes in axils of usually fallen leaves or young leaves, each raceme 4–11.5 cm long at anthesis, with 18–25 flowers. **Flowers** pedicels 2.5–3.5 mm long, pubescent; *hypanthium* 2–2.5 mm long, densely pubescent outside; *perianth* segments 9–11, subequal to slightly differentiated into 2 whorls, each segment 1.1–3 cm long × 0.3–0.4 mm wide, densely hairy outside; *stamens* 45–60, filaments 3–4 mm, anthers oblong, 0.3–0.4 mm long, *ovary* with long hairs at the base; *style* 2.5–3 mm long, glabrous. **Fruits** fleshy, stipitate, 2.5–4 mm long, young fruit green, not seen when mature or ripe, broad ellipsoid, obovoid-subglobose to transverse ellipsoid, 1.5–2.2 cm long, 1.5–2.5 cm wide, apex obtuse, emarginate to shortly acute, glabrous, exocarp smooth and shiny, with a longitudinal groove; mesocarp fleshy, thin, up to 2.5 mm; endocarp stone bony, thick, with longitudinal groove, slightly reticulate especially near the apex; calyx deciduous; style absent or minute at the end of fruit. **Seeds** usually transversely globose laterally, thick, with shallow reticulate glabrous testa outside, glabrous to sparsely hairy near the end inside, seedcoat glabrous.

Additional specimens examined.— **MALAYSIA**, alt. 100 m, November 1844, *King 6847* (**E**00991964!);– **Kepong**, FRIM, R.R.I. Experiment station, alt. 60 m, 17 January 1966, *F.S.P. Ng 100025* (**BKF**049720!);– *ibid*., 3°13'46.0"N, 101°37'22.8"E, alt. 200 m, 26 January 1961, *Wee-lek, C. 223* (**BKF**049722!).– **Pahang**, Kechau, Lipis, 4°27'N, 102°01.94'E, alt. 302 m, 28 February 2012, *S.N. Phoon, C.M. Pannell & Mohd. Nazri A. FRI76086* (**BKF**198102!);– *ibid*., Camauis Highland, alt. 1,300 m, 13 April 1930, *M. R. Henderson 23558* (**BK**!, **SN**†);– **Perak**, alt. 517 m, October s.n., *L. Wray Jr. 3113* (**P**03359401!);– *ibid.,* alt. 517 m, July 1886, *King 10396* (**P**03359404!);– *ibid*., alt. 517 m, September 1886, *King 10902* (**P**03359402!);– **Sarawak**, Bario, Aruv, 03°45'48.9"N, 115°27'10.7"E, alt. 1157 m, 26 January 2016, *H. Kurokawa, M. Aiba, M. Oguro, S. Tagane, Y. Keldi & D. Eudi SWK1315* (**FU**!);– *ibid*., Sri Aman, Batang Ai NP., 01°18'24.60"N, 112°04'29.80"E, alt. 175 m, 24 March 2017, *T. Yahara, M. Zhang, S. Tagane, H. Nagamasu, K. Mase, Belden G.A.N. Bangga & W. Lawrence SWK4399* (**FU**!). **THAILAND**. **Peninsular, Narathiwat**, Sukirin, Ban To Mo, Bala-Hala Wildlife Sanctuary, Tropical Rain Forest, 200 m alt, 6 June 2004, UTM 47 8 00570E, 641486N, *M. Poopath*, *6* (**BKF**174173!, **L**4192118†);– **Yala**: Betong, 5°51'37" N, 101°14'20" E, alt. 544 m, 13 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR230* (**BKF**229964!, **E**!, **TCD**!). **SINGAPORE**, alt. 50 m, 14 August 1948, *J. Sinclair 4979* (**E**00991960!);– ibid., alt. 50 m, 20 May 1930, *J. Sinclair 6498* (**E**00991961!);– ibid., Bulkit, alt. 50 m, December 1891, *Ridley 4666* (**P**03359406!);– ibid., Garden jungle, alt. 50 m, 1 October 1929, *Nur s.n.* (**BK**!, **SN**†);– ibid., Bukit Timah Reserve, alt. 50 m, 26 January 1961, *Chew Wee-Lek CWL233* (**E**00991962!);– ibid., Sungai Buloh, 1°26'41.8"N, 103°43'22.9"E, alt. 50 m, 19 January 1966, *Dardial & Sider 437* (**E**00991963!).

Distribution.— Southern Thailand, near Thailand and Malaysia border, Peninsular Malaysia, Singapore, and Indonesia (Sumatra).

Vernacular name. — **Malaysia:** Medang Kelawar (Pahang); Medang pijat (Kuantan of Pahang); Medang pijat-pijat (Pahang); Meranti pijat (Johor); Medang (Kuala Lumpur, Pahang).

Ecology.— In open areas, gaps, or near streams, primary and secondary forests, hillsides, Evergreen Forest, alt. 0–600 m.

Phenology.— Flowering: February–June. Fruiting: May–September.

Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 944,308.09 km^2; AOO = 120.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

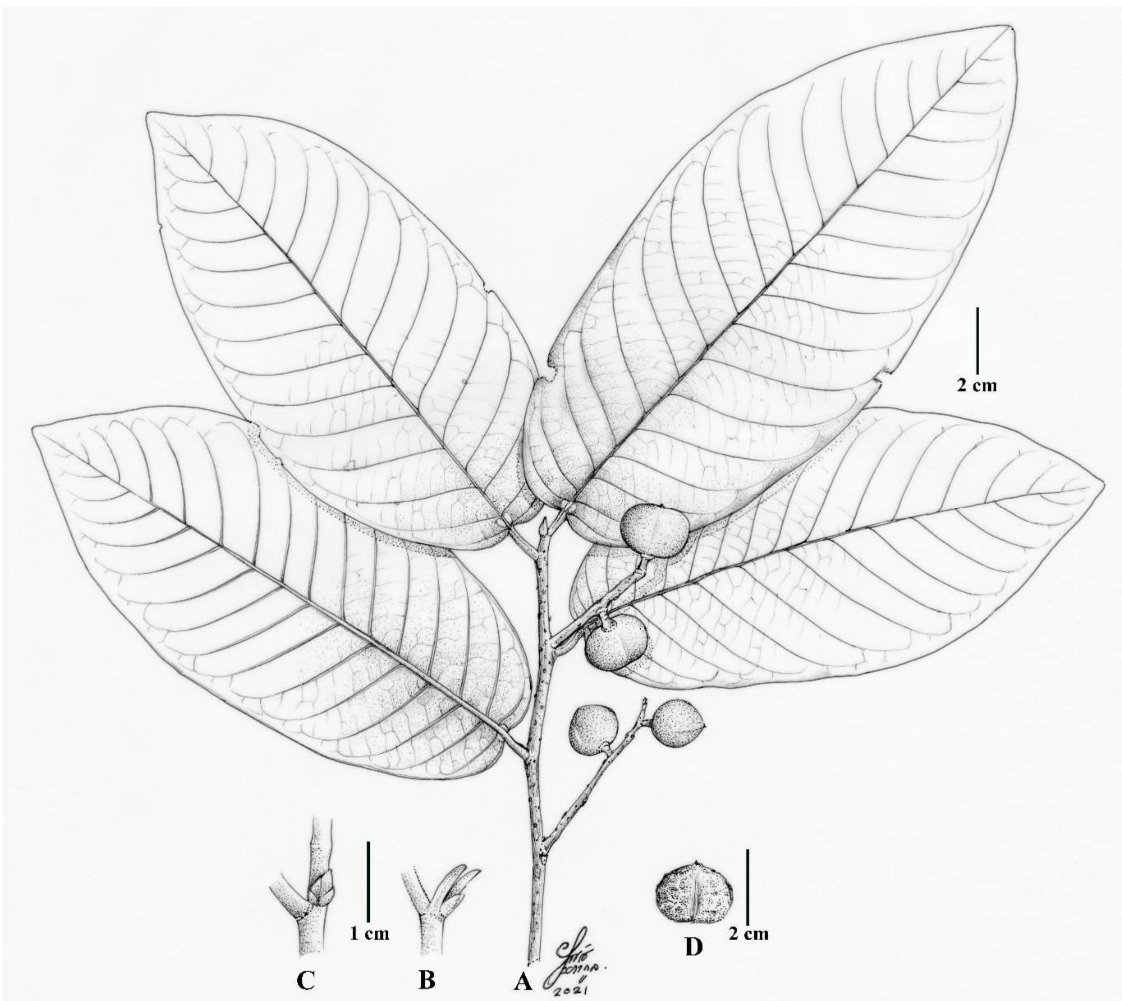


Figure 4.32. *Prunus polystachya* (Hook.f.) Kalkman **A**. fruiting branch, oblong-lanceolate leaves, with two protruding basal glands; **B**. stipule, oblong; **C**. axillary bud; **D**. endocarp stone bony, thick, with longitudinal groove, slightly reticulate. All from *M. Poopath*, *6* (**BKF**). Drawn by Pairuch Rayangkul.

Figure 4.33. *Prunus polystachya* (Hook.f.) Kalkman, vegetative and reproductive morphological characters; A, outer bark; B–F, leaves; B, young leaves, oval, glaucous abaxial; C, oblong, dull green adaxial; D, pale green abaxial; E, basal glands 2, protruding, stipule linear-oblong; F, leaf base cordate with 2-protruding glands; H–I, infructescence in the axil of leaf, young fruits globose; H, mature fruits; I, mature fruits, transversely ellipsoid; J, longitudinal section, endocarp densely long hairy inside apical, seedcoat glabrous. — Photos: A–E & F by S. Rueangruea; B by A. Sinbumroong; G–I by M. Poopath; J by K. Daonurai. — Sources: all from Thailand, Southern; Narathiwat, G–J from *M. Poopath SN6*; Yala, A, C, D, E, F from *S. Rueangruea et al. SR230*. Scale bar = 1 cm.

43. ***Prunus* sp**. **"nanensis"**, sterile specimen, *ined.*

Description: Evergreen, sub-canopy, tree up to 20 m tall, canopy shape globose. **Stem** clear bole, erect; outer bark greyish-brown, smooth with sparse lenticels, spines absent; faint almond smell. **Branchlets** stout, greyish-brown; young twigs, with young twigs sparsely hairy, cataphylls absent; old twigs sparsely hairy with light brown lenticels. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate-oblong, 15–22 cm long × 5–9 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* entire, revolute, densely to sparsely ciliate; *base* asymmetrical, semi-sagittate, semi-amplexicaul to narrowly cordate; young leaves pale green, dull dark green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous; sparsely tomentose to glabrescent on both surfaces, margins densely ciliate; old leaves sparsely tomentose to glabrescent on both surfaces, margins densely ciliate, glabrescent or sparsely hairy, sparsely hairy on midrib adaxially, usually still distinctly hairy at least on midrib, nerves and petiole abaxially; *basal glands* usually 2(0–1), up to 2 mm long, globose, slightly hollow abaxially, over the base of leaf blade margin, sparse small circular glands near and along margin, especially on the upper half; *2° venation* brochidodromous, looped and anastomosing near the margin, 10–12 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken, depressed adaxially, prominent abaxially, moderate to widely angled (50°–65°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles* 0.2–0.5 cm long, stout, shallowly canaliculate in cross-section or terete, sparsely hairy; *petiolar glands* absent. **Stipules** medium to large, 6–10 mm long × 2.5–5 mm wide, leaf-like, oblique-broad ovate, apex acute to acuminate, margin entire, sparsely ciliate, base very shortly stalked to sessile, rounded, densely brown villose to glabrescent, without nerves, sometimes with 4–10 dominant flat circular glands along and inside the margins, semi-persistent or caducous. Sterile specimens (**Figure 4.34**).

Additional specimens examined.— **THAILAND**. **Northern, Nan**: Pua, Doi Phu Kha NP., 19°12'02" N, 101°05'03" E, alt. 1,315 m, 24 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR154* (**BKF**229730!, **TCD**!).

Distribution.— Endemic to Thailand (known only from the specimens cited) (**Maps 4.46 & 4.47**).

Vernacular name. **—** Not known.

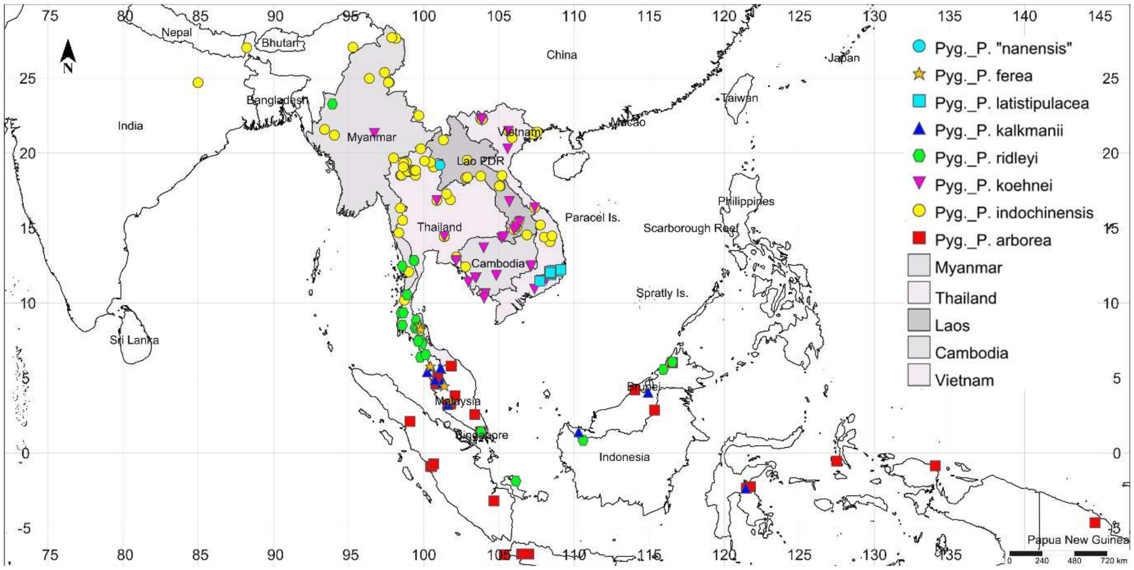
Ecology.**—** Not known.

Phenology. **—** Not known.

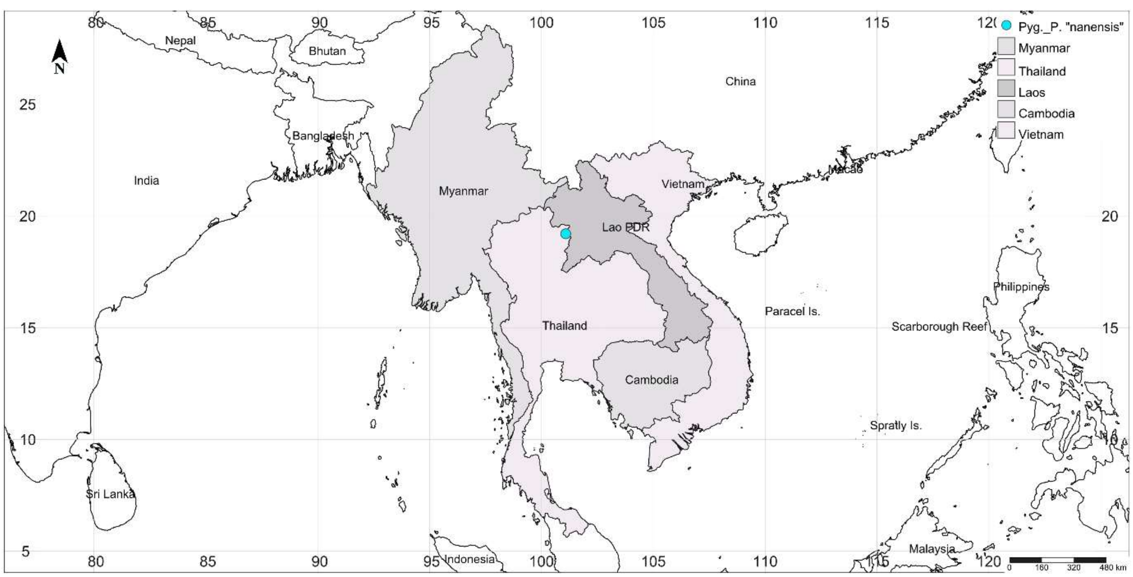
Uses.— Not known

Conservation.— The species is only known from a single location; it appears endemic to Northern Thailand, but I believe may well be found elsewhere. According to IUCN Red (2019), the conservation status here is DD (Data Deficient). More exploration is needed to gain more information to perform a conservation assessment.

Figure 4.34. *Prunus* sp. ‘nanensis’, vegetative and reproductive morphological characters. **A**–**E**, leaves; **A**, leaves alternate, lateral veins depressed adaxially; **B**, lateral vein anastomosing; **C**, basal glands 2, petiole subsessile; **D**, base asymmetrical, semi-sagittate, semi-amplexicaul to narrowly cordate; **E**, stipule leaf-like with 4–10 dominant flat circular glands along and inside the margins. — Photos: all by S. Rueangruea. — Source: all from **Thailand**, Nan, Doi Phu Kha NP, *S. Rueangruea, et al. SR154*. Scale bar = 1 cm.



Map 4.46. Distribution of *Prunus* "nanensis", *P. ferrea* (Craib) Rueangr., J.Parn. & Hodk., *P. latistipulacea* Rueangr., J.Parn. & Hodk., *P. kalkmanii* J.Wen, *P. ridleyi* (King) J.Wen, *P. koehnei* (Koehne) Rueangr., J.Parn. & Hodk., *P. indochinensis* (Hook.f.) Rueangr., J.Parn. & Hodk., and *P. arborea* (Blume) Kalkman, respectively of sect. *Mesopygeum*, infructescence fascicle, 2–6-bundles (except *P. koehnei* (Koehne) Rueangr., J.Parn. & Hodk. panicle-like) in continental Southeast Asia and nearby.



Map 4.47. Distribution of *Prunus* "nanensis" of sect. *Mesopygeum* in continental Southeast Asia.

44. *Prunus koehnei* (Koehne) Rueangr., J.Parn. & Hodk., ***comb. nov.*** and ***nom. nov., ined.***

≡ *Pygeum wilsonii* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(3): 334–445. 1915. Typification: **CHINA**, Western China, Schechuan, Mt. Omi, tree 40 ft, September 1904, *Wilson E. H.* in exped. *Veitch 4858* (lectotype **A**00032446†, designated by Kalkman, 1965; isolectotypes **BM**000622018!, **K**000737225!).

= *Pygeum parreauanum* Pierre ex Cardot *sensu auct.* Kalkman in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 3: 381. 1918, *pro parte*, *quoad*, **VIETNAM**, **Phu-Quoc**, Golfe de Siam, February 1874, fl., *L. Pierre 1422* (lectotype **P**!, isolectotypes seen from **A**†, **BM**!, **BO**, *non vidi*, **E**!, **K**!), designated by Kalkman in *op. cit.*, 13(1): 99. 1965.

Second step typification,— *L. Pierre 1422* (lectotype **P**01819002!; isolectotypes **BM**000622036!, **E**00010506!, **E**00313556!, **GH**00032453!, **K**000737349!, **L**0019555!, **NY**00415951!, **P**0181900-1!), designated here.

= *Pygeum donaiense* J.E.Vidal, in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 296. 1949. Typification: **VIETNAM, Annam, Haut Donaï** province, km 119 de la route no. 20, 700–800 m msl., 22 October 1932, *E. Poilane 21217* (in Vidal, locality by mistake as *21127*) (holotype **P**01819010!; isotypes **E**00010509!, **K**000737345!, **L**0019550-1†, **L**0019558†, **P**01819011!).

= *Pygeum donaiense* var. *crassistylum* J.E.Vidal, in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 296. 1949. Typification: Laos, Savannakhet, 17 October 1983, *E. Poilane 28086* (holotype **P**01819012!; isotypes **L**0019552!, **P**01819013!). The possibility of a mixed gathering is always to be considered, especially when designating a type. I therefore exclude — *E. Poilane 28086* (**L**0019559† and **L**0019560†)

= *Pygeum brachybotrys* Merr. *sensu auct.* Kalkman in A.C.Sm. et al. Journal of the Arnold Arboretum. 23: 169. 1942, *pro parte*, *quoad*, *P.A. Pételot 4029*. Typification: **VIETNAM,** Tonkin, *Xoan-Dao*, *Pho-Ba-Che*, *P.A. Pételot 4029* (holotype **A**00032448†), no isotype seen.

Description: Evergreen, sub-canopy, tree up to 20 m tall, globose. **Stem** clear bole, erect; outer bark blackish-brown to brown, shallowly fissured, spines absent; *inner bark* yellowish-brown; faint almond smell. **Branchlets** slender; young twigs greenish-brown, with young twig rusty-villose, cataphylls absent; old twigs slightly zigzag, blackish-brown, sparsely hairy to glabrescent with prominent brown lenticels or sometimes sub inconspicuous. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate or distichous, oval-lanceolate, elliptic-lanceolate or oblong-lanceolate, 6–14.5 cm long × 2.5–6.5 cm wide; *lamina apex* acute, acuminate or obtuse, angle acute; *margin* entire, densely to sparsely ciliate; *base* asymmetrical to oblique, rounded to subcordate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, subcoriaceous to coriaceous; tomentose adaxially, margins densely ciliate; old leaves glabrescent, tomentose on midrib and lateral nerves adaxially, margins ciliate, glabrescent except the impressed midrib or lateral veins adaxially, sparsely short rather stiff hairs abaxially; *basal glands* usually 0, 1–2 (with less developed basal glands and often without glands), 0.8–2 mm long, circular, ovate or oblong, swollen adaxially, in the basal part of leaf blade, sparse small circular glands near the margins from upper half to apex and sparsely dotted abaxially; *2° venation* weaky brochidodromous, 6–8(–10) alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, narrow angle (< 45°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles* 0.5–1 cm long, slender, shallowly canaliculate in cross-section or terete, pubescent; *petiolar glands* absent. **Stipules** medium, 4–10 mm long × 1.5–5 mm wide, oblong-lanceolate or triangular, apex acuminate, margin entire, ciliate, base truncate, brown tomentose, 2–4 glands on the stipule blade, early caducous. **Inflorescences** compound, fasciculate, or 2–4 panicle-like, dense to lax-flowered, (mainly) on the branches with fallen leaves or in the axils of leaves, 1–3.5 cm long, many-flowered, densely brown tomentose, peduncles 0.3–1 cm; *bracts* 1–3, 0.8–1.5 mm long, size and shape variable, triangular to ovate, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, or flowers imperfect, with a slight to minute pistillodium, opening with mature leaves, white, sessile or subsessile, stout, usually < 1– 2(–3.5) mm long, brown tomentose; *bracteoles* linear to ovate-lanceolate, 0.7–1 mm long, pale green, densely brown hairy, early caducous; *hypanthium* campanulate, 1–3 mm long, densely brown hairy ouside, glabrous inside, otherwise hairy at base; *perianth* petals slightly different from calyx lobes, obscurely 10-lobes, 0.3–0.5 mm long, hairy both side and margin ciliate; *calyx* lobes perianth segments 10–12 lobes, or sepals and petals more or less distinct from one another, the petals being slightly longer or thiner, triangular, minute, green, 0.3–0.5 mm long × 0.3–0.5 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, pubescent outside, pubescent inside; *corolla* petals slightly different or indistinguishable from sepals, whitish-brown, spreading to upright, 0 (5)-merous or perianth, small, 0.3–0.6 mm long × 0.3–0.5 mm wide, equal or subequal, shorter or as long as calyx lobes, ovate-lanceolate or oblong, sessile, apex acute, margin entire, ciliate, base truncate, alternate with calyx lobes, tomentose outside, tomentose inside; *stamens* 20–30 in 1 to 3 series, exserted, more prolonged than perianth; filament filiform, white, 2.5–4.5 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers oblong-oval, 0.2–0.4 mm long; *ovary* glabrous or glabrescent, hairy at point of insertion, 1 locular; *style* extremely short, filiform, stout, (0)2–3(–5.5) mm long, shorter than or as long as stamens, glabrous; stigma subpeltate or stigma not enlarged, greenish-yellow. *Infructescence* 1–4 cm long, densely hairy to glabrescent, few, 1–3 fruited. **Fruits** stalked, 1.5–3.5 mm long, with sparse lenticels, young fruit green, turning dark purple to black when ripe, spherical or sub-transverse-ellipsoid, 0.5–1.1 cm long, 0.6–1.6 cm wide, apex obtuse, rounded or acute; young fruits glabrous or hairy at base; mature fruits glabrous; exocarp smooth and shiny, with a shallowly longitudinal groove; mesocarp fleshy, thin, white; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged, sparsely adpressed hairs inside; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually laterally transversely globose, thick, glabrous testa, and shallowly rugose (**Figure 4.35**).

Additional specimens examined.— **CAMBODIA**. **Cambodge**: Jong, 27 June 1909, fl., *Alleizette A.C. D*, *s.n.* (**L**1892529†);– *ibid.*, Mondulkiri, 6 November 2006, fl. & fr., *Long Christopher*, *K.C. Cheng & M. Leti CL481* (**P**00626354!);– *ibid.*, Koh Kong: Elephant Mountain, Bokor NP., 11°23'35.9” N, 102°58'36.6” E, alt. 236 m, 17 May 2012, lvs., *H. Toyama*, *S. Tagane*, *T. Kajisa*, *K. Sakata*, *M. Nobayashi*, *N. Mihara*, *T. Ide*, *P. Chhang*, *H. Nagamasu 3378* (**BKF**!, **FU**!);– *ibid.*, Phnom Smokio, alt. 300 m, 5 December 1938, *Muller 581* (**P**!);– *ibid.*, 10°37'41.02” N, 104°05'37.43” E, 11 December 2011, lvs., *H. Toyama*, *S. Tagane*, *K. Kajisa*, *M. Nobayashi*, *N. Mihara*, *T. Ide*, *C. Phourin & H. Nagamasu 2049* (**BKF**!, **FU**!);– *ibid.*, alt. 721 m, 12 December 2011, fl. & fr., *H. Toyama*, *S. Tagane*, *T. Ide*, *P. Chhang*, *H. Nagamasu*, *T. Yahara 2116* (**BKF**!, **FU**!);– *ibid.*, alt. 602 m, 8 December 2013, lvs., *H. Toyama*, *K. Fuse*, *F. Iwanaga*, *H. Kanemitsu*, *K. Tagawa*, *M. Chang*, *W. Kim*, *M. Loth 6055* (**BKF**!, **FU**!);– *ibid.*, 10°36'24.04” N, 104°5'35.85” E, alt. 444 m, 11 May 2012, lvs., *H. Toyama*, *S. Tagane*, *T. Mishima*, *K. Tagawa*, *M. Zang*, *P. Chhang*, *F. Iwanaga*, *H. Nagamasu & T. Yahara 2980* (**BKF**!, **FU**!);– **The Central**: Cardamom Mountains, 11°41'39.57” N, 103°29'24.60” E, alt. 530 m, 19 April 2011, lvs., *H. Toyama*, *S. Tagane*, *P. Chhang*, *T. Yahara 609* (**FU**!);– *ibid.*, 11°41'52.46” N, 103°26'16.51” E, alt. 425 m, 18 April 2011, lvs., *H. Toyama*, *S. Tagane*, *P. Chhang*, *T. Yahara 581* (**BKF**!, **FU**!);– **Mondulkiri**: Sen Monorom, roadside to O'romis Hydropower station edge of evergreen forest near stream, 12°29'22.8” N, 107°10'42.2” E, alt. 771 m, 4 November 2016, lvs., *S. Tagane*, *M. Zhang*, *P. Chhang*, *K. Hatake*, *T. Ota & K. Mase 7322* (**FU**!);– **Siem Reap**: Banteay Srei, Khun Ream, Phnom Kulen NP., 13°41'10.9” N, 103°59'26.7” E, alt. 300 m, 16 December 2012, fl. & fr., *H. Toyama*, *N. Wachi 5183* (**BKF**!, **FU**!);– *ibid*., Mont Kulen, alt. 400 m, 11 April 1966, *Martin Mane 485* (**P**!). **CHINA**. **Szechuan:** Omei-hsien Mout., 7 May 1963, *S.S. Chien 5579* (**E**!);– *ibid.*, Western Szechuan, 11 August 1909, *E.H. Wilson 2542* (**E**!). **LAOS**. **Central, Champasak**: Pak Song, Nong Laung village, Bolaven Plateau, 14°53'44.73” N, 106°01'02.36” E, alt. 1,210 m, 13 December 2018, fr., *S. Tagane*, *A. Nagahama*, *P. Souladeth & P. Pisuttimarn L2312* (**BKF**!, **FU**!);– *ibid.*, alt. 1,000 m, 26 September 1928, fl., *E. Poilane 15733* (**K**!, **L**1892570†, **MUS**†, **P**03358526!, **VNM**00013167!);– *ibid.*, 15°04'26.35” N, 106°12'24.15” E, alt. 600 m, 24 September 1928, fl., *E. Poilane 15717* (**K**!, **L**1892572†, **REG**!, **VNM**!);– *ibid.*, alt. 400 m, 5 February 1930, fl., *E. Poilane 16063* (**E**00991981!, **K**!, **L**1892571†, **MUS**†, **P**03358525!);– **Southern, Savannakhet**: 17 October 1938, fl., *E. Poilane 28086* (**L**0019560†, **P**01819012–3!);– **Central Burma, Mandalay**: Shan, Ye-gyan, 20 May 1972, fl., *Kyi Win 61* (**RAF**!). **THAILAND**. **Central, Nakhon Rachasima**: Khao Yai NP., alt. 800 m, 14 June 1972, lvs., *T. Smitinand 11550* (**BKF**049608!);– **Eastern, Chantaburi:** Khao Khitchakut NP., 12°49'46” N, 102°09'33” E, alt. 468 m, 10 April 2019, lvs., *S. Rueangruea*, *S. Kaithongsuk*, *P. Uea-Ari*, *S. Chatrupamai & Anannat T. SR199* (**BKF**224932!, **TCD**!);– **Northeastern, Ubon Rachathani**: Emerald Triangular, Phu Chong Na-Yoi NP, 22 March 2007, fr., *K. Wangwasit*, *M. Norsaengsri & C.*

Lakoet 29930 (**BKF**178104!, **QBG**!);– *ibid.*, 14°20'6.0" N, 105°10'55.6" E, alt. 330 m, 22 March 2007, fr., *K. Wanwasit*, *M. Norsaengsri & C. Lakoet 70322-8* (**BKF**178104!, **QBG**29930!);– *ibid.*, May, fl., *K. Wangwasit 29927* (**BKF**!);– **Northern, Phitsanulok**: Nakhin Thai, Thung Salaeng Luang NP., 16°50'35" N, 100°52'41" E, alt. 850 m, May *s.n.*, fl., *S. Phusomsaeng 114* (**BKF**049567-8!, **L**1892569†, **P**03358560!);– **Western**, Kanchanaburi: Sangkhla Buri, Thung Yai Naresuan WS., 4 May 1992, fr., *T. Santisuk 202* (**BKF**109763!). **VIETNAM**., January 1983, fr., *s.coll.*, *s.n.* (**KYO**!);– **Annam, Khanh Hoa**: Hon Ba, 12°6'46.88" N, 108°58'14.43" E, alt. 919 m, 21 February 2014, lvs., *H. Toyama*, *V.S. Dang*, *S. Tagane*, *K. Fuse*, *T. Yahara*, *H. Nagamasu*, *H. Tran*, *V.N. Nguyên*, *Q.C. Nguyên*, *N.T. Do.*, *N.P.H. Ho V1027* (**BKF**!, **FU**!);– **Kon Tum**, Kon Plong, Po E, Mang La forest, 14°45'12.0"N, 108°30'39.0"E, alt. 600 m, 6 April 2000, fr., *Phan Ke Lok PKL10087* (**L**4407834†);– **Lam Dong**: Blao, alt. 1,400 m, 18 August 1955, fl., *M. Schmid*, *s.n.* (**P**!);– *ibid.*, December 1960, fl., *M. Schmid*, *s.n.* (**L**1892541†, **L**1892550†, **P**03358510!);– *ibid.*, 8 December 1959, fl., *M. Schmid*, *s.n.* (**P**03358516!);– *ibid.*, 17 January 1960, fr., *M. Schmid*, *s.n.* (**P**03358509!, **P**03358517!);– *ibid.*, alt. 850 m, 18 August 1955, *M. Schmid s.n.* (**P**03144346-7!);– *ibid.*, alt. 1,200 m, 12 January 1935, fr., *E. Poilane 23877* (**L**1892551†, **L**1892542†, **P**03358515!);– *ibid.*, Kilom, 12°10'34.7" N, 108°41'08.4" E, alt. 800 m, 22 October 1932, fl., *E. Poilane 21217* (**E**00010509!, **K**000737345!, **P**01819010-1!);– **Merid**: Braian, alt. 1,200 m, January *s.n.*, fr., *E. Poilane, s.n.* (**L**4192370†);– **Thua Thien**: Binh-Dien, alt. 1,200 m, 24 May 1920, lvs., *E. Poilane 1432* (**L**1892523-4†, **MUS**†, **P**03358549-50!, **VNM**00023526!, **VNM**00023528!);– **Cochinchine, Bien Hoa**: Nui Ckua Chan, alt. 700 m, 9 October 1931, fl., *E. Poilane 19448* (**K**!, **P**03358564-5!, **P**01819011!, **US**2496292†);– **Tonkin, Lao Cai**: Pho Lu, 10 February 1936, fr., *E. Poilane 25232* (**P**04815368!);– **Ninh Binh**: Nho Quan, Cuc Phuong NP, 20°17.18'N, 105°35.27'E, alt. 119 m, 11 December 2001, fl., *N. Tien Hiep*, *M. Van Xinh & N.T. Vinh NTH5403* (**P**00783224!);– **Nghe An**: Que Phong, Ban Moung, along the road towards Laos border, 19°34'00.0"N, 104°52'00.0"E, alt. 300 m, 12 April 1998, fr., *D.D. Soejarto, T.N. Ninh, P.H. Hoang 10298* (**L**4198713†);– **Sapa**: alt. 1,500 m, August 1935, fl., *P.A. Pételot 6160* (**VNM**00013164!, **VNM**00013170!);– *ibid.*, alt. 1,400 m, July 1930, fl., *E. Poilane 6163* (**VNM**00013169!);– **Xoan-Dao**, Pho-Ba-Che, 20 May 1926, *J.E.Vidal 1* (**P**03358554!).

Distribution.— Thailand (Eastern), Laos, Cambodia, and Vietnam (**Maps 4.46 & 4.48**).

Vernacular name. — Xi nan tun guo mu (China).

Ecology.— Scattered in open areas, Seasonal Dry Evergreen Forest to Lower Montane Forest, alt. 100–1,300 m.

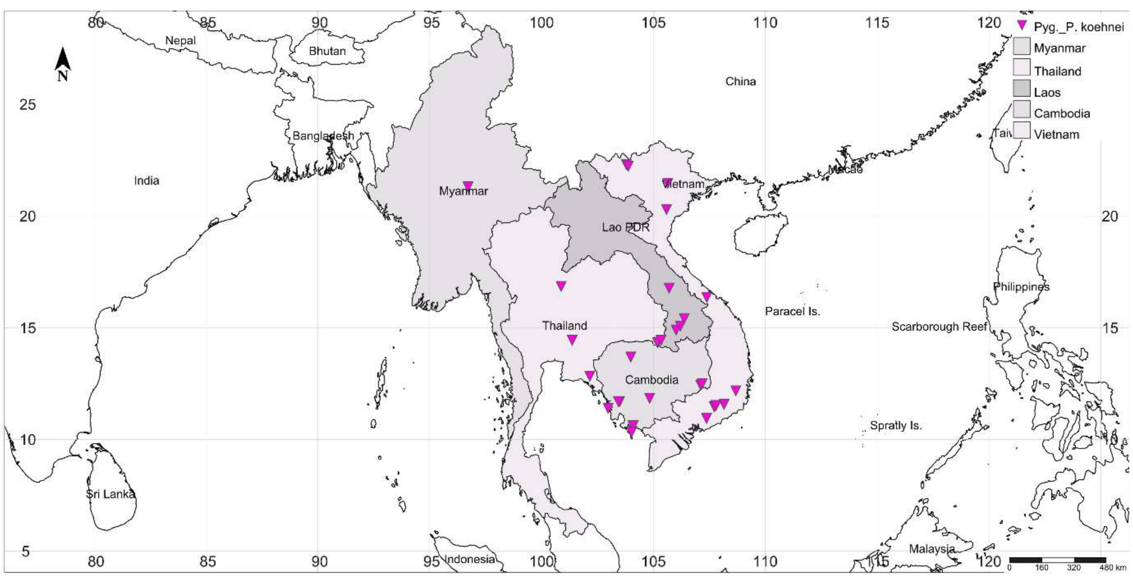
Phenology.— Flowering: July–December. Fruiting: December–March.

Uses.— Not known.

Conservation.— **Conservation**.—This species is known from many locations (> 10 locations): EOO = 173,771.58 km^2; AOO = 68.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman (1965) recognized this taxon as *Pygeum wilsonii* Koehne, a *Prunus arborea* var. *montana* synonym. Because the name *Prunus wilsonii* (C.K.Schneid.) Koehne is already occupied, and because it is a distinct species, I use *Prunus koehnei* as the new name in honor of Prof. Bernhard Adalbert Emil Koehne, who was a leading authority on the plant family Lythraceae and studied various *Prunus* taxa (Neues zur Gattung *Pygeum* (1915)). *Prunus koehnei* is morphologically similar to *Prunus indochinensis*. It is distinguished. However, from the former by its leaf blade that is sparsely strigose hairy abaxially (vs. densely villose), usually flat circular to oval basal leaf glands (vs. basal glands oblong, usually protruding adaxially), ovary and the base of style glabrous, though hairy around the point of insertion (vs. ovary densely tomentose, the base of style sparsely hairy). It is a species characterized by its small leaves, with basal glands ordinarily absent. Still, if present, a single one is evident on the lower surface, slightly concave but not at all saccate, and its unusually short inflorescences and small flowers. I herein elevate it to the species level.

This species is highly distinctive in its large and hollow glands at the base of the leaf blade near the petiole. Its large ovate-oblong and glabrous leaves and large fruits can also be easily distinguished from other lowland *Prunus* species in continental Southeast Asia.



Map 4.48. Distribution of *Prunus koehnei* (Koehne) Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* (Pyg.) in continental Southeast Asia and nearby.

Figure 4.35. *Prunus koehnei* (Koehne) Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters; A, outer bark greyish brown; **B–G**, leaves; **B**, young leaves, distichous; **C**, mature leaves, dull green adaxial; **D** & **E**, ovate-oblong; **F**, base slightly oblique, with 2-circular protruding glands; **G**, conspicuous stipule with 2–4 glands on the stipule blade; **H–J**, inflorescence; **H**, 2–4 panicle-like; **I**, lateral flowers, perianth; **J**, perfect flowers above, and male flower below, filaments hairy; **K** & **L**, infructescence; **K**, fascicle compound raceme, panicle-like; **L**, mature fruit, transverse-ellipsoid in cross-section; **M–O**, dried fruits cross-section from various stages, endocarp and seedcoat glabrous; **M**, immature; **N**, mature; **O**, mature fruit with thick mesocarp. — Photos: A–E & G–L by S. Kaithongsuk; F by S. Rueangruea; M–O by K. Daonurai. — Sources: **Cambodia**, Cambodge, M from *S. Tagane et al. 5183*: **Thailand**; Kanchanaburi, N & O from *T. Wongprasert et al. SN109763*; Sakaew, A–E & G–L from *S. Kaithongsuk et al. s.n*.; Trat, F from S. *Rueangruea et al. SR199*; Scale bar = 1 cm.

45. ***Prunus indochinensis* (Hook.f.) Rueangr**., **J**.**Parn**. **& Hodk, *comb*. *nov*., *nom. nov., ined***.

≡ *Pygeum montanum* Hook.f., Flora of British-India. 2(5): 321. 1878. Typification: **INDIA,** Darjeering, *W. Griffith* 2054 (lectotype **K**!), designated by Kalkman in *op. cit.*, 13(1): 99. 1965.

Second step lectotypification;– *ibid.*, *W. Griffith 2054* (lectotype **K**000737294!; isolectotypes **FI**010982†, **K**000737293!, **K**000737295!, **K**000737296!, **E**00013643!, **M**0214821†, **P**03358535!), designated here.

≡ *Prunus arborea* (Hook.f.) Kalkman var. *montana sensu auct.* Kalkman, Blumea; Tijdschrift voor de Systematiek en de Geografie der Planten (A Journal of Plant Taxonomy and Plant Geography). 13(1): 99. 1965. J.E.Vidal, Flora du Cambodge, du Laos et du Vietnam 6: 189–190, pl. xxv, 5–8. 1968; in Flora of Thailand 2 (1): 71. 1970; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 332. 1993, non *Prunus montana* Schur, Enumeratio plantarum Transsilvaniae.: 179.1866.

= *Pygeum henryi* Dunn., Journal of the Linnean Society, Botany. 35: 493. 1903.

Typification: **CHINA, Yunnan**, Szemao, tree 15 ft, flower white, 1900, *A. Henry 12313A*, lectotype in **K**!, isotypes seen from **A**†, **E**!, **US**†; syntype *13213* **E**!, **K**!, *13213B* (**A**†, **E**!); *12708* (**E**!, **US**†, *non vidi*), designated by Kalkman in *op. cit.*, 13(1): 99. 1965, non *Prunus henryi* (C.K. Schneid.) Koehne.

Second step typification.— *A. Henry 12313A* lectotype **K**000737229!; isolectotypes **A**00032437!, **A**00032438!, **A**00032439†, **E**00011362!, **E**00011364!, **K**000737228!, **MO**-255112†, **NY**00415943†, **NY**00415944†, **US**00107913†; 12313; *12313B* (lectoparatypes **A**00032440†, **BM**†, **E**00010497!, **K**000737227!); 1901, *A. Henry 12708* (isolectoparatypes **A**00032436†, **E**00011363!, **K**000737226!, **L**0019557†, **MO**255110†), designated here.

= *Pygeum ciliatum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 184. 1913.

Typification: **INDIA**, **Assam**: Tingale Bam, S. Tengali, October 1898, *Prain Sammler 282* (lectotype in CAL, designated by Kalkman, 1965; *non vidi*; isolectotypes **BM**000622026!, **BM**000946952!).

= *Pygeum ocellatum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 183. 1913.

Typification: Koehne cited ' J.D. Hooker. F et. Thomson' from Assam, Khasia, reg. temp. 4–5,000 ped., designated by Kalkman in *op. cit.*, 13(1): 99. 1965, *non vidi*

= *Pygeum anomalum* Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 183. 1913.

Typification: **MYANMAR,** Tenasserim, Papun Dagwin Road, Papun Dagwin Road., 24 April 1905, *F.B. Manson* 12 (lectotype in **L**, designated by Kalkman, 1965; isotype seen from **BM**!, **K**!, (**BO**, **BR**529492†, **CAL**, *non vidi*).

Second step lectotypification;– *ibid.*, *F.B. Manson 12* (lectotype **L**0019556!; isolectotypes **BM**000622027!, **BR**0000005294923†, **K**000737297!, **K**000737298!, **P**01819016!, **U**0258781†), designated here.

= *Pygeum sessiliflorum sensu auct.* Kalkman, Cardot in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 3: 381. 1918, *pro parte*, *quoad*, *L. Pierre* 687, **CAMBODIA, Tpong** province, Kuang-krepeuh Mountains, 900–1,500 m. alt., May 1870 (lectotype **P**00753823!, designated by Kalkman 1965; isolectotypes **A**00032455†, **BM**000622035!, **E**00010507!, **E**00313557!**, GH**00032454†, **K**000737229!, **K**000737344!, **L**0019549†, **L**0019554†, **L**0019547-8†, **NY**00415953-4†, **P**00753824!, **P**01819003!, **P**01819004!**, P**03358559!, **SING**0096235†, **US**00107925†).

= *Pygeum affine*, Merr. in A.C.Sm. et al. Journal of the Arnold Arboretum. 23: 168. 1942. Typification: **VIETNAM, Tonkin Sapa**, 1,500 m. alt., August 1935, *P. A. Pételot 6160* (holotype **A**00032447!; isotype **VNM**00013164!); *P. A. Pételot 6161* (paratype **VNM**00013170!).

= *Pygeum atrovillosum* J.E.Vidal, in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 279. 1949.

Typification: **VIETNAM, Annam**: Massif du Long-Bian; Djiring et environs, 1, 000 m msl, 21 February 1914, *A.J.B. Chevalier 31264* (holotype **P**01819005!, isotypes **P**01819006!, **P**01819007!).

= *Pygeum bachmaense* J.E.Vidal in H. Humbert Notulae Systematicae. Herbier du Muséum de Paris. 13: 296. 1949.

Typification: **VIETNAM, Bach-Ma** près Hué, 1,400 m. msl., 21 August 1943, *J.E.Vidal 26* (holotype **P**01819008!, isotype **P**01819009!).

Description: Evergreen, sub-canopy, small tree or tree up to (5–)10–25 m tall, canopy shape oval or globose. **Stem** clear bole, outer bark dark brown, smooth, spines absent; *inner bark* whitish-yellow; faint almond smell. **Branchlets** stout, blackish-brown with prominent lenticels; young twigs greenish-brown, with young twigs pubescent to densely pubescent with densely short, stiff brown hairs, cataphylls absent; old twigs glabrescent with prominent whitish-brown lenticels. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate to ovate-lanceolate, oblong-lanceolate to elliptic-oblong, 8–20 cm long × 3.5–7 cm wide; *lamina apex* acute, caudate to acuminate, angle acute; *margin* entire, densely ciliate; *base* asymmetrical or symmetrical, concave, concavo-convex, subacute or rounded; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, herbaceous to coriaceous; adpressed tomentose adaxially, margins densely ciliate; old leaves adpressed tomentose adaxially, margins densely ciliate, glabrescent except the impressed midrib or lateral veins adaxially, usually retaining its indumentum abaxially; *basal glands* usually 2(0–1), 1–4 mm long, oblong or ovate shape, slightly to distinctly swollen adaxially, in the basal part of leaf blade, sparse small circular glands near the margins from upper half to apex; *2° venation* weaky brochidodromous, 7–12 alternate on either side of the midrib, oblique, ascending, spacing irregular, sunken adaxially, prominent abaxially, narrow to angle moderate (35°–60°); *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles* 0.5–1.5 cm long, stout, shallowly canaliculate in cross-section or terete, pubescent; *petiolar glands* absent. **Stipules** small to medium, 2–10 mm long × 0.8–2.5 mm wide, linear, oblong or triangular, apex acute or acuminate, margin entire, ciliate, base truncate, tomentose, without or with marginal glands, early caducous. **Inflorescences** compound, fasciculate in bundles of 2–6 racemes, lax-flowered, (mainly) on the branches with fallen leaves or in the axils of leaves, 1.5–5 (–10) cm long, many-flowered, densely brown tomentose; *bracts* 2–5, 0.5–1.2 mm long, size and shape variable, triangular to oblong, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white, fragrant; pedicels 1–4 mm long, sometimes very short, brown tomentose; *bracteoles* linear, 0.5–1.5 mm long, pale green, densely brown hairy, early caducous; *hypanthium* urceolate, campanulate to wide turbinate, 1–3 mm long, densely brown hairy; *perianth* petals slightly different from calyx lobes, 10-toothed, 0.5–1.5 mm long, hairy both sides and margin ciliate; *calyx* lobes perianth segments 7–11, or sepals and petals more or less distinct from one another, although the petals slightly longer or thiner, triangular, minute, green, 0.3–1.5 mm long × 0.5–0.9 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, pubescent outside, pubescent inside; *corolla* petals slightly different or indistinguishable from sepals, white to whitish-brown, spreading to upright, 5 (–0) -merous or perianth small, 0.3–1.5 mm long × 0.3–0.8 mm wide, equal or subequal to calyx lobes, obovate-lanceolate, subspathulate-oblong or oblong, sessile, apex acute to obtuse, margin entire, ciliate, base oblong, alternate with calyx lobes, tomentose outside, to inside; *stamens* (20–)30–40(–50) in 1 to 3 series, exserted beyond the perianth; filament filiform, white, 2–4 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers oblong-oval, 0.3–0.6 mm long; *ovary* densely villose, 1 locular; *style* filiform, slender, 1.5–6 mm long, longer than stamens, glabrous or hairy at base; stigma gland not divided, globose, green. *Infructescence* 2–7 cm long, densely hairy to glabrescent, many fruited. **Fruits** fleshy, stipitate, 2.5–8 mm long, young fruit green, turning dark purple when mature or ripe, globular to distinctly didymous, subequal, 0.6–1.2 cm long, 0.7–1.5 cm wide, apex retuse or obtuse; young fruits tomentose; mature fruits glabrescent; exocarp smooth and shiny, with a longitudinal groove, black when ripe (via yellow or red); mesocarp fleshy, thin, white, smelling of bitter almonds; endocarp stone bony, sculpture shallowly reticulate with shallow longitudinal or ridged, glabrous, more rarely hairy; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually transversely globose laterally, thick, with glabrous testa, shallowly rugose, and seedcoat glabrous (**Figure 4.36**).

Additional specimens examined.— **Additional specimens examined**.— **CAMBODIA**, Cambodge, Kuang Repeuh, alt. 900 m, May 1970, *L. Pierre 687* (**BM**!, **E**!, **K**!, **L**†, **P**!). **CHINA**. September 1932, fr., *W.T. Tsang 21589* (**K**!);– Guangdong, Kochow, November 1919, fr., *Peng T.K. 2750* (**K**!);– South Eastern of Shang-sze district, Kwangtung border, Tang Lung village, alt. 700 m, 28 September 1934, fl., *Merr. 24375* (**A**†);– **Yunnan**: alt. 1,100 m, 5 March 1992, fl., *T. Santisuk 275* (**BKF**094900!);– *ibid.*, alt. 1,000 m, 9 March 1992, fr., *T. Santisuk 397* (**BKF**109971!);– *ibid.*, February 1901, fl., *A.*

Henry 12313 (**K**!);– *ibid.*, *A. Henry 12708* (**K**!);– *ibid.*, Ying Jiang, alt. 800 m, 26 November 1993, fr., *T. Smitinand 1055* (**BKF**172385!). **INDIA**. **Assam**: Tingale Bam, S. Tengali, October 1898, fr., *P. Sammler 282* (**BM**000622026!);– *ibid.*, Gawai, January 1899, fl. & fr., *P. Sammler 592* (**BM**000946952!, **P**03358533!, **P**03358536!);– *ibid.*, alt., 1,670m., August 1892, fl., *King s.n.* (**P**03358534!). **LAOS**. **Central, Bolikhamxay**: Paksan, Somsavath village, 18°27'33" N, 103°48'13" E, 18 July 2004, fl., *D. Djendoel Soejarto DDS13491* (**L**4310573†);– **Vientiane**: Phou Khao Khuoay National Protected Area, 18°21'10.48" N, 102°48'20.68" E, alt. 779 m, 22 December 2017, lvs., *T. Yahara*, *S. Tagane*, *P. Souladeth*, *H. Nagamasu*, *A. Naiki*, *S. Chayer & D. Kongxaisavath L1510* (**BKF**!, **FU**!);– *ibid.*, alt. 695 m, 24 December 2017, lvs., *T. Yahara*, *S. Tagane*, *P. Souladeth*, *H. Nagamasu*, *A. Naiki*, *S. Chayer & D. Kongxaisavath L1739* (**BKF**!, **FU**!);– **Northern, Luang Namtha**: Nam Ha, 20°52'11.4" N, 101°18'39.3" E, alt. 810 m, 16 June 2017, *T. Yahara*, *S. Tagane*, *N. Okabe*, *P. Souladeth*, *S. Chayer*, *D. Kongxaisavath & C.J. Jang L568* (**BKF**!, **FU**!);– **Xiang Khouang**: Muong Soui, alt. 1,000 m, 8 February 1932, fr., *E. Poilane 20058* (**E**00991978!, **K**!, **L**1892553†, **L**1892559†, **P**03358532!);– **Southern, Attapeu**: Bolaven, 14°32'54.1" N, 106°52'00.6" E, alt. 501 m, 21 December 2019, lvs., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3727* (**BKF**229978!, **RAF**!, **FOF**!);– **Champasak**: Paksong, between Sala Aime and Bount Tai, alt. 1,500 m, 9 May 1936, fr., *E. Poilane 26034* (**L**1892557†, **P**03358531!);– *ibid.*, Nong Laung village, Bolaven Plateau, 15°04'13.4" N, 106°12'32.6" E, alt. 1,276 m, 17 December 2019, fr., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3298* (**BKF**229802!, **RAF**!, **FOF**!);– *ibid.*, alt. 1,268 m, 12 November 1938, fr., *E. Poilane 28413* (**BKF**049708!, **KYO**!, **MUS**†, **P**03358529!);– *ibid.*, 15°04'43.3" N, 106°12'23.1" E, alt. 1,246 m, 18 December 2019, fl., *P. Souladeth*, *S. Tagane*, *D. Kongxaysavath, S. Rueangruea*, *S. Suddee*, *Y. Suyama*, *E. Suzuki L3468* (**BKF**!, **RAF**!, **FOF**!);– *ibid.*, 15°04'36.6" N, 106°12'31.9" E, alt. 1,210 m, 9 December 2018, lvs., *S. Tagane*, *A. Nagahama*, *P. Souladeth & P. Pisuttimarn L1912* (**FU**!).;– *ibid.*, 14°53'44.73" N, 106°01'02.36" E, alt. 1,210 m, 13 December 2018, fr., *S. Tagane*, *A. Nagahama*, *P. Souladeth & P. Pisuttimarn L2245* (**FU**!);– *ibid.*, 15°28'40.2" N, 106°19'51.0" E, alt. 1,210 m, 22 February 2019, fr., *P. Souladeth*, *S. Tagane*, *A. Sengthong*, *A. Nagahama*, *Y. Suyama & N. Ishii L2645* (**FU**!);– *ibid.*, alt. 1,000 m, 5 October 1928, fr., *E. Poilane 15843* (**L**1892542-3†, **P**03358528!, **VNM**00013168!);– *ibid.*, 15°11'13" N, 106°07'33" E, alt. 980 m, 5 June 2000, fl. & fr., *D.J. Middleton & V. Lamxay 259* (**E**00148196!, **P**03358530!);– **Kham mouan**: Nakai, Sop Ma village, 17º47'49" N, 105º07'03" E, alt. 578 m, 12 March 2006, fr., *B. Svensuksa BT354* (**FOF**0002769!, **NUOL**0002317†);– *ibid.*, alt. 550 m, 28 February 2007, fr., *V. Jacquemont BT882* (**E**00702869!, **FOF**0002772!, **NUOL**0002318†, **P**01065162!);– *ibid.*, alt. 539 m, October 2006, fr., *K. Nanthavong BT693* (**BKF**211790!, **E**00702860!, **FOF**0002777!, **L**1904391†, **HNL**†). **MYANMAR**. 14º40'50.45" N, 98º20'51.50" E, alt. 551 m, 15 November 2018, fl., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Kyaw Yunn Mi*, *Awng Khine Win MY4273* (**FU**!);– *ibid.*, **Myawaddy**: Amherst, Ta-ok plateau, 15 February 1927, fr., *C.E. Parkinson 5222* (**K**!);– *ibid.*, **Taninthayi**, Yaephyu, Mae Lao-Mae Sae WS., 12°05'07.5" N, 99°00'16.5" E, alt.

148 m, 11 June 2016, lvs., *S. Tagane*, *N. Tanaka*, *A. Naiko & Mu Mu Aung MY669* (**BKF**!, **FU**!);– **North Eastern Burma, Tenasserim**, Palatwa, Chan Pyang village, Natmataung NP., 21°34'22.47" N, 93°24'21.7" E, alt. 1,676 m, 11 March 2014, fr., *P. Srisanga*, *M. Norsaengsri*, *R.U.M. Rodda*, *E. Schuettpelz*, *T.T. Mu & L.S. Man 97829* (**E**00758069!, **QBG**79953!);– *ibid.*, 21°11'22.9" N, 94°03'31.1" E, alt. 1,270 m, 22 February 2007, fr., *Fujikawa K.*, *N. Kuroiwa*, *A. Maeda & A. Thay 50095* (**QBG**93767!);– *ibid.*, 22 February 2007, fr., *Fujikawa K.*, *N. Kuroiwa*, *A. Maeda & A. Thay 50096* (**QBG**93767!);– **Kachin**: Mytikyina, alt. 1,500 m, 19 September 1912, fl., Kyaw, *G. Forrest & E.A.C. 45* (**E**00072293!);– *ibid.*, Mytikyina, alt. 1,000 m, 21 September 1912, fl., Kyaw, *G. Forrest & E.A.C. 41* (**E**00072292!);– *ibid.*, Mohnyin, Indawgyi Lake WS., 24°58'22.50" N, 96°22'45.90" E, alt. 753 m, 7 December 2016, lvs., *S. Tagane*, *H. Nagamasu*, *N. Okabe*, *Mu Mu Aung, Kyaw Yunn Mi & A.K. Win MY1147* (**FU**!);– *ibid.*, Naungmung, between Pannadim village and Shingsankhu rest house, Hkakaborazi NP., 27°42'15.2" N, 97°52'40.4" E, 6 November 2015, fl., *K. Armstrong*, *Damon Little*, *Myint San*, *Zaw Naing Tun*, *Pyi Soe Aung, A.Syn & A. Bai 1280* (**NY**02649006†).;– *ibid.*, 27°39'05.5" N, 98°09'23.8" E, 30 October 2015, fl., *K. Armstrong*, *Damon Little*, *Myint San*, *Zaw Naing Tun*, *Pyi Soe Aung. A. Syn & A. Bai 1131* (**NY**02648772†); – **Shan**, Keng Tung, Valley of the Meh Len, alt. 535-690 m, 27 January 1922, fr., *J.F. Rock 2098* (**US**1213023†), excluding the sterile compound leaves belong to *Nephelium hypoleucum*. **THAILAND**. **Central, Nakhon Nayok**: Mueang, Khao Yai NP.: 14°26'49.7" N, 101°22'18.9" E, alt. 1,400 m, 11 September 2002, fr., *J.F. Maxwell 95-206* (**CMUB**!);– *ibid.*, 14°26'N, 101°22'E, alt. 760 m, 16 September 2002, fl., *P. Charoenchai 732* (**BKF**153056!, **CMUB**xx717!, **L**4182886†);– *ibid.*, 14°25'57", 101°22'30", alt. 750 m, 11 September 2002, fl., *J.F. Maxwell 02-352* (**BKF**139869!, **L**4183725-6!);– *ibid.*, 14°26'49.7" N, 101°22'18.9" E, alt. 746 m, 16 September 2002, fl., *P. Charoenchai & S. Poompuang 315* (**BK**263116!, **CMUB**26165!);– *ibid.*, 14°26'49.7" N, 101°22'18.9" E, 24 January 2004, fr., *Boonkongchat A. 316* (**CMUB**23445, **L**4183110–1†);– *ibid.*, 14°26'15" N, 101°22'20" E, 2 December 1994, fr., *T. Smitinand*, *s.n.* (**BKF**170330!);– *ibid.*, Mo Singto area, 14°26'N, 101°22'E, alt. 780 m, 30 January 1995, fr., *W.Y. Brockelman 17* (**CMUB**!, **L**4184628†);– *ibid.*, 14°26'00" N, 101°22'30" E, alt. 750 m, 28 November 2005, fr., *S. Suddee, H.A. Pederson*, *S. Watthana & C. Hemrat 2673* (**BKF**!);– **Prachin Buri**: Khao Yai NP., 14°26'17" N, 101°21'48" E, alt. 750 m, 27 March 1998, fl., *T. Wongprasert*, *s.n.* (**BKF**121067!);– **Eastern, Chantaburi**: Khao Soi Dao, Khao Soi Dao WS., 13°04'48.10" N, 102°10'13.70" E, alt. 600 m, 19 May 2013, lvs., *S. Tagane*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *N. Wachi*, *W. Kiewbang & P. Pansamrong T1726* (**FU**!);– **Northeastern, Loei**: Phu Ruea, Tha Sala, Phu Laung WS., 17°16'51" N, 101°31'01" E, alt. 1,451 m, 28 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR170* (**BKF**229992!, **TCD**!);– **Northern, Chiang Mai**: Pang Tawn, 19°40'00.0" N, 98°00'00.0" E, 1 May 1981, fl., *N. Put 3857* (**BKF**!, **K**!, **L**1892537†);– *ibid.*, Doi Suthep-Pui NP., 18°50'19.57" N, 98°53'45.99" E, alt. 1,323 m, 12 April 1912, fr., *A.F.G. Kerr 254*0 (**K**0000737347-8!); 18°45'N, 99°00'E, alt. 1,600 m, 2 September 1979, lvs., *P. Suvarnakoses 25* (**BKF**011589!);– *ibid.*, Sameung, Doi Mawn Angget: 19°04'06.1" N, 98°38'18.9" E, alt. 1,300 m, 9 October 1998, fl., *J.F. Maxwell 98-1075* (**BKF**123248!,

CMUB14731!, **L**1892532-3†, **L**41831111†, **L**0460282–3!);– *ibid.*, Doi Lohn, Mae Cham Bawng, 18°30'55” N, 98°27'21” E, alt. 1,025 m, 24 October 1996, fl., *J.F. Maxwell 96-1409* (**BKF**108724!, **CMUB**09902!);– *ibid.*, Chiang dao, Mae Taman, 19°19'06.2” N, 98°49'48.2” E, alt. 1,000 m, 4 October 1994, fr., *W. Nanakorn 1995* (**QBG**1995!);– *ibid.*, Mae Rim, **QBG**, 18°53'14” N, 98°51'36” E, alt. 700 m, 9 February 1987, fr., *R. Pooma 15* (**BKF**049598!);– *ibid.*, Mae Taeng, the trail from Mae Sae to Bong Duat hot springs, 19°20'00.0” N, 98°40'00.0” E, 14 October 1990, fl., *J.F. Maxwell 90-1162* (**L**4207738†);– *ibid.*, Mae Rim, Botanic Garden, 18°53'14” N, 98°51'36” E, alt. 400 m, 4 November 1993, fr., *W. Nanakorn 88* (**QBG**088!);– *ibid.*, Chiang Dao, near Huay Mar Gawk station, Doi Chiang Dao WS., 19°22'27” N, 98°50'50” E, alt. 1,400 m, 4 March 1995, fr., *J.F. Maxwell 95-206* (**BKF**089638!, **CMUB**05853!, **L**4195155†);– *ibid.*, Mae Chaem, Doi Inthanon NP.: 18°30'30” N, 98°30'38” E, alt. 1,300 m, 26 April 1994, fr., *J.F. Maxwell 94-551* (**BKF**188895!, **CMUB**04608!, **L**4207736†);– *ibid.*, 18°32'26.7” N, 98°31'48.4” E, alt. 1,200 m, 17 September 1989, fl., *R. Pooma 352* (**BKF**049599!, **CMUB**06668!);– *ibid.*, 18°31'25.65” N, 99°27'21.00” E, alt. 1,074 m, 19 November 2012, fl., *S. Tagane T1408* (**BKF**216463!, **FU**!);– *ibid.*, Mueang, Doi Suthep-Pui NP.: 18°50'34” N, 98°53'54” E, alt. 1,375 m, 15 November 1988, fl., *J.F. Maxwell 88-1322* (**BKF**049569!, **L**1892567†);– *ibid.*, 18°50’19.57” N, 98°53’45.99” E, alt. 1,200 m, 6 March 1959, fl., *Th. Sorensen*, *K. Larsen & B. Hansen 7069* (**K**!);– *ibid.*, 18°48'17.6” N, 98°54'11.2” E, alt. 1,200 m, 9 January 1988, fr., *J.F. Maxwell 88-29* (**L**1892568†);– *ibid.*, 18°47'28” N, 98°55'58” E, alt. 1,200 m, 1 January 1988, fr., *J.F. Maxwell 88-349* (**BKF**049571!, **L**0706823†, **L**1892555†);– *ibid.*, 18°48'17.6” N, 98°54'11.2” E, alt. 1,030 m, 26 December 1994, fr., *S. Kopachon S025b1* (**CMUB**07876!);– *ibid.*, at Park headquarter,18°48'16” N, 98°55'25” E, alt. 1,000 m, 18 April 1995, fl., *S. Gardner 8* (**BKF**089589!, **L**4195140†);– *ibid.*, Chang Khian village, 18°50'22” N, 98°53'49” E, alt. 1,375 m, 23 March 1991, fr., *J.F. Maxwell 91-295* (**BKF**090724!, **E**00991976!, **L**4207722†);– *Chiang Rai*: 20°17'14” N, 99°48'34” E, alt. 1,200 m, 12 September 1990, fl., *T. Smitinand 90-249* (**BKF**049578!);– *ibid.*, Mae Sai, between Ta Kaw and Meh Soi, 4 January 1922, fr., *J.F. Rock 1684* (**E**00991977!, **K**!, **P**03358561!);– **Lampang**: 16°53'17” N, 101°46'47” E, 10 April 1975, fr., *s.coll.*, *s.n.* (**BKF**!);– *ibid.*, Mueang Pan, Chae Son NP., 18°49'53” N, 99°23'17” E, alt. 1,500 m, 7 February 2004, fr., *J.F. Maxwell 04-53* (**BKF**176601!, **CMUB**2322!);– *ibid.*, Doi Saket, Mueang phan, Jae Son NP., 18°51'58” N, 99°19'24” E, alt. 1,225 m, 2 November 1996, fl., *J.F. Maxwell 96-1472* (**BKF**111789!, **CMUB**09821!, **L**4207864†);– **Nan**: Pua, Doi Phu Kha NP., 19°12'02” N, 101°05'02” E, alt. 1,313 m, 24 March 2019, lvs., *S. Rueangruea*, *M. Poopath & S. Jirakorn SR155* (**BKF**229999!, **TCD**!);– *ibid.*, Tha Wang Pha, Doi Tiu, 19°04’N, 100°40’E, alt. 1,000 m, 14 November 1993, fl. & fr., *S.S. Larsen 44318* (**BKF**!, **K**!);– **Pha-Yao**: Pong, Phu Lung Ka, 19°23'18.2” N, 100°27'15.9” E, alt. 80 m, 25 June 1954, fl., *T. Smitinand 9596* (**BKF**!, **K**!);– *ibid.*, **Pha-Yao**: Pong, Phu Lung Ka, 25 June 1954, fl., *T. Smitinand 1650* (**K**!);– *ibid.*, **Phitsanulok**: Nakhin Thai, Thung Salaeng Luang NP., 16°50'35” N, 100°52'41” E, alt. 60 m, 12 February 1966, fr., *T. Smitinand*, *s.n.* (**BKF**116142!). **VIETNAM**. **Annam, Bachma**: alt. 1,400 m, 21 August 1943, fl., *J.E.Vidal 26* (**P**01819008-9!);– **Djiring**: Long-Bian, 21 February 1914, fl., *A.J.B. Chevalier 31264* (**L**†, **P**01819005–

7!);– **Gia Lai**: Mang Yang, Kon Ka Kinh, 14°05'18.6” N, 108°24'34.0” E, alt. 991 m, 24 April 2019, fl., *T. Yahara*, *S. Tagane*, *A. Nagahama*, *N. Komada*, *H.V. Thanh*, *N.C. Thinh V11040* (**FU**!);–**Ha Tinh**: Huong Son, Nga Doi, Ba Mu, 18°30'00.0” N, 105°13'00.0” E, 30 May 2001, fl., *T.N. Ninh*, *P.H. Hoang & N.D. Anh 11393* (**L**0809610-2†);– **Kon Tum**: Takka, Dekto, 13 March 1941, fr., *E. Poilane 32308* (**L**1892554†, **P**03358551!);– *ibid.*, Dak Gley, alt. 1,000 m, 15 January 1947*, E. Poilane 32701* (**P**04166065-6!);– *ibid.*, Ngoc Linh, Ngoc Linh Nature Reserve, 15°12'35.52” N, 107°46'17.7” E, alt. 1,429 m, 15 February 2017, fr., *S. Tagane*, *H. Nagamasu*, *N.V. Ngoc*, *H.T. Binh*, *H.T. Son*, *C.J. Yang & A. Kawakubo V6705* (**BKF**!, **FU**!);– **Lam Dong**: Haut Donai, Station agricole de Blao, alt. 800 m, 25 June 1933, fl., *E. Poilane 22737* (**E**00991982!, **P**03358514!);– *ibid.*, 30 July 1961, fl., *M. Schmid*, *s.n.* (**L**1892545†**, P**03358512**!**);– Kon Chu Rang NR., 14°28'27.2” N, 108°32'25.5” E, alt. 890 m, 24 April 2019, fr., *T. Yahara*, *S. Tagane*, *A. Nagahama*, *N. Komada*, *H.V. Thanh*, *N.C. Thinh V10443* (**FU**!);– **Ninh Binh**, Cuc Phoung NP, 22°15'13"N, 105°42'90"E, alt. 870 m, 6 August 1999, *N.M. Coung 381* (**L**419723†);– **Thua Thien**: Hue, Nui Bach Ma station, 18 December 1940, fr., *E. Poilane 31214* (**E**00991974!, **L**1892546-7†, **P**03358552!);– **Tonkin, Lao Cai**, Pho Lu, 28 March 1936, *E. Poilane 25431* (**P**!);– **Sapa**, alt. 1,500 m, August 1930, fl., *P.A. Pételot 6161* (**VNM**!);– **Dam Ha**: Sai Wong Mo Shan, Lomg Ngong village, 18 August 1940, fr., *W.T. Tsang 303087* (**A**†, **K**!);– **Ha Coi**: Chuk Phai, November, fl., *W.T. Tsang 6891* (**K**!);– **Kom Tum**: Dak Gley, *C.* 10 km to North Dak Gley town, 19 November 1995, fl., *L. Averyanov*, *N.T. Ban*, *A. Budantzev*, *L. Budeantzev*, *N.T. Hiep*, *D.D. Huyen*, *P.K. Loc & G. Ykovlev VH1817* (**P**03358591!);– **Lai Chau**: Tam Duong, Fan Si Pan, Hoang Lien NP., 22°17'01.8” N, 103°55'33.3” E, alt. 870 m, 29 April 2016, lvs., *T. Yahara*, *H. Toyama*, *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *V.N. Nguyên*, *T.B. Hoang & T.S. Hoang V4716* (**BKF**!, **FU**!);– **Thai Binh**: Xoan-Dao, Pho-Ba-Che, 21°15'35.1” N, 107°17'50.2” E, October *s.n.*, fl., *Merr. 4029* (**A**†).

Distribution.**—** Temperate Himalaya, Assam (Pakistan, E. (Sylhet), Bhutan); India, N.E. (Sikkim, W. Bengal); China, S. (Szechwan, Kweichow, Yunnan, Kwangsi, Kwangtung, Hongkong, Hainan); Myanmar; Thailand; Laos; Cambodia, and Vietnam (**Maps 4.46 & 4.49**).

Etymology.— The epithet "indochinensis" refers to the collecting locality in the Indo-Chinesefloristic region.

Vernacular name.**— China**: Yun nan guo mu. **Thailand**: แตงชั่ง Taeng chang (Lampang), นูดต้น Nuut ton (Central).

Ecology.**—** Evergreen Forest, Dry Seasonal Evergreen Forest, Mixed Deciduous Forest, and Lower Montane Forest, 0–2,000 m. (msl.), especially between alt. 900–1,500 m.

Phenology.**—** Flowering: September–June. Fruiting: January–August.

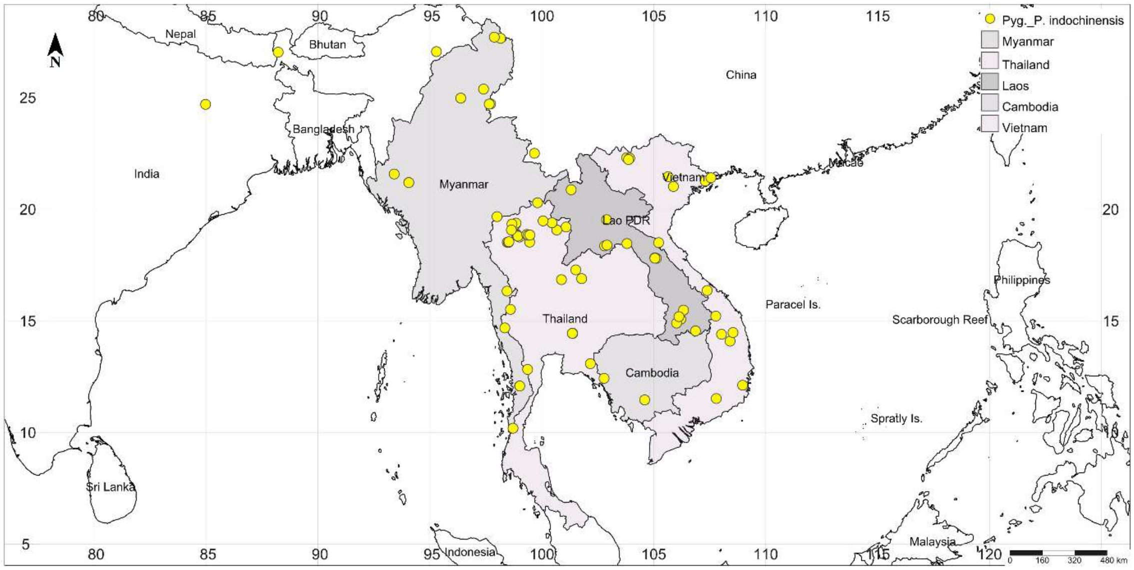
Uses.— Some collections mentioned wood reddish local use of the timber.

Conservation.—This species is known from many locations (> 10 locations): EOO = 1,273,771.58 km^2; AOO = 128.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman (1965) also stated that the material of *Pygeum montanum* and several taxa belonged to *Prunus arborea* as *Prunus arborea* var. *montana* because they have only minor differences, *e.g*., in shape and indumentum of the leaves. However, *Prunus arborea* var. *montana* (*P. indochinensis*) is easily separated from *Prunus arborea* by its mature leaves that are tomentose abaxially (vs. mature leaves usually glabrescent to glabrous abaxially), basal leaf glands protruding and hollowed abaxially (vs. basal leaf glands ordinary absent, obscured or flat, not concave abaxially), endocarp glabrescent or glabrous inside (vs. endocarp densely pubescent inside), seedcoat glabrous (vs. seedcoat densely tomentose). Moreover, the distributions are significantly different, occurring in separate floristic regions *P. indochinensis is* mainly found in the Indo-Burma and Indo-Chinese regions, reaching the upper part of Southern Thailand (vs. *Prunus arborea* occurring in the lower part of Southern Thailand, Malaysia, Sumatra, Borneo, through Australia) (**Map 4.46**). I herein elevate *Prunus arborea* var. *montana* to species level as *Prunus indochinensis*.

Since the seedcoat's hairiness is a constant character in almost all species of the genus, Kalkman only reluctantly united a variety of specimens with hairy and glabrous seeds in *Prunus arborea*. As a hairy seedcoat is found in *'Pygeum topengii'*, this species should be separated. '*Pygeum laxiflorum'* specimens have typical, glabrous seeds, and I separated them as *Prunus lanceifolia*. This variety is related to *Prunus arborea* var. *stipulacea*, *sensu. auct.* Kalkman, the main, and admittedly not entirely sharp, the difference is found in the stipules' shape, dimensions, and persistence. The two varieties also differ in their seedcoats, but not consistently. Characteristically, the leaves are hairy (but sometimes glabrous) in var. *stipulacea,* allowing separation from *Prunus ridleyi* J.Wen. There is also a close relationship between *P. arborea* var. *densa*. It was divided into *P. kalkmanii* J.Wen. Still (Wen & Potter, in press). For more information, see the individual species descriptions and notes.

Figure 4.36. *Prunus indochinensis* (Hook.f.) Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters; A, outer and inner bark; **B**–**F**, leaves; **B**, young shoot; **C**, mature leaves adaxial; **D**, alternate, pale green abaxial; **E**, basal glands 2, oblong, protruding; **F**, stipules, densely hairy, margin glandular; **G–I**, inflorescence; **G**, in the axil of leaf and on the fallen leaves branch; **H**, fasciculate in bundles of 2–5(–10) racemes; **I**, perianth; **J**–**L**, infructescence; **J**, young fruits green; **K,** fruits densely to sparsely hairy; **L**, mature fruit, transverse ellipsoid, turning black when ripe; **M**–**O**, section, endocarp, and seedcoat glabrous; **M**, a cross-section of ripe fruit; **N**, longitudinal section of young fruit; **O**, a cross-section of mature fruit. — Photos: A–F, J–M by S. Rueangruea; G–I by Em Son; N & O by T. Thananthaisong. — Sources: **China**, Yunnan, N from *T. Smitinand et al. 1055*: **Laos**, Champasak, B F L M from *P. Souladeth et al. L3298*: **Thailand**, Chiang Mai, O from *Maxwell 94-551*; Loei, C D, E, from, *S. Rueangurea et al. SR170*; Petchaboon A J–K: **Vietnam**, Lai Chau, G–I by Em Son: Scale bar = 1 cm.



Map 4.49. Distribution of *Prunus indochinensis* (Hook.f.) Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia and nearby.

46. ***Prunus lanceifolia* (Merr.) Rueangr., J.Parn. & Hodk.** ***nom. nov. comb. nov., ined.***

Type as the basionym below.

≡ *Pygeum laxiflorum sensu auct.* Kalkman, Merr. ex H.L.Li, in A.C.Sm. et al. Journal of the Arnold Arboretum. 26: 64. 1945. (excluding *Prunus laxiflora* Kit., Linnaea; Ein Journal für die Botanik in ihrem ganzen Umfange. 32(4–5): 602. 1864, *nom. nud*., and *Prunus laxiflora* Koehne, Plantae Wilsonianae. 1(1): 70. 1911. *pro parte*, *quoad*, *W.T. Tsang 24375*)

Typification: **China: Kwang Tung**, a tree, 9 m tall, in light woods, flower white, 21 July 1937, Shin Wan Tai Shan, *Liang H.Y*. 69816; **Kwangsi**, Shang-sze District, Shin Wan Tai Shan, Tang Lung Village, a tree 20 ft high, flower white fragrant, 28 September 1934, *W.T. Tsang 24375* (Type). **Indo-China: VIETNAM,** Tonkin, Northeastern of Mon-cay, Pac-si and the vicinity, small tree 20 ft high, reasonably common in thickets, in dry clay soil, fruits black, 27–30 September 1936, *W.T. Tsang* 26891. **Ha-coi**, Chuk-phai, Taai Wong Mo Shan and the vicinity, 23–31 October 1936, *W.T. Tsang* 27088; a tree 25–35 ft high, reasonably common in thickets, fruits black, *W.T. Tsang 2722*1.

Typification, — *W.T. Tsang 24375* (**A**00032441†), no isotype seen; lectotype *69816* (**A**†); *26891* (**A**†**, P**!); *27088* (**A**†), *27221* (**P**!), designated by Kalkman in *op. cit.*, 13(1): 99. 1965.

Second step lectotypification, — *W.T. Tsang 24375* (lectotype **A**00032441†, isolectotypes **F**0068346†, **MO**-255108†, **NY**00415945†), designated here.

Description: Evergreen, sub-canopy, small tree to tree 7–20 m tall, canopy shape oval or globose. **Stem** clear bole, erect; outer bark dark grey, smooth, spines absent; *inner bark* with a faint almond smell. **Branchlets** stout, blackish-brown to dark purplish-brown, with prominent lenticels;

young twigs greenish-brown, pubescent with dense brown hairs, cataphylls absent; old twigs glabrescent with sparse prominent whitish-brown lenticels. *Axillary winter bud* solitary, ovoid, 2–4 mm, brown pubescent, apex obtuse to acute; *terminal winter bud* absent. **Leaves** plicate in the bud, alternate, ovate-lanceolate to lanceolate, 7–10 cm long × 2–3.5 cm wide; *lamina apex* acuminate, angle acute; *margin* entire, sparsely ciliate, or glabrescent; *base* asymmetrical or symmetrical, acute, concavo-convex to broadly acute; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous to subcoriaceous; sparsely tomentose on both sides, margins slightly ciliate; old leaves sparsely tomentose on both sides, margins slightly ciliate, glabrescent to glabrous adaxially, glabrescent or sparsely hairy abaxially; *basal glands* usually 2(0–1), up to 1.5 mm long, eglandular or the glands obscure and not at all protruding, except in very young leaves, oblong or ovate shape, in the basal part, parallel along midrib, sparse small circular glands near the margins from upper half to apex; *2° venation* weaky brochidodromous, 6–8 alternate on either side of the midrib, oblique, ascending, spacing irregular, sunken adaxially, prominent abaxially, very narrow angle (25–30°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles* 0.6–1 cm long, stout, shallowly canaliculate in cross-section or terete, glabrous or sparsely pubescent; *petiolar glands* absent. **Stipules** medium to large, 6–10 mm long × 1.5–2 mm wide, linear or oblong, apex acute or obtuse, margin entire, ciliate to glabrescent with glands, base oblong, sparsely pubescent to glabrescent, without glands or with marginal glands, early caducous. **Inflorescences** compound, fasciculate in bundles of 2–3, sometimes solitary, lax-flowered, (mainly) on the branches with fallen leaves or in the axils of leaves, 3–5 cm long, many-flowered, densely brown tomentose; *bracts* 2–5, 3–5 mm long, size and shape variable, oblong, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white; pedicels slender, 1.5–4 mm long, brown tomentose to glabrescent; *bracteoles* linear, 1–1.5 mm long, pale green, densely brown hairy, early caducous; *hypanthium* campanulate to obconic, 1.5–2 mm long, densely brown hairy; *perianth* petals slightly different from calyx lobes, 5-toothed, 0.8–1.2 mm long, hairy both side and margin ciliate; *calyx* lobes 5–6, triangular, minute, green, 1–1.5 mm long × 0.5–0.7 mm wide, subequal, apex acute to acuminate, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, pubescent outside and inside; *corolla* petals slightly different to or indistinguishable from sepals, whitish-brown, spreading to upright, 5–6 (as many as sepals), small, 1–1.5 mm long × 0.5–0.8 mm wide, equal or subequal, as long as or slightly longer than calyx lobes, oblong, ovate-lanceolate or triangular, sessile, apex acute to obtuse, margin entire, ciliate, base oblong, or truncate, alternate with calyx lobes, tomentose outside, tomentose inside; *stamens* 15–20 in 1 to 3 series, exserted, more prolonged than perianth; filament filiform, white, 4–6 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* glabrous, 1 locular; *style* filiform, slender, 2–3 mm long, shorter than stamens, glabrous or hairy at base. *Infructescence* 3–5 cm long, sparsely pubescent to glabrous, few, 1–4 fruited. **Fruits** fleshy, young fruit green, turning dark purple when ripe, compressed ovoid-globose to transversely shortly oblong, 0.7–1 cm long, 0.9–1.2 cm wide, apex retuse or obtuse; young fruits glabrous; mature fruits glabrescent; exocarp smooth and shiny, with a longitudinal groove, black when ripe (via yellow or red); mesocarp fleshy, thin, white, smelling of bitter almonds; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged, glabrous, more rarely hairy; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually laterally transversely globose, thick, glabrous, and shallowly rugose testa.

Additional specimens examined.— **VIETNAM**. **Tonkin**: Dam Ha, Sai Wong Mo Shan Lomg Ngong village, 18 July 1940, fl., *W.T. Tsang 30387* (**E**00991987!, **K**!, **L**1892540†);– Ha Coi, Chuk Phai, November 1936, fr., *W.T. Tsang 27221* (**A**†, **K**!, **P**03358558!);– *ibid.*, Kwangtung and Tonkin border, 23 October 1936, fr., *W.T. Tsang 27088* (**K**!, **P**03358557!);– **Mon-cay**: Pac-si and vicinity, 21°20'30.5" N, 106°58'13.5" E, 27–30 September 1936, fr., *W.T. Tsang 26891* (**K**!, **P**03358556!).

Distribution.— Known only from the specimens cited (**Maps 4.29 & 4.50**).

Etymology.— The epithet '*lanceifolia*' refers to its narrow leaf.

Vernacular name. **— China**: ChinaShu hua tun guo mu.

Ecology.**—** Evergreen Forest to Lower Montane Forest, near streams, foothills, alt. 1,200–1,600 m.

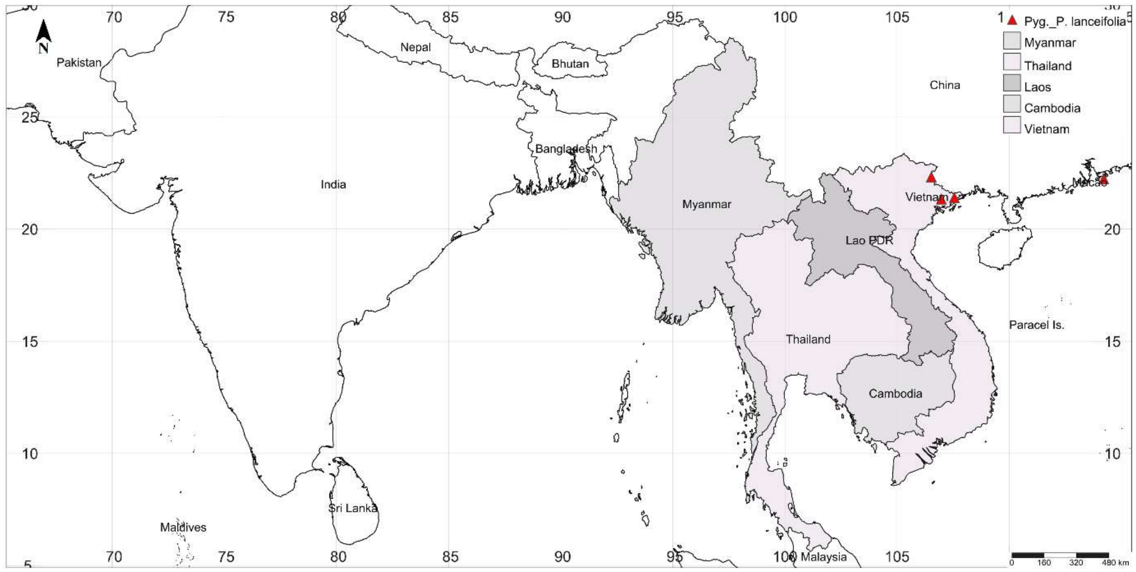
Phenology.**—** Flowering: July–September. Fruiting: September–December.

Uses.— Not known.

Conservation.— This species is known from more than five but ≤ 10 locations, EOO = 14,191.11 km^2; AOO = 12.00 km^2. The number of individuals in each subpopulation is ≤ 1,000. I consider the conservation status of the species currently to be VU (Vulnerable); B1B2aC2a(i)D2 (IUCN, 2019).

Note. — Kalkman (1965, 1993) treated *Pygeum laxiflorum* as a synonym of *Prunus arborea* var. *montana*. We herein elevate it as an individual species, *Prunus indochinensis,* as mentioned above. Moreover, the morphological characteristics support *Pygeum laxiflorum* being distinguished from typical *P. indochinensis.* We herein recognize it at the individual species level. Because the name "*Prunus laxiflora*" is already occupied, We use *Prunus lanceifolia* as the new name: the epithet 'lanceifolia' refers to its narrow leaf.

Prunus lanceifolia is most similar to *P. indochinensis* in leaves having pubescent abaxially, racemes 2–6 in bundles, endocarp, and seedcoat are glabrous inside. However, *P. lanceifolia* is distinguished from *P. indochinensis* by having leaf glabrous abaxially (vs. tomentose axially), margin glabrous (vs. margin densely ciliate), leaves ovate-lanceolate or lanceolate (vs. ovate to ovate-lanceolate, oblong-lanceolate to elliptic-oblong), narrow, up to 3.5 cm wide (vs. broad, 3.5–7 cm wide), basal leaf glands flat, slightly hollowed, or absent in all leaves (vs. basal leaf glands distinctly and deeply hollowed), ovary glabrous (vs. ovary densely villose).



Map 4.50. Distribution of *Prunus lanceifolia* (Merr.) Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia.

47. ***Prunus arborea* (Blume) Kalkman** in Blumea 13: 90. 1965. Kalkman, The Old World species of *Prunus* subgen. *Laurocerasus*, including those formerly called *Pygeum*: 94–96, fig. 34: 94. 1965; Prance & Whitmore, in Tree Flora of Malaya 2: 338. 1973; Kalkman, in Flora Malesiana. Series 1. Spermatophyta 11(2): 329, fig. 18: 330. 1993. Typification: as for below.

≡ *Polydontia arborea* Blume, Bijdragen tot de flora van Nederlandsch Indië. 17: 1105. 1826. Typification**: INDONESIA, Java** in the woods and mountain regions of West Java, cited as "Kitumbilah" *Blume 654* (lectotype **L**0019541†, sheet no. 908,196–179, designated by Kalkman, 1965), isolectotypes probably also in **BO** (*non vidi*), **L**0019542†, **U**0094806†),

≡ *Polystorthia arboreum* (Blume) Hassk., in Hoeven Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. 11: 226. 1844, *non. vidi.*

≡ *Pygeum arboreum* (Blume) Blume, in Mel. Bot nr. 2: 11. 1855, see Taxon 35: 272–285, Van Steenis (1986) states *Pygeum arboreum* does not have (Blume) Endl. ex C. Muell. in Walp. as the author but (Blume) Blume; Endlicher, Gen. Pl. (1840) already reduced *Polydontia* to *Pygeum* but did not make the specific combination.

≡ *Pygeum blumei* Teijsm. & Binn., Catalogus Plantarum quae in Horto Botanico Bogoriensi Coluntur.: 252. 1866, *nom. superfl.*

Typification. **INDONESIA**, **Java**, *Blume 654* (holotype L0019541†; isotype L0019542†).

≡ *Pygeum blumei* Teijsm. & Binn. ex Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 200. 1914.

= *Pygeum parviflorum* Teijsm. & Binn. in Natuurkundig Tijdschrift voor Nederlandsch-Indië. Jakarta. 2: 309. 1851; Teijsm. & Binn, Nederlandsch Kruidkundig Archief. Verslagen en Mededelingen der Nederlandsche Botanische Vereeniging. 3: 412. 1855.

Typification. **INDONESIA, Java**, cultivated, *Teijsmann & Binnendijk*, *s.n.* (holotype **L**0019540†; isotype **K**000737318!).

= *Digaster sumatranus* Miq., Flora van Nederlandsch Indie, Eerste Bijvoegsel. 2: 330. 1861.

≡ *Pygeum sumatranum* (Miq.) Miq., Flora van Nederlandsch Indie, Eerste Bijvoegsel. 3: 619. 1861.

Typification: **INDONESIA, Sumatra oriental**, Palembang, Kebu-lahat, Angkola, *Teijsmann HB 3968* (lectotype **U**0005868†, designated by Kalkman, 1965; isolectotype **GH**00026463†).

= *Pygeum junghuhnii* Koehne in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 193. 1913.

Typification: **INDONESIA, Sumatra**, Sumatera Utara, Angkola, Hochankola, *Junghuhn F.W.*, *s.n.* (lectotype **L**0019537†; isolectotype **U**0123352†), designated by Kalkman, Blumea 13(1): 99. 1965.

= *Pygeum floribundum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 51(2): 190. 1913. Typification: as for the basionym below.

≡ *Pygeum intermedium* King, Journal of the Asiatic Society of Bengal. Part 2. Natural History. 66: 288. 1897, *pro parte*, *quoad*, *Maigay 626*.

Typification**: MALAYSIA, Malacca**, *Maingay 626* (holotype CAL, *non vidi*; isotypes **BM**000622068†, **GH**00032460†, **K**000737283!, **K**000737285!).

= *Pygeum pilinospermum* Koehne, in Engl. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 52(4–5): 342. 1915.

Typification: **PAPUA NEW GUINEA**, Kaiser Wilhelmsland, Sepik, 10 m, flowering, 22 March 1912, *C.L. Ledermann 6718* holotype in **B** (lost), (lectotype **K**000737357! designated by Kalkman, 1965; isolectotypes **E**!, **SING**0068724†); lectoparatype, *ibid.*, 50–100 m alt. 3 July 1912, fruiting, *C.L. Ledermann 7762* (**K**000737356!), designated by Kalkman in *op. cit.*, 13(1): 99. 1965.

Description: Evergreen, sub-canopy, tree up to 35 m tall, canopy shape globose. **Stem** clear bole; outer bark greyish-red brown, smooth, spines absent; inner bark, reddish-brown, faint almond smell. **Branchlets** stout, blackish-brown with prominent lenticels; young twigs greenish-brown, with young twigs densely pubescent, cataphylls absent; old twigs sparsely hairy to glabrescent. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic or ovate, 6–20 cm long × 2–7.5 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* entire, glabrescent or sparsely ciliate; *base* asymmetrical or symmetrical, rounded or broad-cuneate, dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous to sub-coriaceous; densely pubescent;

old leaves densely pubescent, early glabrescent adaxially, sparsely tomentose abaxially; *basal glands* present or absent, usually 2 (–4), sometimes only 1(–0), small, up to 1.5 mm long, circular or ovate, hollowed or slightly excavated on the underside, not protruding adaxially, in the basal part of leaf blade, additional sparse small circular glands near the margins from upper half to apex; *2° venation* weaky brochidodromous, 7–12 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles*, 0.8–1.5 cm long, stout, shallowly canaliculate in cross-section or terete, pubescent to glabrescent; *petiolar glands* absent. **Stipules** medium, 1.5–6 (–8) mm long × 1–4 mm wide, narrowly triangular to linear, apex acuminate, margin entire, ciliate to glabrescent, base truncate, sparsely pubescent to glabrescent outside, appressed hairs inside, early caducous. **Inflorescences** compound, fasciculate in bundles of 2–5(–10) racemes, lax-flowered, (mainly) on the branches with fallen leaves, occasionally on axils of leaves, 2–6 cm long, 12–25 flowered, pubescent to glabrescent; *bracts* 1–3, 0.6–0.8 mm long, size and shape variable, triangular to oblong, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white, pedicellate, slender, (1)2–3.5(–6) mm long, brown tomentose; *bracteoles* linear, 0.7–1.5 mm long, pale green, sparsely brown hairy, early caducous; *hypanthium* campanulate, 1–2.3 mm long, densely brown hairy outside; *perianth* segments 9–10, subequal, only rarely more or less regularly divided into sepals and petals, but the 2 whorls never very different, obscurely 10-lobed, 0.5–1.1 mm long, 0.5–-0.6 mm wide, hairy both side and margin ciliate; *calyx* lobes perianth segments 6–12, or sepals and petals more or less distinct from one another, the petals being slightly longer and thiner, triangular, minute, green, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, apex acute, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, pubescent outside and inside; *corolla* petals slightly different or indistinguishable from sepals, whitish-brown, spreading to upright, 5 (–0) -merous or perianth, small, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, petals not distinct from calyx lobes, or in one ± different whorl, ovate-lanceolate or oblong, sessile, apex acute, margin entire, ciliate, base truncate, alternate with calyx lobes, tomentose outside and inside; *stamens* 20–30(–40) in 1 to 3 series, exserted, more prolonged than perianth; filament filiform, white, 3–5.5 mm long, glabrous; anthers oblong-oval, 0.5–1 mm long; *ovary* usually densely hairy, 1 locular; *style* filiform, slender, 3.5–5 mm long, longer than stamens, glabrescent to hairy; stigma gland not divided, globose, green. *Infructescence* 1–4.5 cm long, densely hairy to glabrescent, few, 1–6 fruited. **Fruits** fleshy, stipitate, 1–5 mm long, young fruit green, turning dark purple when mature or ripe, transversely ellipsoid to didymous, 0.5–1.1 cm long, 0.7–1.5 cm wide, apex retuse or obtuse; young fruits tomentose; mature fruits glabrescent; exocarp smooth and shiny, with a longitudinal groove; mesocarp fleshy, thin, white; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged, pubescent inside; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** are usually transversely globose laterally, thick, with glabrous shallowly rugose testa, seedcoat densely hairy, rarely sparsely so (**Figure 4.37**).

Additional specimens examined.— **INDONESIA**. Gn. Gede Pangorango, 6°44'31.79"S, 107°00'32.93" E, 25 September 2011, fl., *T. Yahara*, *H. Nagamasu*, *A. Naiki*, *R. Ichihashi*, *A. Hidayat*, *A. Sadili*, *M. Ardiyani & D. Darnaedi IJ13* (**BKF**!, **FU**!);– *s.d.*, fl., *S.coll.*, *s.n.* (**U**0094806†);– **Bogor**: W. Sumbawa, 5 November 1961, fl., *A. Kostermans 19175* (**P**03144259!);– **Java**: February 1867, fl., *S.coll.*, *s.n.* (**K**!);– Java South West, Udjung Kulon Nature reserve, Pajung Mt, 8 January 1964, fl., *N. Wirawan 241* (**KYO**!);– Java West, Gede Pangorango NP., 06°44'50.56"S, 106°59'42.12" E, alt. 1,571 m, 3 October 2011, lvs., *T. Yahara*, *H. Nagamasu*, *A. Naiki*, *H. Toyama*, *R. Ichihashi*, *A. Hidayat*, *A. Sadili*, *M. Ardiyani & D. Darnaedi IJ859* (**FU**!);– Java West, Halimun Natonal Park, 06°44'35.9"S, 106°31'39.1" E, alt. 1,280 m, 18 October 2011, lvs., *S. Tagane & A. Salidi IJ1255* (**FU**!*)*;– *ibid.*, lvs., *S. Tagane & A. Salidi IJ1291* (**FU**!);– *ibid.*, Sakabumi, Cicurug, Salak, November *s.n.*, fl., *C.L. Blume 654* (**L**†);– **Kalimantan**: Bekala, Kayan mentarang NP., 2°51'55.1" N, 115°22'35.0" E, alt. 500 m, 27 March 2002, fl., *M. Koizumi 235* (**KYO**!);– **Moluccas**: Bacan, Amasing Hill, 0°31'47.1"S, 127°28'26.4" E, alt. 100 m, 4 November 1974, fl., *E.F. de Vogel 3848* (**KYO**!);– **Sulawesi**: Soroako, 2°15'S, 121°45'E, alt. 500 m, 2 July 1979, fl., *M. Van Balgooy 3842* (**KYO**!);– *ibid.*, Pinang, Gadut, Padang, 00°53'56.4"S, 100°31'55.4" E, alt. 1,820 m, 9 August 2014, fr., *Fujii S.*, *S. Tagane & H. Kanemitsu IS87*0 (**FU**!);– *ibid.*, Selatan, 2°20'S, 121°28'E, alt. 400 m, 10 December 1979, fl., *E.F. de Vogel 6207* (**KYO**);– *ibid.*, Solok Air Sirah, 0°43'38.7"S, 100°40'36.3" E, alt. 1,100 m, 3 March 1996, fl. & fr., *Okada*, *H. Nagamasu*, *T. Fukuhara & Y. Mori 6084* (**KYO**!);– *ibid.*, Sumetera selatan, Palemb, November *s.y.*, fr., *s.coll. HB3968* (**U**†);– *ibid.*, February *s.y.*, fl., *J.E. Teysmann*, *s.n.* (**K**!);– *ibid.*, Hochankola, Sumatera, Utara, November *s.n.*, fr., *Junghuhn F.W.*, *s.n.* (**U**†). **MALAYSIA**. 06°02'36.23" N, 116°33'35.58" E, alt. 643 m, 1 September 2018, fl., *S. Tagane*, *M. Zhang & A. Nagahama SB1562* (**FU**!);– alt. 67 m, 21 February 1968, fr., *M. Shah 1385A* (**BKF**049717!);– February *s.n.*, fl. & fr., *A.C. Maingay 626* (**K**000737283-5!);– January 1883, fl., *King 3791* (**K**000737286-7!);– **Bango**: 5 February 1920, fl., *F.G. Ahwad 5022* (**K**!);– **Kepong**: Selangor23 August 1977, fl., *K.M. Kochummen FRI19063* (**K**!);– **Kinta**: 27 November 1954, fl., Jacob 5*1261* (**K**!);– **Malacca**: November 1862, fl., *W. Griffith 2052* (**K**!, **P**03358590!);– *ibid.*, 1863, fl., *W. Griffith 2055* (**P**03358592!);– **Pahang**: Gunong benom, 17 April 1937, fl., *M.D. Nur. 32679* (**K**!);– *ibid.*, Mersing, Endau-Rompin, 25 September 2011, fl., *Imin K. 76093* (**L**3990071†);– *ibid.*, Gunong benom, Game Reserve, 15 March 1967, fl., *T.C. Whitmore FRI3173* (**K**!);– **Peninsular Malaysia**: November *s.n.*, fl., *W. Griffith s.n.* (**K**000737284!);– **Perak**: Lumut, Steep bridge, 16 February 1967, fr., *T.C. Whitmore FRI0987* (**K**!);– **Sarawak**: trail to latak Waterfall, Lambir Hills NP., 04°12'07.1" N, 114°02'41.2" E, alt. 50 m, 20 July 2016, lvs., *T. Yahara*, *S. Tagane & K. Fuse SWK2188* (**FU**!).;– **Ulu**: Gombak, V.J.R. Ridge, 22 March 1969, fl., *K.M. Kochummen FRI2717* (**K**!). **PAPUA NEW GUINEA**. **Kaiser Wilhemsland**, 6°50'00.0"S, 146°40'00.0" E, November 1867, fl., *C.L. Ledermann 6718* (**E**!, **K**!);– **East Sepik, Etappen**: Deutsch Neu Guinea Station Etappenberg, alt. 850 m, 30 October 1912, fl., *C.L. Ledermann 5969* (**K**000737358!, **L**†);– **Manokwari**: Sidei, 23 July 1958, fl., *G. Iwanggin 5750* (**KYO**!). **SINGAPORE**. November 1892, fl., *Ridley 4452* (**K**!, **P**03144262!);– Seletar Reservoir, 18 April 1953, lvs., *J. Sinclair*

39565 (**K**!);– Noo Soon, 1°26'13.5" N, 103°51'04.1" E, alt. 10 m, 17 February 1982, fr., *J.F. Maxwell 82-47* (**BKF**!);– *ibid.*, alt. 5 m, 14 February 1983, fl., *J.F. Maxwell 83-13* (**BKF**049716!). **THAILAND**. **Peninsular, Nakhon Si Thammarat**: Ron Phiboon, Khao Ram Rom, 8°14'11" N, 99°48'13" E, alt. 940 m, 1 May 2019, lvs., *S. Rueangruea*, *P. Puttarak & C. Suddoo SR215* (**BKF**229945-6!, **TCD**!);– **Narathiwat**: Sukirin, Phu Khao Thong, Hala-Bala WS., 5°48'07" N, 101°50'27" E, alt. 194 m, 11 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR225* (**BKF**199838!, **BKF**229957!, **TCD**!);– *ibid.*, Waeng, Khlong Sapan Song, 5°47'55" N, 101°50'01" E, alt. 350 m, 28 April 2011, fr., *P. Puudja*, *Chuemchomglin P. & C. Hemrat 1700* (**BKF**212908!);– *ibid.*, 25 April 2012, fl. & fr., *P. Puudja & C. Hemrat 1811* (**BKF**196460!);– *ibid.*, Hala-Bala WS., 5°47'55" N, 101°50'01" E, alt. 115 m, 10 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR224* (**BKF**229955!, **TCD**!).

Distribution.— Myanmar, Peninsular Thailand, Malay Peninsula, Malasia, Borneo, Jawa, Lesser Sunda Islands, Maluku, New Guinea, Sulawesi, Sumatra, Singapore, Indonesia and Philippines, (**Maps 4.46 & 4.51**).

Vernacular name. — **Thailand**: ชะนูด Cha nut (Ranong); นูดต้น Nut ton (Nakhon Si Thammarat). **Indonesia**: Poko mandong paya (Negeri Sembilan); Poko meddang churona (Malacca); Pepijat (Selangor); Kawajang (Sundanese in Java); Tennbila, ki (Sundanese in Java).

Ecology.— Primary and secondary Lowland Evergreen Forest trough Montane Forest Evergreen Forest alt. 0–1,900 m.

Phenology.— Flowering: October–February. Fruiting: January–April.

Uses.— Several collectors mention the timber as well-suited for house-building purposes; once (Malaya), the bark has been reported as being used for walls of native houses.

Conservation.— **Conservation**.—This species is known from many locations (> 10 locations): EOO = 15,982,388.43 km^2; AOO = 452.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— Kalkman (1965, 1993) adopted an inclusive species concept for *Prunus arborea*, believing it cannot be clearly defined. I, however, agree with J.Wen (in press) that *P. arborea* sensu Kalkman should be defined more narrowly. A recent study for the Malay Peninsula by J.Wen elevates the typical *P. arborea* var. *densa* (King) Kalkman and *P. arborea* var. *stipulacea* (King) Kalkman each to species rank, as *Prunus kalkmanii* J.Wen, and *Prunus ridleyi* J.Wen, respectively. Moreover, she also recognized *Prunus patens* (Ridl.) J.Wen includes some elements identified by Kalkman as var. *densa* and var. *stipulacea*. In addition, I argue that *P. arborea* var. *montana* should be defined more narrowly. In the continental Southeast Asia case, I recognize *P. latisipulacea*, which includes some elements identified by Kalkman as *P. arborea* var. *stipulacea*. I elevated the typical *P. arborea* var. *montana* to species rank as *P. indochinensis* and *P. parreauana*, respectively.

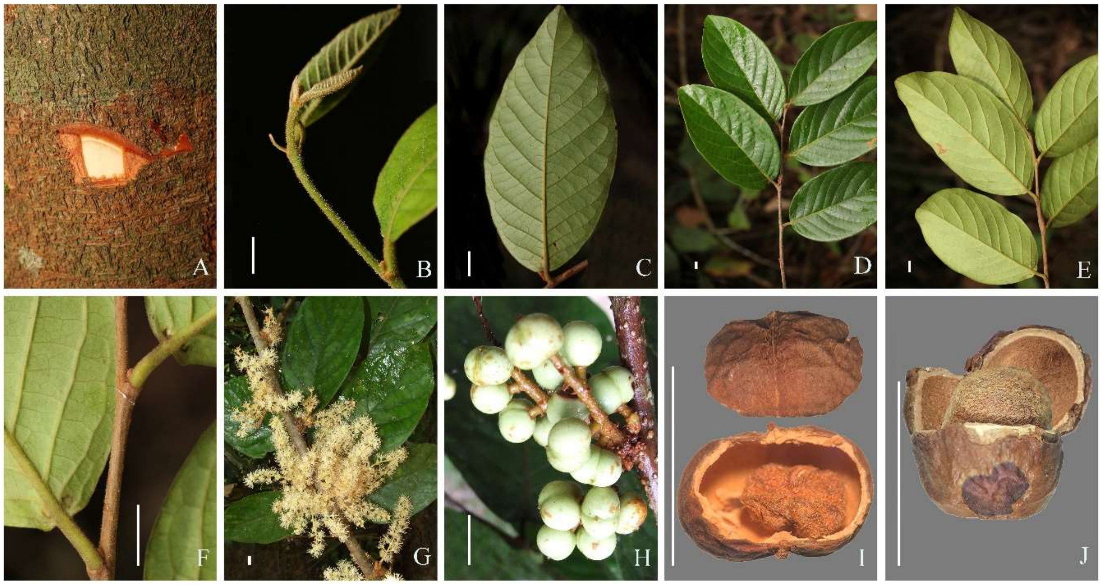
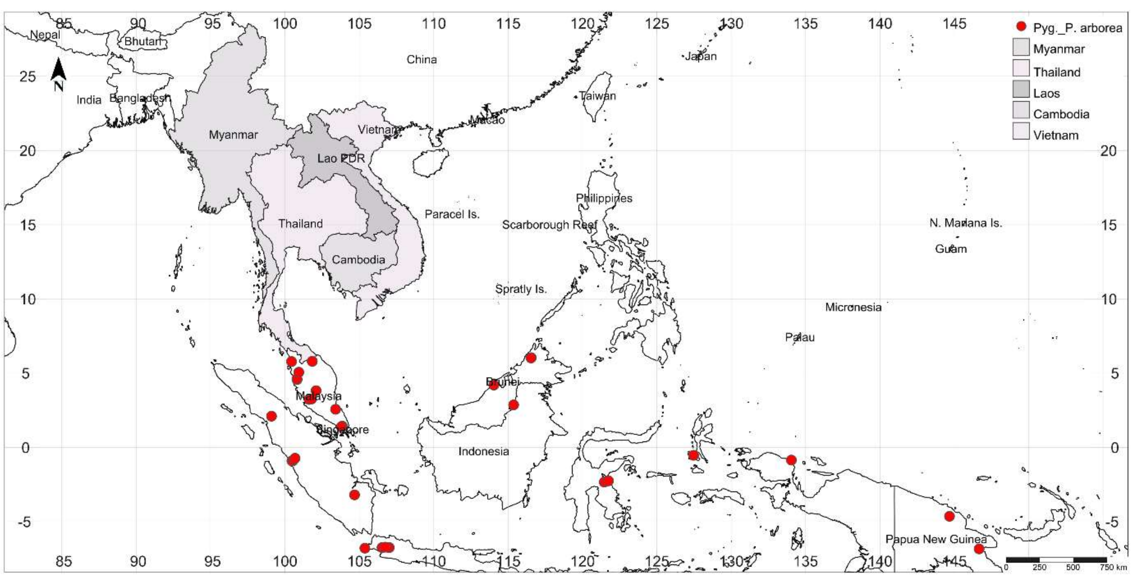


Figure 4.37. *Prunus arborea* (Blume) Kalkman, vegetative and reproductive morphological characters; A, outer bark and inner bark; **B–F**, leaves; **B**, young shoot with linear or filiform stipules; **C**, young leaf slightly glaucous abaxial; **D**, alternate, dull green adaxial; **E**, tomentose abaxial; **F**, basal leaf with 2-circular glands; **G**, inflorescence, fasciculate in bundles of 2–5(–10); **H**, infructescence, fruits hairy; **I** & **J**, cross-section, fruit, endocarp inside, and seedcoat densely hairy. — Photos: A–F by S. Rueangruea, G–H by P. Karaket, I & J by T. Thananthaisong. — Sources: **Indonesia**, Papua New Guinea J from *W. Takeuchi & J. Kulang 11549*: **Thailand**, Narathiwat, Bala-Hala WS; A from *S. Rueangruea et al. SR226*; B, C from *SR224*; D–F from; G–I, *from P. Puudjaa & C. Hemrat 1700*: Scale bar = 1 cm.



Map 4.51. Distribution of *Prunus arborea* (Blume) Kalkman of sect. *Mesopygeum* in continental Southeast Asia and nearby.

48. ***Prunus ferrea* (Craib) Rueangr**., **J**.**Parn**. **& Hodk**. ***comb*. *nov*.**, ***ined***.

Type as for the basionym below.

≡ *Pygeum ferreum sensu. auct.* Kalkman, Craib, Contributions to the Flora of Siam. Additamentum, XXVI in Bulletin of Miscellaneous Information, Royal Gardens, Kew. 1929(4): 106. 1929, *pro parte*, *quoad A.F.G. Kerr 15501*.

Typification: **THAILAND, Nakorn Si Thammarat**, Khao Luang National Park, 1,300 m alt., Lower Montane Forest, 30 April 1928, fl., *A.F.G. Kerr 15501* (lectotype **K**!, isotype seen from **E**!), designated by Kalkman in *op. cit.*, 13(1): 99. 1965. The protologue of *Pygeum ferreum* Craib cited only a locality and collector specimen number but did not specify a herbarium, thus indicating all specimens of that gathering as syntypes.

Second step lectotypification; – *ibid, A.F.G. Kerr 15501* (lectotype **K**000737346!, isolectotypes **BM**000622034!, **BK**213988!, **E**00010508!, **TCD**0016634!, **TCD**0016635!); lectoparatypes – *ibid*, alt 1,700 m, April 1928, fl., *A.F.G. Kerr 15530* (**K**!, **TCD**0016634!), designated here.

Description: Evergreen, sub-canopy, shrub to small tree 3–15 m tall, canopy shape globose. **Stem** clear bole, erect; outer bark greyish-brown to dark brown, smooth with brown lenticels, spines absent; *inner bark* reddish-brown to dark brown when old; strong almond smell. **Branchlets** stout, grey to greyish-brown with large lenticels; young twigs greenish-brown, covered with ferruginous pubescence, cataphylls absent; old twigs greyish-brown, sparsely rusty to black hairy to glabrescent with numerous conspicuous orbicular brown lenticels. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate or distichous, ovate, elliptic oblong to ovate-lanceolate, 6–15 cm long × 2.2–5 cm wide; *lamina apex* acute to acuminate, angle acute; *margin* entire, revolute, sparsely ciliate, or glabrescent; *base* asymmetrical to sub-symmetrical, broadly acute to rounded; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous to coriaceous; densely to sparsely brown pubescent; old leaves densely to sparsely brown pubescent, glabrescent except the impressed midrib and lateral veins adaxially, sparse stiff brown hairs abaxially; *basal glands* usually 2, flat, small, 0.5–1(–1.5) mm long, circular or ovate lightly excavated on the underside, not protruding adaxially, over the base of leaf blade margin, sparse small circular glands near the margins from upper half to apex; *2° venation* weaky brochidodromous, 7–12 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles*, 0.8–1.8 cm long, stout, shallowly canaliculate in cross-section or terete, pubescent; *petiolar glands* absent. **Stipules** medium, 2–6.5 mm long × 2–4 mm wide, ovate-lanceolate, leaf-like, apex acute, acuminate or rounded, margin entire, ciliate, base truncate or stipitate-like, densely brown hairy, sparsely glandular between the margin and stipule blade, early caducous to semi-persistent. **Inflorescences** compound, fasciculate in bundles of 2–6 racemes, lax-flowered, or dense at the terminal, (mainly) on the fallen leaves branches, occasionally in the axils of leaves, 1–4.5 cm long, many-flowered, densely rusty tomentose; *bracts* 2–5, 0.5–1 mm long, size and shape variable, triangular to oblong, apex acute or obtuse, densely hairy, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, whitish-brown, fragrant; pedicellate at base, gradual recurving, sessile near the terminal flower, slender or stout, 0.5–6 mm long, brown tomentose, pedicel elongating at anthesis; *bracteoles* triangular, linear to oblong, 0.7–1.2 mm long, pale green, densely brown hairy, early caducous; *hypanthium* campanulate, 2–3 mm long, densely brown hairy outside, glabrous except for the base densely tomentose inside; *perianth* petals slightly different from calyx lobes, 0.5–1.5 mm long, hairy both side and margin ciliate; *calyx* lobes perianth segments 10–12 lobes, or sepals and petals more or less distinct from one another, the petals being slightly longer and thiner, triangular-laceolate, minute, green, 0.5–0.8 mm long × 0.3–0.5 mm wide, subequal, apex acute, margin entire, ciliate, base truncate or oblong, separate in bud, spreading when mature, deciduous, pubescent outside, pubescent inside; *corolla* petals slightly different or indistinguishable from sepals, whitish-brown, spreading to upright, 5–6 (as many as sepals), small, 0.5–1 mm long × 0.3–0.5 mm wide, equal or subequal, as long as or slightly longer than calyx lobes, oblong-lanceolate, sessile, apex acute, margin entire, ciliate, base oblong, alternate with calyx lobes, tomentose outside, tomentose inside; *stamens* 35–40 in 1 to 3 series, exserted, longer than perianth; filament filiform, white, 2.5–4 mm long, glabrous or sometimes sparesly to densely tomentose at the lower half; anthers narrowly oblong, 0.5–1 mm long; *ovary* densely long tomentose, 1 locular; *style* filiform, slender, unilaterally grooved, 4–5 mm long, longer or equal length to stamens, glabrous, but densely hairy at lower part; stigma unilateral with peltate. *Infructescence* 1–4.5 cm long, glabrescent to hairy with conspicuous whitish-brown lenticels, 1–5 fruited. **Fruits** fleshy, stipitate, 1–3 mm long, young fruit green, turning dark purple to black when mature or ripe, distinctly didymous, subequal, 0.6–0.9 cm long, 1–1.5 cm wide, apex retuse or emarginate; young fruits densely tomentose; mature fruits sparsely tomentose to glabrescent; exocarp smooth and shiny, with a shallowly longitudinal groove; mesocarp fleshy, thin, white; endocarp stone bony, shallowly reticulate and shallowly longitudinal furrowed or ridged; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually laterally transversely globose, thick, glabrous testa, and shallowly grooved (**Figure 4.38**).

Additional specimens examined.— **MALAYSIA**. **Pahang**: Cameron Highlands, Beremban, 1 March 1968, fl., *K. Ogata KEP110310* (**K**!);– **Selangor,** Gunung Ulu Kili, alt. 300 m, 12 October 1978, *Benjamin C. Stone 13962* (**L**1892515†). **THAILAND**. **Peninsular, Nakhon Si Thammarat:** Ron Phiboon, Ram Rom subunit, Nam Tok Yong, 8°14'10" N, 99°48'11" E, alt. 937 m, 19 July 2013, fr., *V. Chaemchumroon*, *J.S. Strijk*, *S. Sirimongkol*, *S. Rueangruea & N. Ritphet VC586*0 (**BKF**210027!, **L**4367458†);– *ibid.*, Kiri Wong, Khao Laung NP.: alt. 1,700 m., 30 April 1928, shrub *c.* 3 m. tall, fl., *A.F.G. Kerr 15530* (**K**!, **TCD**!) !);– *ibid.*, 8°29'39.1" N, 99°44'26.8" E, alt. 1,763 m, 11 February 2015, fl., *S. Tagane*, *H. Toyama*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *H. Kanemitsu*, *W. Kiewbang & C. Hemrat T3768* (**FU**!);– *ibid.*, 8°28'54.7" N, 99°45'01.5" E, alt. 884 m, 14 February 2015, fl., *S. Tagane*, *H. Toyama*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *H. Kanemitsu*, *W. Kiewbang & C. Hemrat T4075* (**FU**!);– **Surat Thani**: Na San, Khao Nong summit, Tai Rom Yen NP., 8°50'N, 99°30E, alt. 1,350 m, 24 February 2006, fl., *S. Gardner & P. Sidisunthorn ST2364* (**BKF**184167!, **K**!, **QBG**44224!).

Distribution.**—** Thailand (Khao Laung National Park and Khao Ramlom). Trough Peninsular Malaysia (known only from the specimens cited**)** (**Maps 4.46 & 4.52**).

Vernacular name. **—** Not known.

Ecology.**—** Lower Montane Forest, alt. 750–1,300 m.

Phenology.**—** Flowering: April–May. Fruiting: May–July.

Uses.— Not known.

Conservation.**—** This species is known from more than five but ≤ 10 locations: EOO = 10,319.97 km^2; AOO = 24.00 km^2. The number of individuals in each subpopulation is ≤ 1,000. I consider the conservation status of the species currently to be VU (Vulnerable); B1B2aC2a(i)D2 (IUCN, 2019).

Note.— Kalkman (1965, 1993) adopted a broad species concept for *Prunus arborea*, which cannot be clearly defined with any morphological characters. The varieties may co-exist in a single locality but may have reproductive isolation. I agree with J.Wen (pers. comm.), working on *Prunus* in the Malay Peninsula that *Prunus arborea* should be defined more narrowly. In the case of *Pygeum ferreum sensu. auct.* Kalkman (*Op. cit.*) included some elements of *Prunus arborea* var. *arborea*. We separated this into a different species, *Prunus ferrea* (Craib) Rueangr., J.Parn. & Hodk. This species is well characterized and can be easily distinguished from *Prunus arborea* in having leaf-like stipules with sparse glands (vs. Stipules linear, oblong-lanceolate to triangular, without or inconspicuous glands), stamens 35–40 (vs. stamens 20–30), endocarp and seedcoat usually glabrous (endocarp pubescent inside; seedcoat densely hairy, rarely more sparsely so).

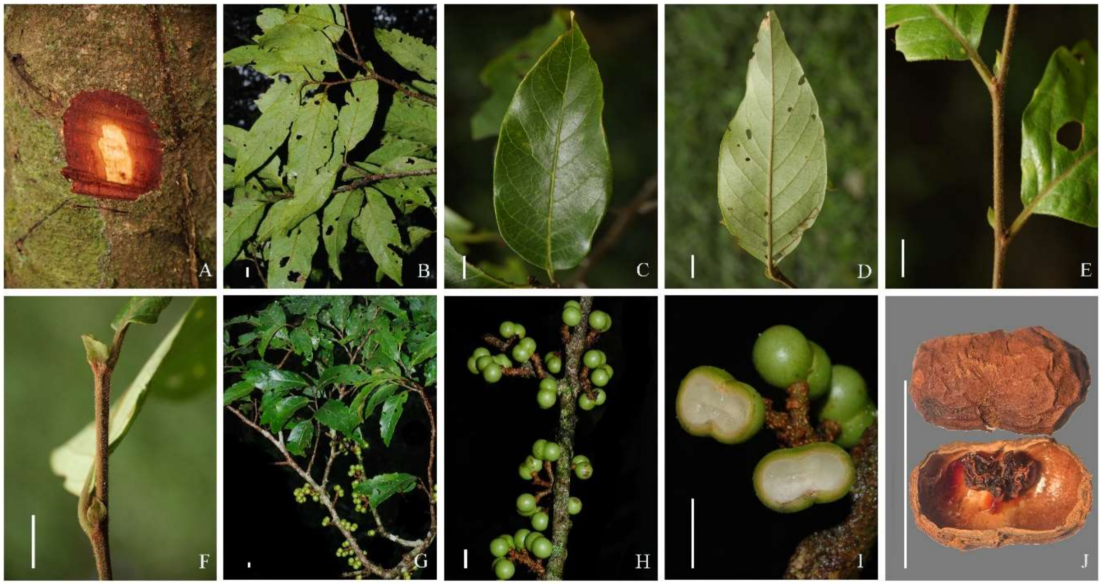
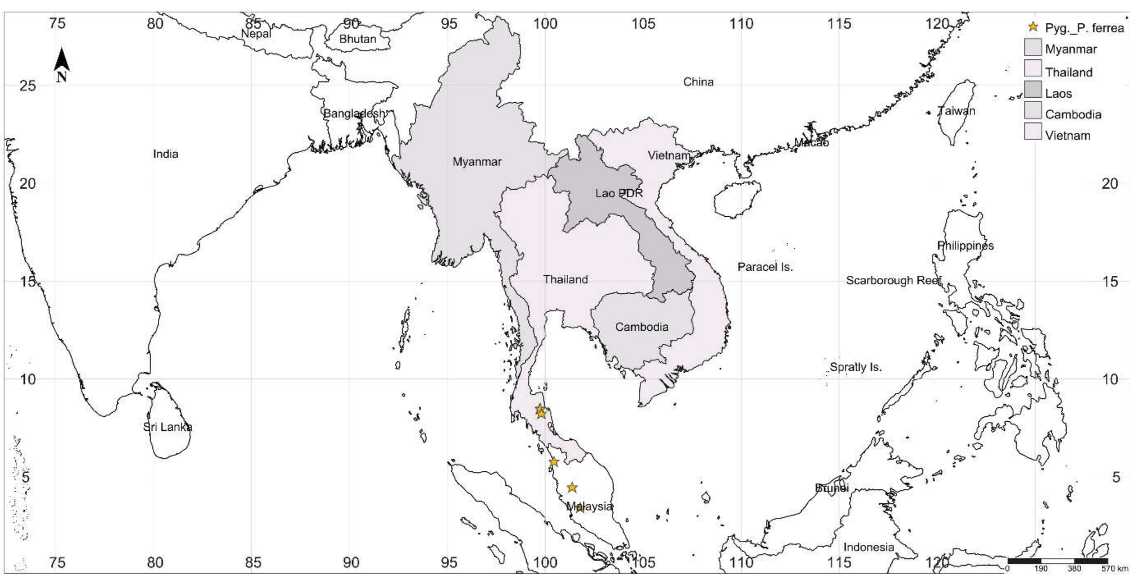


Figure 4.38. *Prunus ferrea* (Craib) Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters; A, outer and inner bark; **B–E**, leaves; **B**, alternate; **C**, ovate-lanceolate, margin undulate; **D**, slightly glaucous abaxial; **E**, basal glands usually 2, flat, small; **F**, stipules leaf-like, densely brown hairy, sparsely glandular on the stipule blade; **G**–I, infructescence; **G**, fruiting on the fallen leaves branch; **H**, fasciculate in bundles of 2–6 racemes; **I**, mature fruits, transverse ellipsoid; **J**, cross-section, endocarp, and seedcoat glabrous to sparsely hairy. — Photos: A – I by S. Rueangruea; J by T. Thananthaisong. — Sources: all from **Thailand**, Nakhon Si Thammarat, A, C–F from S. *Rueangruea and P. Puttarak SR215*; B, G, H, I & J from *V. Chamchamroon VC5765.* Scale bar = 1 cm.



Map 4.52. Distribution of *Prunus ferrea* (Craib) Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia and nearby.

49. ***Prunus kalkmanii* J.Wen**. ***nom. nov.* (in press).**

≡ *Pygeum parviflorum* Teijsm. & Binn. var. *densum* King, The Journal of the Asiatic Society of Bengal., Part 2. Natural History. Calcutta. 66: 292. 1897. *Prunus arborea* var. *densa* (King) Kalkman, Blumea 13: 100. 1965.

Typification: **MALAYSIA**. **Perak**: Malaya, Perak, top of hill, 800-1000 ft, tree 30–40 ft high, stems 10–15 inches in diameter, flowers very light green with a silvery gloss, Aug 1886, fl, *King (Ulu Bubong) 10753* (lectotype L0019544†, isolectotypes: **BM**000622076!, **K**!, **P**03358567!), isolectotype designated by Kalkman, 1965.

= *Pygeum sericeum* Koehne, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. Leipzig. 51: 189. 1913.

Typification: **MALAYSIA**. **Perak**: Malaya, Perak, top of the hill, 800-1000 ft, tree 30–40 ft high, stems 10–15 inches in diameter, flowers very light green with a silvery gloss, Aug 1886, fl, *King (Ulu Bubong) 10753* (lectotype L 0019546†, isolectotype: K!), lectosyntypes: **Perak**: Larut, top of low hills, open Jungle, 500-800 ft, 40-60 ft high, stem 10-15 inches in diameter, flowers and stamens deep yellow, Aug 1886, fl, *King (Ulu Bubong) 10827* (lectotype **BM**000622075!, designated by Kalkman, 1965; isolectotypes **BM**000622076!, **K**!, **P**03358566!, **SING**†, 2 sheets).

= *Pygeum sericeum* Koehne var. *denudatum* Koehne, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. Leipzig. 51: 189. 1913.

Typification**:** Indonesia. Sumatra, Sul M. Singalan, 1878, fr., *O. Beccari 358* (lectotype **L** 0019538†, designated by Kalkman, 1965; isolectotypes **BM**000622069!, **K**000737319!).

Description: Evergreen, sub-canopy, tree up to 20 m tall, canopy shape globose. **Stem** clear bole, erect; outer bark greyish-brown to dark brown with distinct dark brown lenticels, smooth spines absent; *inner bark* pinkish-brown when young, reddish-brown with age; strong almond smell. **Branchlets** moderate to slender, greyish-brown with white lenticels, densely finely pubescent, cataphylls absent; old twigs glabrous. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, elliptic, elliptic-oblong or ovate, 8–16 cm long × 4–6 cm wide; *lamina apex* acuminate, acute to obtuse, angle acute; *margin* entire, revolute, sparsely ciliate when young, glabrous when mature; *base* asymmetrical or symmetrical, cuneate or broadly cuneate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, chartaceous; sparsely hairy; old leaves sparsely hairy, glabrous adaxially, glabrescent to glabrous abaxially; *basal glands* 0(–2), small, up to 1 mm long, circular or ovate, lightly excavated on the underside, not protruding adaxially, in the basal part of blade, additional sparse small circular glands parallel the margins, especially on the upper half; *2° venation* weaky brochidodromous, (8–)10–12 alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, angle moderate (45°–60°); *3° venation* mixed alternate and opposite percurrent; *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles* 0.8–1.2 cm long, slender, shallowly canaliculate in cross-section or terete, pubescent to glabrescent when young, glabrescent to glabrous when mature; *petiolar glands* absent. **Stipules** medium, 3–6 mm long × 1.5–4 mm wide, gibbose, ovate, oblique leaf-like to oblong, apex acuminate to acute, margin entire, sparsely ciliate to glabrescent, base stipitate-like to sessile, sparsely pubescent to glabrescent, outer surface with 1–3 crateriform glands on outer surface, swollen and protruding inside, other small brown marginal glands, caducous. **Inflorescence** compound, racemes 3–6 in bundle, 1–2.5 cm long × 6–12-flowered.; **Flowers** bisexual, opening with mature leaves, white to cream-colored with brown indumentum, sessile or short pedicellate, densely brown tomentose; *bracteoles* linear, 1–2.5 mm long, pale green, sparsely brown hairy outside, glabrous inside, early caducous; *hypanthium* campanulate, 1.5–2 mm long, densely brown pubescent outside; *perianth* segment 10, subequal, petals slightly different from calyx lobes, obscurely 6–8(–10)-lobes, subequal or (very rarely) more or less regularly divided into sepals and petals, but never very different, 1–1.3 mm long × 0.5–0.7 mm wide, densely hairy both sides and margin ciliate; *stamens* 10–20 in 1 to 3 series, exserted, more extended than perianth; filament filiform, white, 3–3.5 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers oblong-oval, *c.* 0.3 × 0.5 mm; *ovary* densely brown tomentose at anthesis, 1 locular; *style* filiform, slender, 3–4 mm long, pubescent at the base, glabrescent to glabrous in the upper half; stigma peltate, 1 mm in diameter. *Infructescence* 2–5 cm long × 2–2.5 wide, densely hairy to glabrescent, lenticellate, few, 1–3 fruited. **Fruits** fleshy, stipitate, 2–5 mm long, young fruit green, turning white to cream, ultimately almost black when ripe, transversely ellipsoid to didymous, 0.7–0.9 cm long × 0.8–1 cm wide, apex retuse or obtuse; young and mature fruits sparsely hairy; exocarp smooth and shiny, with a longitudinal groove; mesocarp fleshy, thin, white; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged; endocarp glabrous inside; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually transversely globose laterally, thick, hairy, shallowly rugose testa, and seedcoat glabrous (**Figure 4.39**).

Additional specimens examined.— MALAYSIA, *Scortechini 330* (**K**!, **L**†); – **Johor**: Gunung Ledang summit, ericaceous forest, 4100’, shrub 3’, 18 Mar 1981, *K. M. Kochummen 29204* (**L**†); Bukit Tinggi FR, regenerated forest, 600’, small tree, height 60’, girth 1.5’, crown bushy, bole smooth & crooked, bark dark brown, slash inner bark red, slash wood orange, 1 Feb 1980, fr, *Mat Asri FRI25565* (**K**000605034!, **L**†). **Kedah**: Plot II Gunong Inas F.R., ridge, 3200’, 1 May 1968, fl & fr, *P. F. Burgess FRI9317* (**L**†); road to Gunong Jerai (Kedah Peak), primary forest, hillside, 500 ft, tree height 45’, girth 1.5’, bole straight, bark smooth, slash inner bark red, slash wood white, fruits green, round, 22 Jan 1969, *Y. C. Chan FRI13113* (**K**!, **L**†); Gunong Jerai, limestone, 3800’, 8 Nov 1962, fl, shrub 12 ft, flowers cream, *Samsuri Ahmad 293* (**K**!, **L**); Gunong Jerai, limestone, 3800’, tree 40-50’ tall, 8 Nov 1962, fl, *Samsuri Ahmad 298* (**L**†);– **Pahang**: 47 mile, Telom road, 4800 ft, 14 May 1936, fl, small tree c. 20', *R. E. Holttum 31249* (**K**!, 2 sheets, **L**†, 2 sheets);– **Pasir**: Kuau, 26 January 1967, fl., *F.S.P. Ng FRI1850* (**K**!). **Penang**: Government Hill, Jan 1885, fl, *Curtis 162* (K); Penang Hill, c. 2300 ft, 21 Sep 1934, fl, *M. R. Henderson 21352* (**K**!, 2 sheets, **KEP**, **SINGK!, P**03144251!). **Perak**: Larut, 2000-3000', tree 70' tall, Dec 1884, fl, *King 6986* (**E**00991951!, **P**01818999!, **L**†); – *ibid*., 2000-2500', a tree 50-70 ft high, stem 8-12 inches in diameter, leaves rich glossy deep green, Feb 1885, fl, *King 7236* (**P**03144255**!, SING**†); – *ibid*., Lumut, Steep bridge, alt. 250 m, 16 February 1967, *T.C. Whitmore FRI0987* (**K**!); – *ibid*., 4th mile Maxwell Hill Road, 3000', tree 35' tall, girth 1.5', bole smooth red-brown, fruits green in lusters on twigs & branches, 29 Oct 1969, *K. M. Kochummen FRI2890* (**K**!, **L**†); – **Pulau Tiomam**: Camp II, Gunong Kajang, 2500-3500 ft, forest, small shrub 10 ft, 17 Apr 1962, fr, *Kadim & Noor 604* (**L**†). **THAILAND**. **Peninsular, Yala**: Betong, 5°38'41" N, 101°07'47" E, alt. 678 m, 13 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR228* (**BKF**229959!, **TCD**!);– *ibid.*, 5°39'35" N, 101°07'38" E, alt. 661 m, 13 May 2019, lvs., *S. Rueangruea*, *M. Poopath*, *S. Yuprasert & S. Jirakorn SR229* (**BKF**229961!, **TCD**!).

Distribution.— Thailand, Thai-Malay border (known only from the specimens cited), Malay Peninsula, Penang, Sumatra, and Indonesia (Borneo) (**Maps 4.46 & 4.53**).

Vernacular name. **— Malaysia**: Bisan meranti (Penang); Medang pijat (Perak); Pepijat (Perak).

Ecology.**—** Shady or in an open area along trails of Lowland Evergreen Forest to Montane Forest, alt. (150–)400–800 (–2,000) m.

Phenology.**—** Flowering in January to May and Fruiting May to August.

Uses.— Not known.

Conservation.—This species is known from many locations (> 10 locations): EOO = 200,734.58 km^2; AOO = 108.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

Note.— *Prunus kalkmanii* is recognized by its stipules on the outer surface, having 1–3 crateriform glands; leaves ovate or elliptic to elliptic-oblong. *Prunus kalkmanii* is a close relative of *P. arborea.* It is distinguished form *P. arborea* by the former's thicker leaves (subcoriaceous vs. chartaceous), leaf bases acute to broadly acute (vs. rounded), endocarp inside, and seedcoat glabrous (vs. densely pubescent), stipules with protruding glands, hollowed abaxially (vs. crateriform glands), and mature leaves glabrous to glabrescent (vs. mature leaves usually still hairy abaxial).

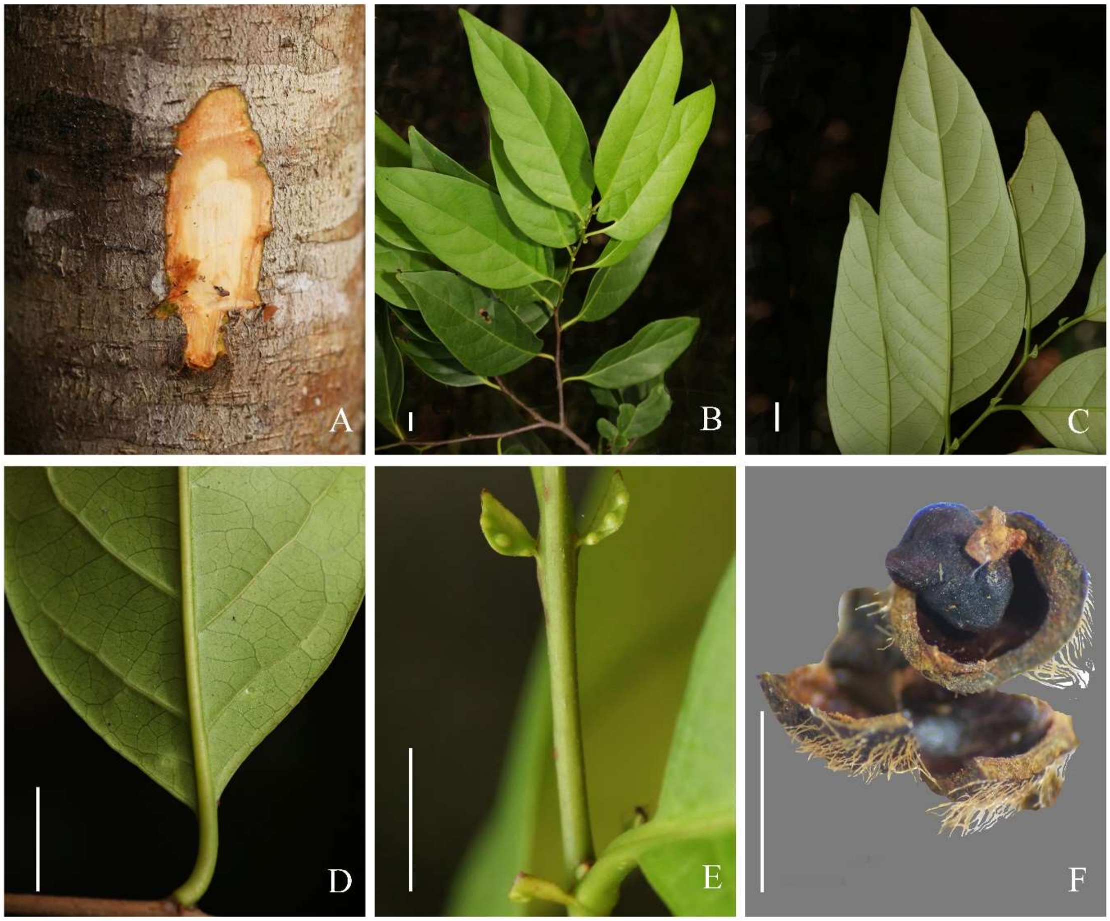
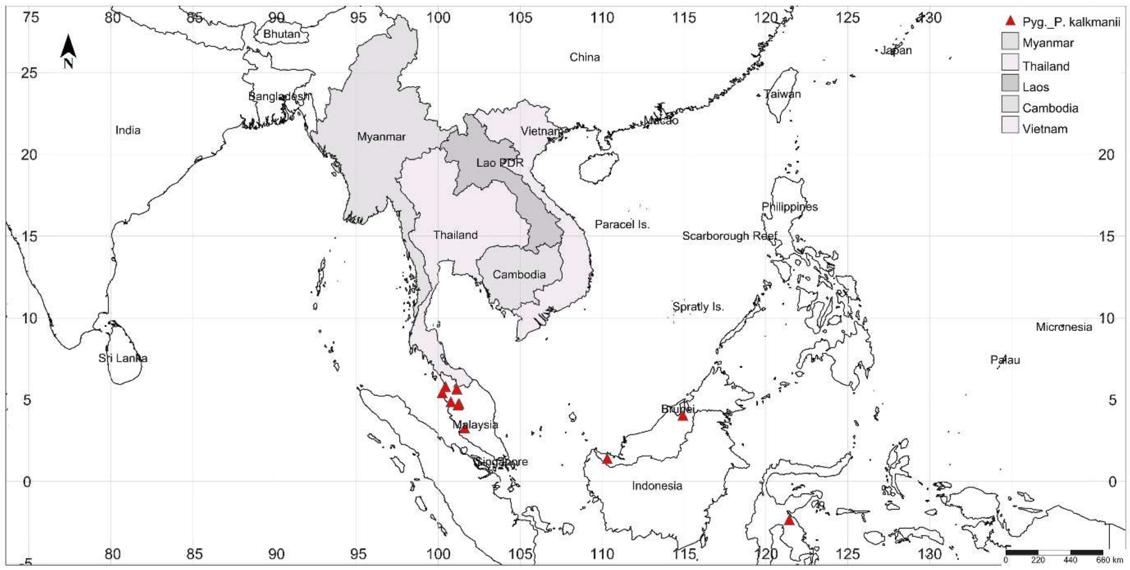


Figure 4.39. *Prunus kalkmanii* J.Wen., vegetative and reproductive morphological characters; A, outer and inner bark; **B**–**D**, leaves; **B**, leaf ovate-lanceolate; **C**, slightly glaucous abaxial; **D**, basal glands, 0(–2), small, inconspicuous; **E**, stipules oblique leaf-like, outer surface with 1–3 crateriform glands, swollen and protruding inside; **F**, fruits densely hairy, endocarp and seedcoat glabrous. — Photos: A–E by S. Rueangruea; F by T. Thananthaisong. — Sources: **Thailand**, Nakhon Si Thammarat; A from *S. Rueangruea et al. SR215*; B–E from *SR229*: **Indonesia**, West Sumatra, Singgalan; F from *O. Beccari 358*. Scale bar = 1 cm.



Map 4.53 Distribution of *Prunus kalkmanii* J.Wen of sect. *Mesopygeum* in continental Southeast Asia and nearby.

50. ***Prunus ridleyi* (King) J.Wen, *comb. nov. ined.* (in press).**

≡ *Pygeum stipulaceum* King, Journal of the Asiatic Society of Bengal. Part 2. Natural History. 66: 287. 1897.

Typification**: MALAYSIA,** Peninsular Malaysia, Perak, Scortechini, 500–700 ft., September 1866, *King's Coll.*, *Ulu Buboug*, *11020* (lectotype **K**000737262! Designated by Kalkman, 1965; isolectotype in **CAL**, *non vidi*). King cited the specimen erroneously as *Scortechini 11020*, designated by Kalkman.

≡ *Prunus arborea var. stipulacea* (King) Kalkman**,** Blumea; Tijdschrift voor de Systematiek en de Geografie der Planten (A Journal of Plant Taxonomy and Plant Geography). 13: 98. 1965.

Excluding *Pygeum ellipticum* Merr., J. Straits Branch Roy. Journal of the Asiatic Society of Bengal: 82. 1917. Typification**: MALAYSIA,** Mt, Poe, *Jee Koo. s.n.*, *non vidi*, could not be located in **SAR**. Type *non vidi*.

Excluding *Pygeum pachyphyllum* Merr., J. Straits Branch Roy. Asiat. Soc.: 83. 1917.

Typification: **MALAYSIA, Borneo**, Saba, Mount Bungal, 9 December 1915, *M. S. Clemens 11200* (holotype **A**00032463!, isotype **US**00107920!).

= *Pygeum capitellatum* Hook.f., Flora of British-India. 2(5): 321. 1878. *Prunus arborea* var. *montana* (Hook.f.) *sensu auct.* Kalkman in Blumea. 13: 99. 1965, *pro parte, quoad J.W. Helfer 2053*.

Typification: **MYANMAR**, Tenasserim and Andamans, 1861-2, fl., *J.W. Helfer 2053* (lectotype **K**000737301!, designated by Kalkman 1965; isolectotypes **GH**00032458†, **HBG**511155†, **K**000737299!, **K**000737300!, **L**0019553†, **M**0214826†, **P**01819014!, **P**01819015!).

Description: Evergreen, sub-canopy, tree up to 25 m tall, canopy shape globose. **Stem** clear bole, erect; outer bark greyish-brown, smooth with distinct lenticels. Outer bark 4–5 mm thick, spines absent; inner bark, *sap*, exudating gum; faint almond smell. **Branchlets** stout, greyish-brown; young twigs greenish-brown, young twigs densely covered with light yellow-brownish-rusty pubescence, cataphylls absent; old twigs sparsely hairy with light brown lenticels. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate, oblong to broadly elliptic; *lamina apex* acute or acuminate, angle acute; *margin* entire, revolute, densely ciliate; *base* symmetrical or asymmetrical, broadly rounded to slightly cordate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, coriaceous; rusty tomentose on both surfaces, margins densely ciliate; old leaves more or less pubescent adaxially, densely light rusty tomentose abaxially, margins entire to sparsely toothed with a few irregular dentate teeth, slightly curved when dry, densely ciliate, glabrescent or sparsely hairy, sparsely hairy on midrib adaxially, usually still distinctly hairy at least on midrib, nerves and petiole abaxial; *basal glands* present or absent, usually 2(0–1), 0.5–1 to 2 mm long, circular to oblong, flat or slightly hollow abaxially, over the base of leaf blade margin; aditional glands sparse small circular glands near and along margin, especially on the upper half; *2° venation* brochidodromous, looped and anastomosing near the margin, 9–13 (–16) alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, secondary veins and tertiary conspicuous on both surfaces, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles*, 0.5–1.5 cm long, stout, shallowly canaliculate in cross-section or terete, pubescent; *petiolar glands* absent. **Stipules** on the twigs or petiole (pseudostipule), large, 4–8 (–12) mm long × 2.5–7 (–10) mm wide, broadly ovate to narrow triangular, apex acute to obtuse, margin entire, sparsely ciliate to glabrescent, base sessile, rounded to cordate, densely brown villose to glabrescent, with 4–10 nerves, sometimes with 2–8 circular glands, more or less persistent, at least not caducous. **Inflorescences** compound, fascicle in bundles of 2–6 racemes, rarely mixed with solitary ones, lax-flowered, mainly on the branches abaxial the leaves, 2–5 (–7) cm long, many-flowered, densely rusty pubescent; bracts 1–3, 0.6–0.8 mm long, size and shape variable, broadly elliptic, concave, apex acute or obtuse, densely hairy outside, glabrous inside, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white to cream-coloured with brown indummentum, sessile or short pedicellate, stout and short, 0–3 mm long, densely brown tomentose; *bracteoles* narrowly ovate, lanceolate to linear, 2–3 mm long, 1.3–1.7 mm wide, pale green, densely brown hairy, early caducous; *hypanthium* campanulate, 1–3 mm long, densely yellowish-brown hairy; *perianth* petals slightly different from calyx lobes, obscurely 8–11-lobes, subequal or (very rarely) more or less regularly divided into sepals and petals, but never very different, 0.3–0.5 mm long, hairy both sides and margin ciliate; *calyx* lobes perianth, triangular, minute, green, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, apex acute or obtuse, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, pubescent outside and inside; *corolla* petals slightly different or indistinguishable from sepals, 0 (5)-merous or perianth, small, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, petals not distinct from calyx lobes, or in one ± distinct whorl, triangular to ovate, sessile, apex acute to obtuse, margin entire, ciliate, base truncate, alternate with calyx lobes, tomentose outside and inside; *stamens* 18–25 in 1 to 3 series, exserted, longer than perianth; filament filiform, white, 1.5–3.5 mm long, glabrous; anthers oblong-oval, 0.3–0.5 mm long; *ovary* densely tomentose, 1 locular; *style* filiform, slender, 3–4.5 mm long, longer than stamens, glabrescent in the basal half, glabrous in the upper half; stigma capitate. *Infructescence* 2–6 cm long, densely hairy to glabrescent, few, 1–3 fruited. **Fruits** fleshy, stipitate, 1–5 mm long, young fruit green, turning white to cream, red, dark purple, ultimately almost black when mature or ripe, transversely ellipsoid to didymous, 0.6–0.8(–1.1) cm long, 0.8–1.2 cm wide, apex retuse or obtuse; young fruits tomentose; mature fruits densely hairy; exocarp smooth and shiny, with a longitudinal groove; mesocarp fleshy, thin, white; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged, densely pubescent inside; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** are usually transversely globose laterally, thick, with hairy, shallowly rugose testa, and sparsely hairy seedcoats to glabrous (**Figures 4.40 & 4.41**).

Additional specimens examined.— **INDONESIA**. **Bangka**, Soeugai Liat, Bou, alt. 500 m, s.d., *Teysmann s.n.* (**K**000737320!, **US**!);– **Java**, 12 April 1901, *Koorders 38738B* (**P**03144260!);– **Sanggau**, Balai, Tae village, alt. 500 m, 9 January 1994, C. Peters & A. Susanto 1139 (L4207640†). **MALAYSIA**. **Johor**: Rengam FR, Compt. 25, logged Area, 14 Apr 1971, fr, *K. M. Kochummen FRI16398* (**K**!). **Langkawi**: Kedah, Gunung Raya, 16 March 1990, fr., *S. Kamarudin FRI31451* (**K**!). **Sabah**: Mount Bungal, alt. 194 m, 9 December 1915, fr., *J. & M.S. Clemens 11200* (**K**000737262!, **US**†);– Kinabalu, alt. 1330 m, 9 October 1933, fl., *J. & M.S. Clemens 40634* (BM!);– ibid., Dallas, Kinabalu, alt. 900 m, 13 April 1933, *J. & M.S. Clemens 32855* (**BM**!);– ibid., alt. 900 m, 12 November 1931, J. & M.S. Clemens 27056 (BM!);– ibid., alt. 900 m, 26 September 1931, *J. & M.S. Clemens 26607* (**BM**!). **MYANMAR**.**;– Upper Burma, Chin**: 23°16'10.8” N, 93°55'45.4” E, alt. 1,230 m, 25 November 2019, lvs., *N. Tanaka*, *S. Akiyama*, *Mu Mu Aung & S. Rueangruea MY5796* (**BKF**229782!, **NMNS**!, **RAF**!,);– **Lower Burma, Kayin**: Tenasserim, Tenasserim, and Andaman, April 1861, fl., *s.coll. 2053* (**K**!);– **Tanintharyi**: Myeik, Kyunsu, Pataw island, 12°27'27.91” N, 98°34'36.99” E, alt. 180 m, 8 June 2016, lvs., *S. Tagane*, *N. Tanaka*, *A. Naiko. & Mu Mu Aung MY433* (**BKF**!, **FU**!). **SINGAPORE**. South Side, Seletar Reservoir, 18 April 1993, lvs., *J. Sinclair 7347* (**E**00991952!);– Pipeline, Seletar Reservoir, 9 May 1993, lvs., *J. Sinclair 7412* (**E**00991953!);– *ibid.*, 9 May 1953, *J. Sinclair SFN 39615* (**K**!);– *ibid.*, 9 May 1993, *J. Sinclair 39615* (**K**!);– *ibid.*, Nee Soon Rifle Range, Seletar Forest, 23 Apr 1954, sterile, *J. Sinclair SFN 40263* (**K**!);– *ibid.*, Road leading to Nee Soon Rifle Ranger, Seletar Reservoir, 23 April 1954, lvs., *J. Sinclair 8047* (**E**00991954!). **THAILAND**. **Peninsular, Southern, Nakhon Si Thammarat**: Thung Song, Yong Waterfall, alt. 1,000 m, 11 March 1986, fr., *T. Smitinand*, *s.n.* (**BKF**097717!);– *ibid.*, Thung Song, Yong Waterfall, alt. 50 m, May, fl., *T.*

Smitinand & T. Santisuk 87 (**BKF**049611!);– *ibid.*, Kiri Wong, Khao Laung NP., 8°22'44.4” N, 99°44'15.8” E, alt. 279 m, 16 February 2015, fl., *S. Tagane*, *H. Toyama*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *H. Kanemitsu*, *W. Kiewbang & C. Hemrat T4252* (**FU**!);– *ibid.*, 8°43'02.6” N, 99°40'40.7” E, alt. 322 m, 14 December 2015, lvs., *S. Tagane*, *H. Toyama*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *H. Kanemitsu*, *W. Kiewbang & C. Hemrat T4940* (**FU**!);– *ibid.*, alt. 200 m, 17 March 1985, fr., *J.F. Maxwell 85-309* (**BKF**049625!, **E**00991979!, **L**1892566†, **P**03358562!);– **Phang Nga**: Khao Pawta Laung Kaew NP., 6°33'36.0” N, 100°08'24.0” E, alt. 1,300 m, 14 May 2004, fl., *S. Gardner & P. Sidisunthorn ST512* (**BKF**!);– **Phetchaburi**: Kaeng Krachan, Phanoen Thung ranger substation, Kaeng Krachan NP., 12°49'56.8” N, 99°21'32.6” E, alt. 826 m, 2 January 2020, lvs., *S. Rueangruea*, *A. Rueangruea & Sirichai & Sutuch. SR252* (**BKF**229839!, **TCD**!);– *ibid.*, 12°49'19.7” N, 99°21'57.7” E, alt. 960 m, 22 October 2013, fr., *S. Tagane*, *H. Nagamasu*, *A. Naiki*, *S. Rueangruea*, *S. Suddee*, *K. Fuse*, *W. Kiewbang & P. Pansamrong T1993* (**BKF**206322!, **FU**!);– **Ranong**: 10°33'25” N, 98°54'03” E, 24 April 1974, fl., *S. Phusomsaeng & Singhasthit S. 509* (**BKF**!);– *ibid.,* La-Un, 10°11'20.8” N, 98°42'50.7” E, alt. 100 m, 3 January 1929, fl., *A.F.G. Kerr 16525* (**BK**213989!, **K**!).;– *ibid.*, Suk Samran, Khlong Nakha WS., 9°20'38” N, 98°30'25” E, alt. 900 m, 8 December 2005, fl., *S. Gardner & S. Khumchompoo ST2032* (**BKF**!, **K**!);– *ibid.*, the road from Kampuan to Muang Chon, 9°20’N, 98°30E, alt. 90 m, 8 February 2005, fr., *S. Gardner & S. Khumchompoo ST2030* (**BKF**184166!, **K**!);– **Surat Thani**: Pa Kiampao, Tachang, 9°21'31” N, 98°38'48” E, 2 March 1974, fr., *B. Nimanong 9* (**BKF**049614!, **K**!, **KYO**!);– **Trang**: 7°33'18” N, 99°47'3” E, alt. 80 m, 15 March 1929, fr., *A.F.G. Kerr 17492* (**BM**!, **E**00991975!, **K**!, **TCD**0016636!);– *ibid.*, Na Yong, Khao Chong, 7°32'38” N, 99°47'33” E, 7 April 1971, fr., *S. Phusomsaeng 422* (**BKF**!);– *ibid.*, January 1962, lvs., *Ogawa*, *K. Yoda & K. Ogino 1129* (**KYO**!);– *ibid.*, 7 April 1971, fr., *S. Phusomsaeng 427* (**BKF**021805!, **K**!, **L**1892526†);– Palian, Khao Banthat WS., 7°17'40” N, 99°52'56” E, alt. 97 m, 2 May 2019, lvs., *S. Rueangruea*, *P. Puttarak & C. Suddoo SR221* (**BKF**229951-2!, **TCD**!);– Palian, Khao Banthat WS., Tontae waterfall, 7°17'40.3” N, 99°52'57.9” E, alt. 49 m, April 2003, fr., *Sinbumroong A. & Davies S. AS399* (**A**†, **BKF**157053!, **K**!, **L**4184442†);– Yan Takhao, Peninsular Botanic Garden (Thung Khai), 7°27'52” N, 99°38'26” E, alt. 47 m, 30 April 2019, lvs., *S. Rueangruea*, *P. Puttarak*, *C. Suddoo & S. Bunyavejchewin SR213* (**BKF**229941-2!, **TCD**!);– 7°32'38” N, 99°47'33” E, alt. 82 m, 1 December 1965, fl., *Bunnab C. 146* (**BKF**049610!);– *ibid.*, Yan Takhao, Peninsular Botanic Garden (Thung Khai): 7°28’N, 99°38’E, alt. 25 m, 20 February 2004, fr., *S. Gardner & P. Sidisunthorn ST0047* (**BKF**160734!, **K**!).

Distribution.— Western Thailand throughout Myanmar, Malaysia, Singapore, and Indonesia (**Maps 4.46 & 4.54**).

Vernacular name. — **Thailand**: นูดพระ Nude Pra (Thailand, Peninsula); Pepijat (Malay Peninsula).

Ecology.— Evergreen Forest, from sea level to alt. 1,500 m.

Phenology.— Flowering January–May; fruiting April–July.

Uses.— Not known.

Conservation.**—**This species is known from many locations (> 10 locations): EOO = 786,723.58 km^2; AOO = 68.00 km^2. The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern) (IUCN, 2019).

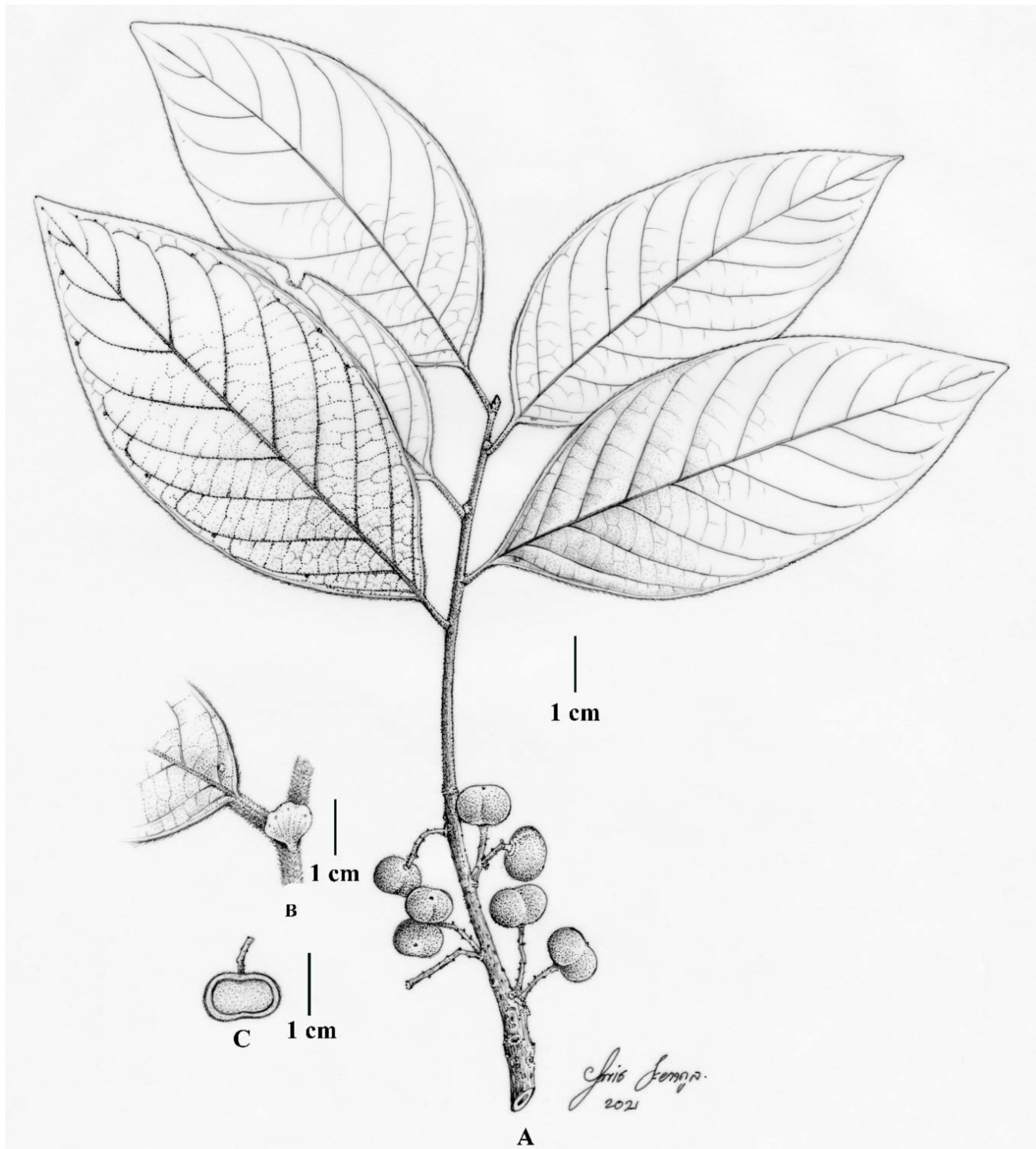


Figure 4.40. *Prunus ridleyi* (King) J.Wen **A**. fruiting branch, elliptic-oblong leaves, densely tomentose; **B**. stipule, medium to large stipule with many glands; **C**. fruits sparsely tomentose, endocarp and seedcoat with few hairs. All from *Sinbumroong A. & Davies S. AS399* (**BKF**). Drawn by Pairuch Rayangkul.

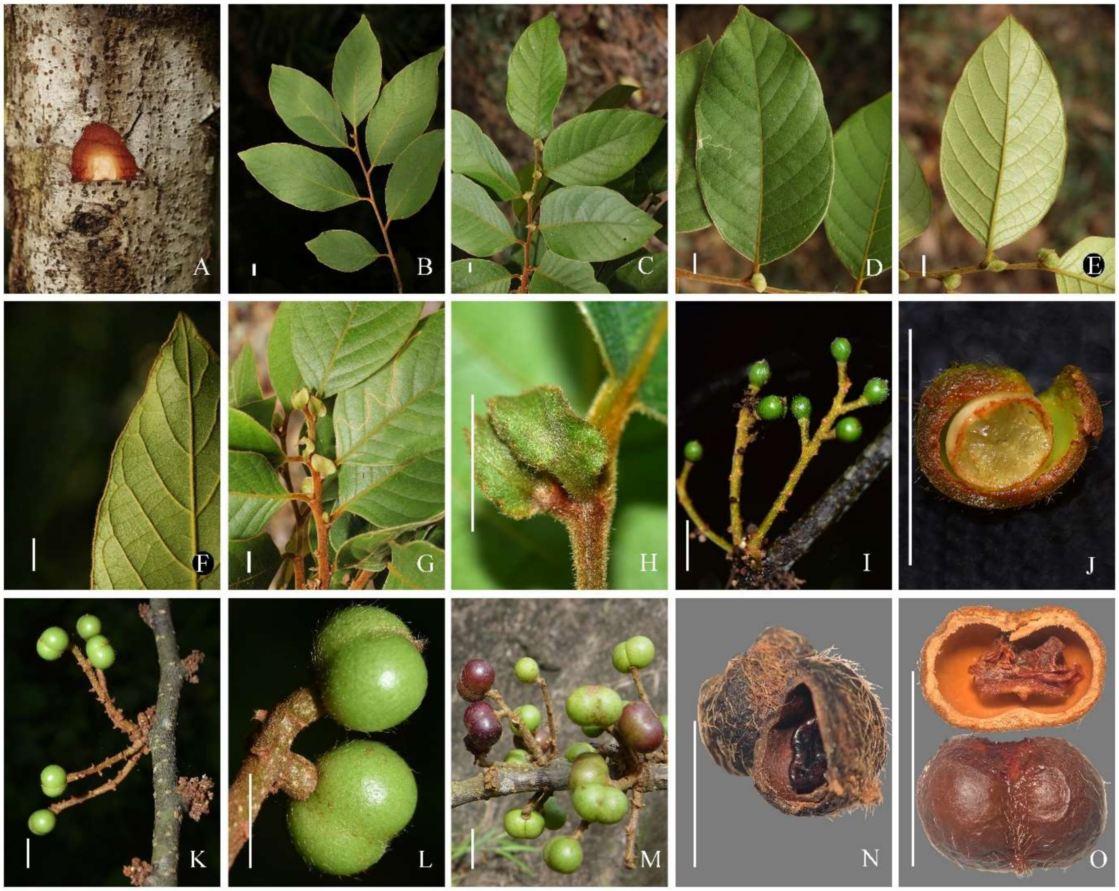
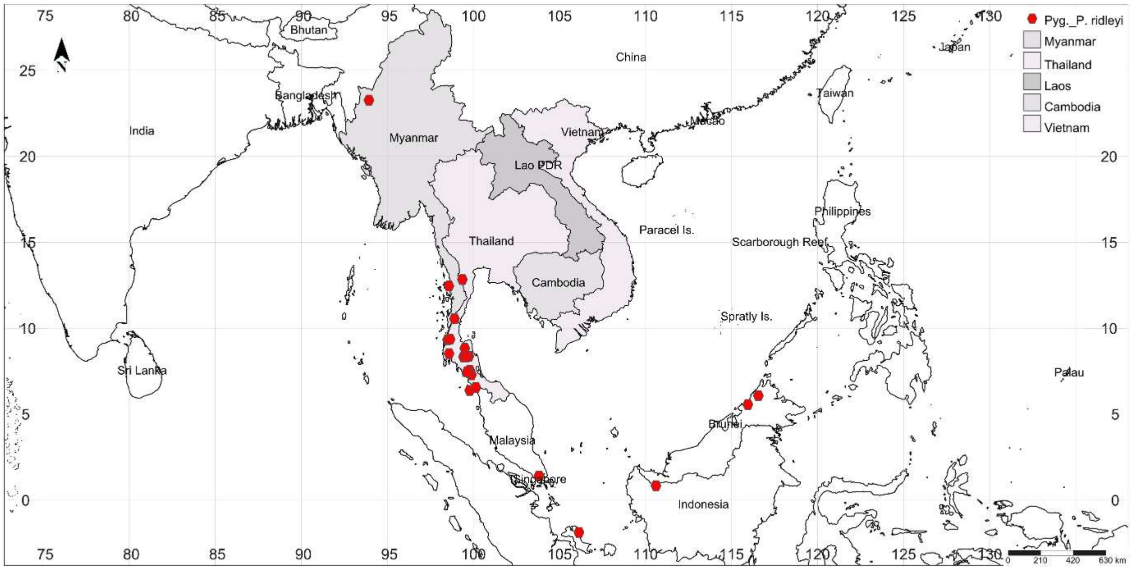


Figure 4.41. *Prunus ridleyi* J.Wen, habit, vegetative, and reproductive morphological characters; **A**, outer bark greyish brown, inner bark brown, **B**–**G**, leaves; **B**, leaves elliptic to elliptic ovate; **C**, twig rusty tomentose; **D**, coriaceous; rusty tomentose on both surfaces; **E**, lateral veins prominent abaxial, basal glands 2, inconspicuous; **F**, additional glands on the leaf blade near margin, margin ciliate; **G**, stipules large, tomentose; **H**, stipule blade with 2–8 circular glands; **I**, infructescence, fascicle in bundles of 2–6 racemes; young fruit hairy cross-section, endocarp, and seedcoat glabrous; **K–M**, infructescence; **K**, mature fruits; **L**, transverse ellipsoid, densely tomentose; **M**, turning black when ripe; **N–O**, fruit cross-section, endocarp and seedcoat glabrous to glabrescent. — Photos: A–G by S. Rueangruea; H–J by S. Raksue; K, L, N & O by T. Thannanthaisong; M by A. Sinbumroong. — Sources: all From **Thailand**: Nakhon Si Tahmmarat, K, L, O from *T. Thanantahisong et al. s.n.*: Petchaburi, C–E, G–J from *S. Rueangruea et al. SR252*: Trang, A, B & F from *S. Rueangruea & P. Puttarak SR221*; M; N from *S. Gardner & P. Sidisunthorn ST0047*. Scale bar = 1 cm.



Map 4.54. Distribution of *Prunus ridleyi* (King) J.Wen of sect. *Mesopygeum* in continental Southeast Asia and nearby.

51. ***Prunus latistipulacea*** **Rueangr., J.Parn. & Hodk. sp. nov.,** ***ined.***

Typification: **VIETNAM**. Annam, Lam Dong, Dinh Gia Rieng, Langbian, Bi Doup Nui Ba NP., 12º02'48.13” N, 108º26'06.67” E, alt. 1,918 m, 25 June 2018, fr., *S. Tagane*, *V.N. Ngoc & T.Q. Cuong V9023* (holotype **BKF**!, isotype **FU**!).

Description: Evergreen, sub-canopy, tree up to 25 m tall, canopy shape globose. **Stem** clear bole, erect; outer bark greyish-brown, smooth with distinct lenticels, living bark 4–5 mm thick, spines absent; inner bark, sap exudating gum; faint almond smell. **Branchlets** stout, greyish-brown; young twigs greenish-brown, densely rusty tomentose, cataphylls absent; old twigs sparsely hairy with light brown lenticels. *Axillary winter bud* solitary, ovoid; *terminal winter bud* absent. **Leaves** plicate in bud, alternate, ovate-oblong to broadly elliptic, 10–22(–25) cm long × 4–9 (–13) cm wide; *lamina apex* acute or acuminate, angle acute; *margin* entire, revolute, densely ciliate; *base* symmetrical or asymmetrical, broadly rounded to slightly cordate; young leaves dull green adaxially, pale green abaxially, turning yellow before falling, coriaceous; rusty tomentose on both surfaces, margins densely ciliate; old leaves rusty tomentose on both surfaces, margins densely ciliate, glabrescent or sparsely hairy, sparsely hairy on midrib adaxially, usually still distinctly hairy at least on midrib, nerves and petiole abaxially; *basal glands* present or absent, usually 2(0–1), up to 2 mm long, circular to oblong, flat or slightly hollow abaxially, over the base of leaf blade margin, sparse small circular glands near and along margin, especially on the upper half; *2°* ; *2° venation* brochidodromous, looped and anastomosing near the margin, 10–13 (–16) alternate on either side of the midrib, oblique, spreading and arched, spacing irregular, sunken adaxially, prominent abaxially, moderate to widely angled (50°–65°); *4° venation* alternate percurrent; *5° venation* regular polygonal reticulate; *petioles* 0.5–1.5 cm long, stout, shallowly canaliculate in cross-section or terete, pubescent; *petiolar glands* absent. **Stipules** on the twigs or petiole (pseudostipule), large, 4–8 (–15) mm long × (3–)7 (–10) mm wide, broadly ovate, apex acute to obtuse, margin entire, sparsely ciliate to glabrescent, base sessile, rounded to cordate, densely brown villose to glabrescent, with 4–10 nerves, sometimes with 2–8 circular glands, semi-persistent. **Inflorescences** compound, fascicle in bundles 2–4 racemes, rarely mixed with solitary ones, lax-flowered, mainly on the branches abaxial the leaves, 2–5 (–7) cm long, many-flowered, densely rusty pubescent; bracts 1–3, 0.6–0.8 mm long, size and shape variable, broadly elliptic, concave, apex acute or obtuse, densely hairy outside, glabrous inside, margin ciliate, caducous. **Flowers** bisexual, opening with mature leaves, white to cream-coloured with brown indummentum, sessile or short pedicellate, stout and short, 1–3 mm long, densely brown tomentose; *bracteoles* linear, 1–2.5 mm long, pale green, densely brown hairy outside, glabrous inside, early caducous; *hypanthium* campanulate, 2–3 mm long, densely brown hairy outside, hairy at the base, otherwise glabrous inside; *perianth* petals slightly different from calyx lobes, obscurely 6–8(–10)-lobes, subequal or (very rarely) more or less regularly divided into sepals and petals, but never very different, 0.3–0.5 mm long, hairy both sides and margin ciliate; *calyx* lobes perianth, triangular, minute, green, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, apex acute or obtuse, margin entire, ciliate, base truncate, separate in bud, spreading when mature, deciduous, pubescent outside and inside; *corolla* petals slightly different or indistinguishable from sepals, 0 (5)-merous or perianth, small, 1–1.5 mm long × 0.3–0.5 mm wide, subequal, petals not distinct from calyx lobes, or in one ± distinct whorl, triangular to ovate, sessile, apex acute to obtuse, margin entire, ciliate, base truncate, alternate with calyx lobes, tomentose outside and inside; *stamens* 20–30 in 1 to 3 series, exserted, longer than perianth; filament filiform, white, 2.5–3.5 mm long, usually glabrous or sometimes sparsely hairy on the lower half; anthers oblong-oval, *c.* 0.3 by 0.5 mm; *ovary* densely brown tomentose, 1 locular; *style* filiform, slender, 1.5–3 mm long, glabrescent at the base, glabrous in the upper half; stigma peltate, 1 mm in diameter. *Infructescence* 2–6 cm long, 2–2.5 thick, densely hairy to glabrescent, lenticellate, few, 1–3 fruited. **Fruits** fleshy, stipitate, 2–5 mm long, young fruit green, turning white to cream, red, dark purple, ultimately almost black when ripe, transversely ellipsoid to didymous, 1.1–1.6 cm long, 1.5–2 cm wide, apex retuse or obtuse; young and mature fruits densely tomentose; exocarp smooth and shiny, with a longitudinal groove; mesocarp fleshy, thin, white; endocarp stone bony, shallowly reticulate and shallowly longitudinal or ridged; endocarp densely hairy inside; calyx deciduous; style absent or minute at the end of the fruit. **Seeds** usually transversely globose laterally, thick, with hairy shallowly rugose testa, and seedcoat densely hairy (**Figure 4.42 & 4.43**).

Additional specimens examined.— **VIETNAM**. **Annam, Khanh Hoa**, Hon Ba, Bi Doup Nui Ba NP.: 12°6'46.88” N, 108°58'14.43” E, alt. 919 m, 21 February 2014, lvs., *H. Toyama*, *V.S. Dang*, *S. Tagane*, *K. Fuse*, *T. Yahara*, *H. Nagamasu*, *H. Tran*, *V.N. Nguyên*, *Q.C. Nguyên*, *N.T. Do*, *N.P.H. Ho V999* (**BKF**!, **FU**!);– **Lam Dong**, Cong Troi, 12°06'06.85” N, 108°23'00.32” E, alt. 1,866 m, 21 September

2018, fr., *S. Tagane & Truong Quang Cuong V9270* (**FU**!);– *ibid.*, Haut Donai, alt. 2,000 m, 19 October 1940, fr., *E. Poilane 31046* (**E**00991980!, **K**!, **MUS**†, **P**03358518!);;– *ibid.*, Bi Doup Nui Ba NP., 12°05'57"N, 108°22'35"E, alt. 1780 m, 19 May 2009, fr., *J.Wen, Nguyên Tiên Hiêp, Nguyen Quang Hieu, Le Van Son & D. Nong 11018* (**US**3589567†);– *ibid.*, Mt. Langbian, 12°02'46.3" N, 108°26'01.5" E, alt. 1,905 m, 25 March 2018, lvs., *T. Yahara*, *H. Nagamasu*, *H. Toyama*, *M. Zhang*, *N. Ai.*, *N.V. Ngoc.*, *H.T. Binh & K. Tsuchiyaojin V7962* (**BKF**!, **FU**!);– *ibid.*, Dalat, Boun Ja, 11°53'25.6" N, 108°28'47.6" E, June *s.n.*, lvs., *M. Schmid*, *s.n.* (**P**03358519!, **P**03358521!);– *ibid.*, Mang Lin, 19 October 1955, lvs., *M. Schmid 48* (**P**03358520!);– *ibid.*, Dinh Gia Rieng, Giang Ly, 12º09'36.61" N, 108º32'11.16" E, alt. 1,656 m, 16 June 2018, lvs., *T. Yahara*, *S. Tagane*, *M. Zhang*, *A. Nagahama*, *K. Tsuchiya*, *V.N. Ngoc & H.T. Binh V8415* (**BKF**!, **FU**!);– *ibid.*, Langbian, 12º02'48.13" N, 108º26'06.67" E, alt. 1,918 m, 24 June 2018, lvs., *S. Tagane*, *A. Nagahama*, *K. Tsuchiya & V.N. Ngoc V8953* (**FU**!);– **Nhatrang**, alt. 1200 m, 19 May 1922, *E. Poilane* 3415 (**P**03358522-4!, **VNM**00013180!).

Distribution.— Endemic to Vietnam, Annam, Bi Doup Nui Ba NP (known only from the specimens cited) (**Maps 4.46 & 4.55**).

Vernacular name. **— Vietnam**: Coy Do Cu.

Etymology.— The epithet 'latistipulata' refers to the enormous size of the semi-persistent stipules.

Ecology.**—** Primary and secondary forest, also in karangas and mossy forest types, alt. 900–2,000 m.

Phenology.**—** Flowering: October–November. Fruiting: November–December.

Uses.— Wood is light-coloured (few data).

Conservation.— This species is known from more than five locations: EOO = 2,419.09 km^2; AOO = 28.00 km^2. The number of individuals in the population is small, The number of mature individuals < 50. I consider the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1 (IUCN, 2019).

Note.— *Prunus latistipulacea* is highly distinctive in its leaf, floral, and fruit morphology compared with other species in continental Southeast Asia. *Prunus latistipulacea* is, however, most similar to *Prunus ridleyi* J.Wen, which, as more narrowly defined, corresponds to Kalkman's (1965), typical *P. arborea* var. *stipulacea* in having leaves densely covered with hairs, with significant and persistent stipules, 8–15 mm long, and with numerous glands. *Prunus latistipulacea* can, however, be easily distinguished by its leaf base that is broadly rounded to slightly cordate (vs. rounded to broadly acute), lateral veins 10–13 (–16) (vs. 9–12), bigger fruits, 1.1–1.6 cm long, 1.5–2 cm wide (vs. 0.7–0.9 cm long, 0.8–1 cm wide), endocarp and seedcoat densely pubescent (vs. endocarp densely hairy, seedcoat glabrous).

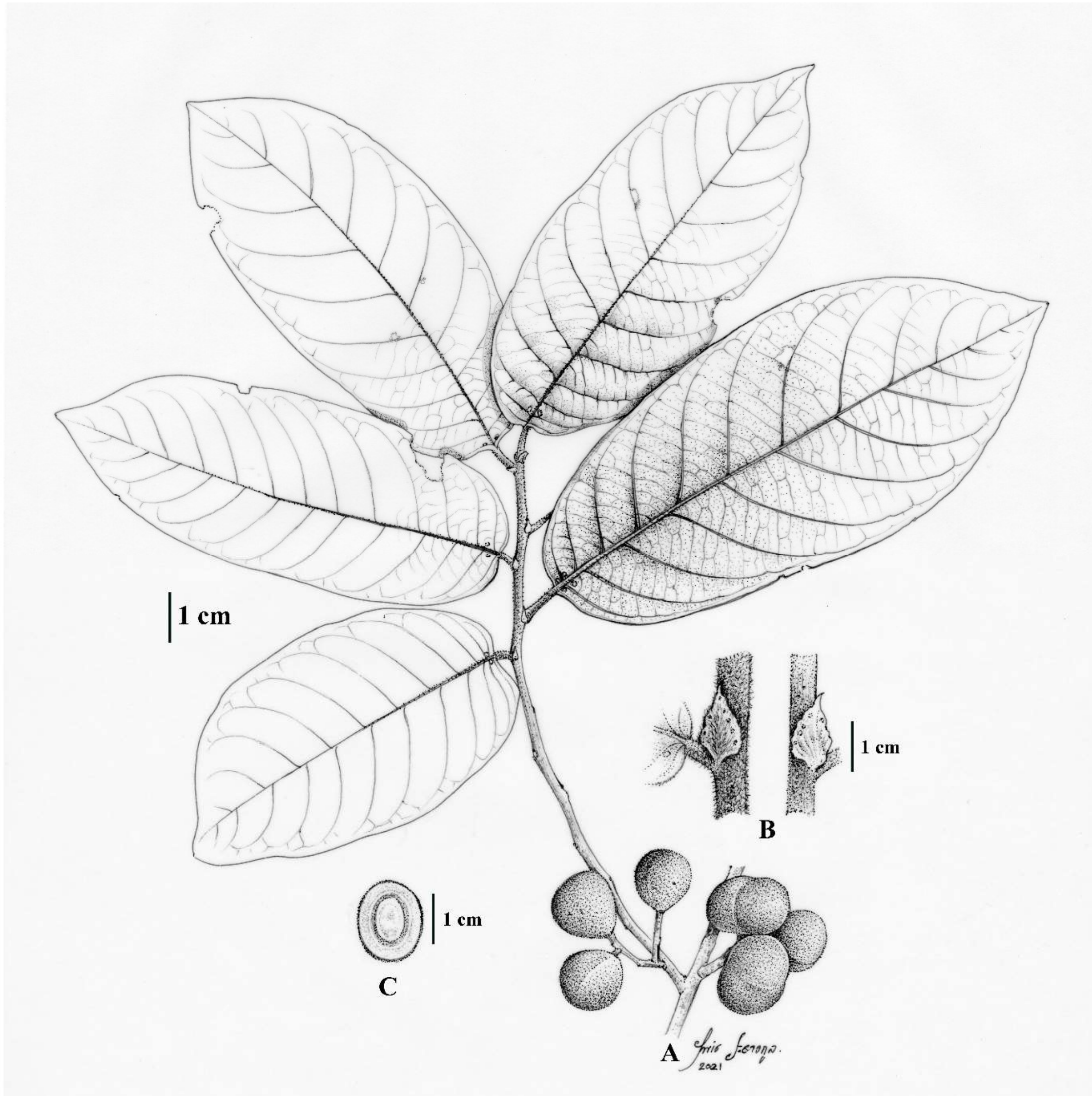


Figure 4.42. *Prunus latistipulacea* Rueangr., J.Parn. & Hodk. **A**. fruiting branch, all parts covered with tomentose hairs, oblong leaves; **B**. fruit (cross-section), fruit, inside of endocarp and seedcoat densely tomentose; **C**. many glands on the large stipule; All from *S. Tagane et al. V9023* (**BKF**). Drawn by Pairuch Rayangkul.

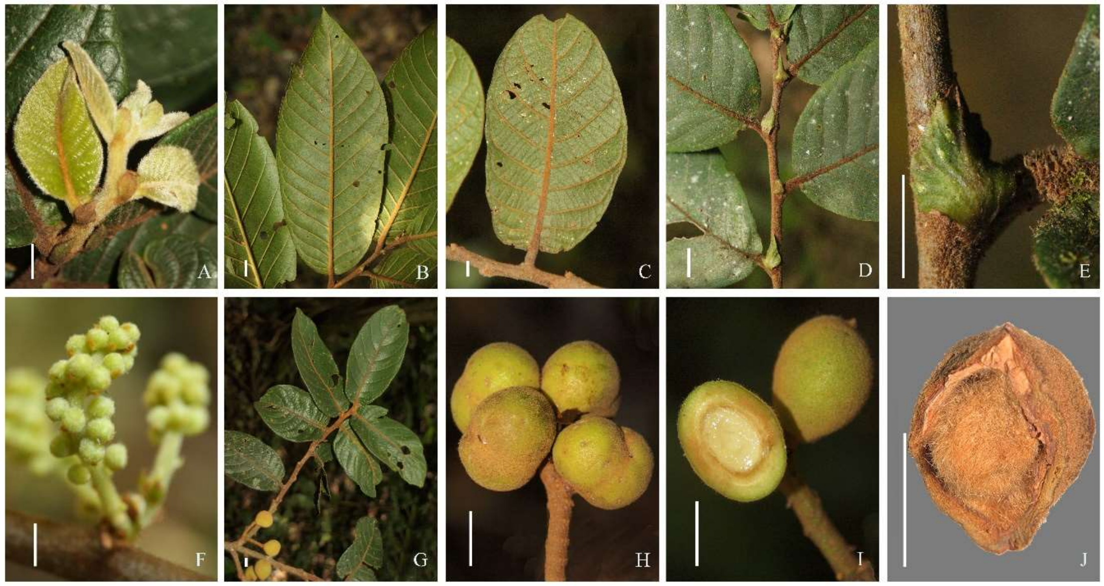
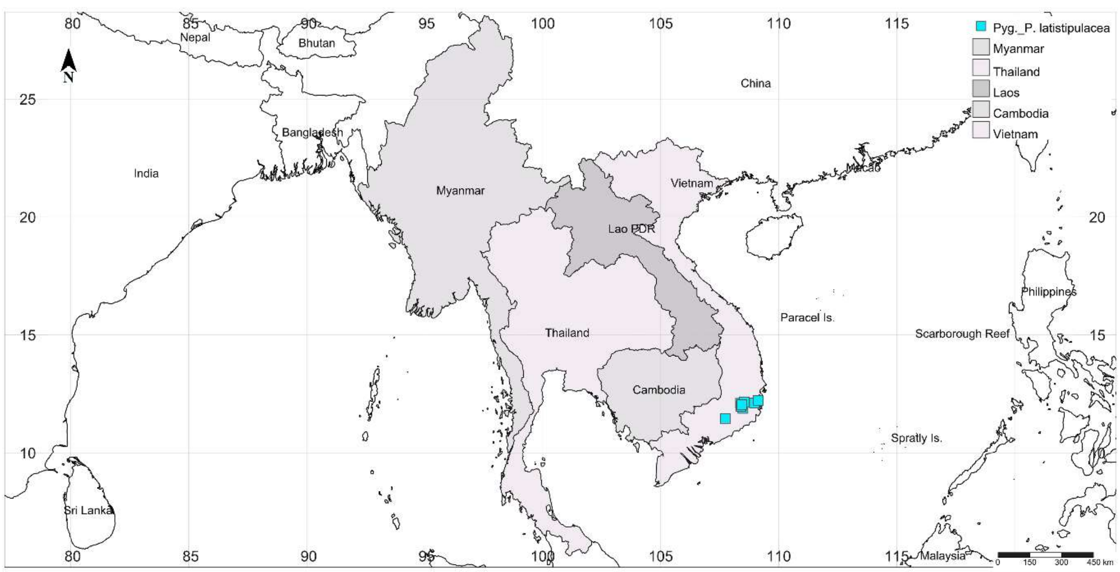


Figure 4.43. *Prunus latistipulacea* Rueangr., J.Parn. & Hodk., vegetative and reproductive morphological characters. **A–D**, leaves; A, young shoot, densely tomentose; **B**, leaves oblong; **C**, coriaceous, conspicuous scalariform abaxial; **D**, leaf alternate with large stipule; **E**, basal leaf slightly cordate, stipule and glands on the stipule blade; **F**, inflorescence, fascicle in bundles 2–4 racemes on the fallen leaves branch; **G**–**I**, infructescence; **G**, with leaves; **H**, mature fruits, transverse ellipsoid; **I** & **J**, cross-section; **I**, fruits tomentose; **J**, endocarp, and seedcoat densely hairy. — Photos: A, C, F–I by S. Tagane; B, D & E by S. Rueangruea. — Sources: all from **Vietnam**, Annam, Lam Dong, A, C, F–I from *S. Tagane et al. V9023*. Scale bar = 1 cm.



Map 4.55. Distribution of *Prunus latistipulacea* Rueangr., J.Parn. & Hodk. of sect. *Mesopygeum* in continental Southeast Asia.

4.4 The status of *Prunus* species

The IUCN Red List of the threatened *Prunus* species in continental Southeast Asia has been updated following the IUCN Red List information (http//www.iucnredlist.org) and tree assessments of the total number of the specimen examined of *Prunus* from herbarium specimens and data from GBIF database (https://www.gbif.org/search) and using GeoCat (the https://geocat.iucnredlist.org/) to perform rapid geospatial analysis of species simply and powerfully for Area of occupancy (AOO) and Extent of occurrence (EOO). The **Criteria** (1994-2001 Version 3.1-2001) following: EX − Extinct, EW − Extinct in the Wild, CR − Critically Endangered, EN − Endangered, VU − Vulnerable, (VU), (EN), (CR) − (According to some published criteria), NT − Near Threatened, LC − Least concern. As a result, the *Prunus* tree assesses 50 species in the study area. This species is currently known from only one locality, restricted to the Lower Montane Forest, Southern Thailand. The type locality is near the top of Khao Pawta Laung Kaew NP. However, only a few individual trees are known. I consider the conservation status of the species currently to be DD ((Data Deficient- (IUCN, 2019). There are 4 species: P. "inthanonensis," *P. longistyla, P.* "nanensis", and *P. santisukii*. There are 36 species from many locations (> 10). The number of individuals in each subpopulation is high. I consider the conservation status of the species currently to be LC (Least Concern). The species is known from more than five but ≤ 10 locations. The number of individuals in each subpopulation is ≤ 1,000. I consider the conservation status of the species currently to be VU (Vulnerable); B1B2aC2a(i)D25 There are 5 species, namely *P. apiculata, P. bokorensis*, *P. crassistyla, P. ferrea, P. lanceifolia* respectively. The species is known from not more than 5 locations. The number of individuals in the population is small, and the number of mature individuals is < 50. I consider the conservation status of the species currently to be CR (Critically Endangered); B1B2aC2a(i)D1; there are 6 species, namely *P. hongiaoensis*, *P. kaengkrachanensi*s, *P. latistipulacea*, *P. racemopilosa*, *P. vandebultii*, and *P.* "yalaensis" respectively.

4.5 Conclusions

This chapter has thoroughly updated and revised the taxonomic understanding of *Prunus s.l.* in continental Southeast Asia. In addition, the *Prunus* species are examined, described, and discussed with illustrations, distribution maps, nomenclature notes, and a key to the species.

Seven subgenera are recognized: *Amygdalus*, *Armeniaca, Cerasus*, *Padus*, *Maddenia*, *Prunus*, and *Laurocerasus*.. A total of 50 species of *Prunus* are identified in continental Southeast Asia, including three species whose taxonomic positions are unresolved. In total, the 50 species can be divided into the categories shown in Figure 4.44 that summarise the new findings of this chapter, such as the new species, new combinations, and new records, in the context of what was already understood. Absolute species numbers and percentages relative to the total of 50 are provided.

There are 28 (56 %) previously accepted species, namely *P. arborea*, *P. brachypoda*, *P. bracteopadus*, *P. buergeriana*, *P. campanulata*, *P. cerasoides*, *P. cornuta*, *P. fordiana*, *P. napaulensis*, *P. gongshanensis*, *P. himalayana*, *P. hongiaoensis*, *P. javanica*, *P. jenkinsii*, *P. kaengkrachanensis*, *P. lancilimba*, *P. maingayi*, *P. mugus*, *P. mume*, *P. persica*, *P. phaeosticta*, *P. pseudocerasus*, *P. salicina*, *P. serrula*, *P. trichantha*, *P. trichostoma*, *P. undulata*, and *P. zippeliana*.

There are five new species (10 %), namely, *P. bokorensis*, *P. latistipulacea*, *P. santisukii*, *P. taganei*, and *P. vandebultii*. There are also three new combinations, *P. apiculata*, *P. ferrea*, and *P. longistyla*; five (6 %) new combinations and new names, *P. indochinensis*, *P. lanceifolia*, *P. latifructa*, *P. koehnei*, and *P. poilanei*; and two new combinations and new status, *P. crassistyla*, and *P. racemopilosa*. There are three (6%) unresolved names, *P.* “inthanonensis”, *P.* “nanensis”, and *P.* “yalaensis”. In addition, the Chinese species, *Pygeum topengii* Merr is split out from *Prunus arborea* var. *montana* (Hook.f.) Kalkman.

A total of 236 synonyms are recognized from the 50 accepted specific taxa, including 25 names that are lectotypified here. These species are *Cerasus cantabrigiensis* (Stapf) Ohle, *Cerasus glaucifolia* Wall., *Cerasus puddum* Wall., *Cerasus trichostoma* (Koehne) T.T. Yu & C.L.Li, *Prunus bokorensis* Rueangr., J.Parn. & Hodk., *Prunus cornuta* var. *villosa* H.Hara, *Prunus glyptocarya* Koehne, *Prunus latidentata* Koehne, *Prunus lobulata* Koehne, *Prunus majestica* Koehne in Sarg., *Prunus micromeloides* Koehne, *Prunus nepalensis* sensu auct. Hook. f., *Prunus oxydonta* Koehne, *Prunus pleuroptera* Koehne, *Prunus santisukii* Rueangr., J.Parn. & Hodk., *Prunus taganei* Rueangr., J.Parn. & Hodk., *Prunus vandebultii* Rueangr., J.Pran. & Hodk., *Prunus zappeyana* Koehne, *Prunus zappeyana* var. *subsimplex* Koehne, *Pygeum acuminatum* Colebr. *Pygeum anomalum* Koehne, *Pygeum ferreum* Craib, *Pygeum henryi* Dunn., *Pygeum laxiflorum* Merr. ex H.L.Li, and *Pygeum montanum* Hook.f. respectively. In addition 28 new synonyms namely *Laurocerasus zippeliana* var. *crassistyla* (Cardot) T.T.Yu & L.T.Lu, *Prunus arborea* (Hook.f.) Kalkman var. *montana* Kalkman, *Prunus fordiana* Dunn. var. *racemopilosa* J.E. Vidal, *Prunus kingdonwardii* Merr., *Prunus macrophylla* var. *crassistyla* Cardot, *Prunus zippeliana* Miq. var. *crassistyla* (Card.) J. E.Vidal, Pygeum *acuminatum* Colebr., *Pygeum affine* Merr., *Pygeum anomalum* Koehne, *Pygeum apiculatum* J.E.Vidal, *Pygeum atrovillosum* J.E.Vidal, *Pygeum bachmaense* J.E.Vidal, *Pygeum brachybotrys* Merr. sensu auct. Kalkman, *Pygeum ciliatum* Koehne, *Pygeum cochinchinense* J.E.Vidal, *Pygeum donaiense* J.E.Vidal, *Pygeum donaiense* var. *crassistylum* J.E.Vidal, *Pygeum ferreum* Craib, *Pygeum gardneri* Hook.f., *Pygeum glaberrimum* Hook.f., *Pygeum henryi* Dunn., *Pygeum laxiflorum* Merr. ex H.L.Li, *Pygeum montanum* Hook.f., and *Pygeum ocellatum* Koehne, *Pygeum parreauanum* Pierre ex Cardot, *Pygeum sessiliflorum* Kalkman, *Pygeum sisparense* Gamble, and *Pygeum wilsonii* Koehne respectively. The high number of synonyms is due to several factors. Firstly, taxonomic information/literature was less freely available in the past than it is currently available for *Prunus*. Therefore, some synonyms reflect the need for more communication and the availability of literature. Secondly, it was often the case that limited plant material was available when the species were described, obscuring the range of morphological variation in the species/genus and leading to taxonomists relying on too variable characters, for example, the present or absence of hairs on a nonreproductive organ such as a leaf or twig. And many species have been previously incorrectly distinguished simply because they were collected in geographically separated areas, e.g., on different islands.

Four species (8 %) are new records to Thailand: *P. kalkmanii*, *P. polystachya*, *P. pygeoides*, and *P. ridleyi*. This updates biogeographic knowledge of the region and reflects the need to explore the region's diversity further. There is also no doubt that many species still need to be described because many specimens do not match any known species among the existing collections. Furthermore, some species that were collected are sterile (lack inflorescences). Some areas, such as Myanmar, Laos, and Cambodia, are still poorly sampled and lack taxonomic studies. Therefore, much of the flora of these regions remains undocumented, and future collection in these areas would undoubtedly yield several new *Prunus* species based on the rate of species discovery from this thesis. With several narrow endemics and few wide-ranging species with unexplained distribution patterns, subgen. *Laurocerasus* sect. *Laurocerasus* and *Mesopygium* they are distributed from low altitudes near the sea level to high elevations. According to the concept of Kalkman (1965), they would make an exciting subject for biogeographical studies. Building a dated molecular phylogeny of the subgenus, with a particular focus on the subgenera, would be an excellent point to answer some of the questions raised by the revised taxonomy of the *Prunus*. It would be wise to raise *Mesopygium* to subgeneric rank.

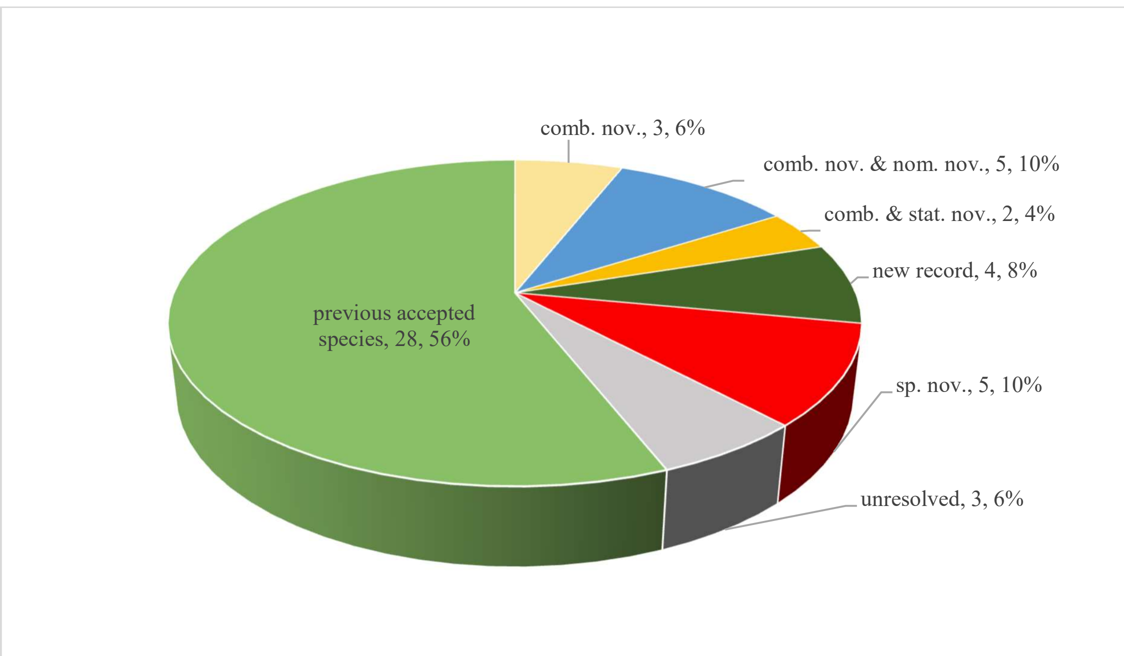


Figure 4.44. A summary of *Prunus* species in continental Southeast Asia. The number of species and their percentage relative to 50 species is shown.

Chapter 5 Biogeographical and ecological analyses

5.1 Introduction

Studying the distribution patterns of plants (phytogeography) is essential to understanding the origin, migration, distribution (disjunction or continuous), and evolution of the taxa studied in this thesis. Information about the history of land movements (plate tectonics) and other details on the biogeography of Southeast Asia that relate to the origin of flora can be found in two excellent publications: Biogeographical Evolution of the Malay Archipelago' edited by T.C. Whitmore (1987) and 'Biogeography and Geological Evolution of SE Asia' edited by Hall and Holloway (1998).

Rosaceous species have adapted to various environments, ranging from mesic to xeric communities and tropical forest to Tundra ecosystems (Zhang et al., 2017). The dating of the large-scale evolutionary history of Rosaceae remains poorly understood, although most previous dating studies estimated a stem age of Rosaceae between 90 and 80 Ma in the Late Cretaceous (Wikstrom et al., 2001; Li et al., 2015) and young age of only 40.8 or 31.9 Ma (Xue et al., 2012), and a period that is likely to be much too old of 367-170 Ma (Jeong et al., 1999). Rosaceae were estimated to have originated during the Late Cretaceous, with evidence for rapid diversification events during several geological periods. The important lineages rapidly diversified in warm and wet habits during the Late Cretaceous. The rapid diversification of genera from the early Oligocene onwards occurred in colder and drier environments (Zhang et al., 2017).

In the case of *Prunus,* it is worth noting that the genus may have originated in the early Miocene (30 Myr) (Tiffney, 1985). At this time, limited floristic exchange between Asia and Europe was still possible through 'island-hopping' across the Tethys Seaway (Tiffney, 1985).

Chin et al. (2014) indicate that the most recent common ancestor (MRCA) of temperate crop species was a component of the continuous boreotropical forests of the Northern Hemisphere, while the MRCA of tropical species represented the last remains of the boreotropical elements and subsequently radiated throughout the Old and New World tropics from refugial areas at lower latitude. Several geologic events, climatic oscillations, and independent dispersals across continents via the Bering and the North Atlantic Land Bridge during different geographic periods drove complex biogeographic histories leading to the present global distribution of *Prunus* (Tiffney, 1985). However, hypotheses about evolutionary trends, interrelationships, and biogeography of *Prunus* in continental Southeast Asia are based on minimal data. This chapter aims to provide a brief synopsis of the habitats, ecology, distribution, and endemism of *Prunus s.l.* with particular emphasis on continental Southeast Asian taxa.

Prunus is wildly distributed throughout Asia from India to New Guinea and the Solomon Islands, Europe, North America, Central America, and South America, with only a few species in Australia and Africa (Kalkman, 1965; Wen et al., 2008; Zhao et al., 2018). *Prunus* is defined by various morphological characters, as described in Chapter 2, and can be divided into seven subgenera and two sections (Kalkman, 1965). It is a classification I accept and follow (see key in Chapter 4). It appeared that individual subgenera differed in characteristic morphology and possessed discrete distributions (latitude, longitude, and altitude).

In this chapter, therefore, I further dissect the distribution of *Prunus* in terms of a simple consideration of the available data under various headings and, where appropriate, statistically test the available data. The areas I explore are:

1. Are there general patterns to *Prunus* species' ecology and habitat preferences in the area under study (Section 5.3)?
2. Do the subgenera/sections exhibit different patterns of distribution (Section 5.4)?
3. What patterns or changes, if any, are notable in the distribution of *Prunus* by floristic regions (Section 5.5.1)?
5. How do topographic factors affect the distribution of *Prunu*s (Section 5.5.2)?
6. What patterns or changes, if any, are notable in the distribution of *Prunus* by country (Section 5.5.3)?
7. Is there congruence between the phytogeographic regions and the numbers and types of *Prunus* species they contain (Section 5.5.4)?
8. Are there discernable patterns in the distribution of cultivated and widespread endemic taxa (Section 5.6)?
9. How do the currently generally recognized phytogeographic regions of Thailand and Peninsula Malaya relate to *Prunus* (Section 5.7)?
10. Does an analysis of provincial (Changwat) data reflect the phytogeographic regions recognized (Section 5.8).?

5.2 Materials and methods

In order to approach an answer to these questions, I use some statistical analysis where appropriate. Specifically, I use the Kruskal-Wallis test. This nonparametric (distribution-independent) statistical test allows the testing of samples to see whether they have the same distribution. It therefore allows comparisons of latitude, longitude, and altitude. It extends the Mann-Whitney U test (commonly used for comparing only two groups), which I also use. The Sørensen Coefficient is used to compare the similarity of common species to pairs of individual countries. In this case, the formula for the Sørensen Coefficient is:

$$\mathbf{CCs(\%) = 2*c/(S1+S2)*100}$$

Where: c = the number of species common to both communities

S1 = the number of species in community 1

S2 = the number of species in community 2

A standard multivariate tool used in this chapter to analyze non-parametric data: non-metric multidimensional scaling or NMDS. NMDS aims to collapse information from multiple dimensions (e.g., from various communities, sites, countries, etc.) into just a few to visualize and interpret them more easily. Though computer processor power is very demanding, NMDS is a highly flexible

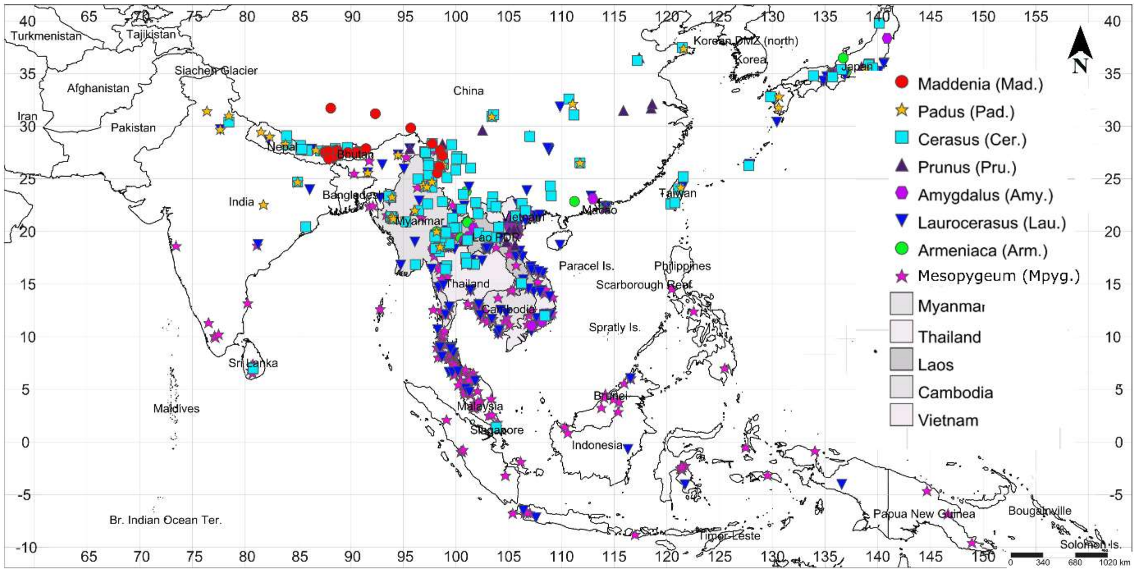
methodology that can accommodate various kinds of data. The goal of NMDS, as used here, is to present the original position of communities in multi-dimension space as accurately as possible using a reduced number of dimensions that can be easily plotted and visualized. So, I used NMDS to understand the interrelationships between floristic regions and between Changwats based on presence-absence data for *Prunus* species. NMDS preserves the original rank orders of the data, though distances between points may not be precisely scalar.
The analyses were performed using IBM SPSS Statistic (v. 28.0.1.1(142)).

5.3 General comments on distribution

Prunus species grow in diverse habitats at various altitudes, from sea level to 4,300 m. They are found in dry, moist, cold temperature environments, in shade or open areas, by stream banks, roadsides, or path-sides in various forest types (see below), on sandy soil, and multiple bedrocks, though mainly limestone. They occur on dunes in the desert and across multiple forest types (Tropical Evergreen, Dry Seasonal Evergreen, Mixed Deciduous, Lower Montane, Upper Montane, and Alpine). The distribution of *Prunus* species is varied (see the distribution data and maps in Chapter 4). Based on existing records and my field trip experience, only one species, *Prunus indochinensis*, appears confined to a single habitat type - Dry Deciduous Dipterocarp Forests

Some *Prunus* species show disjunct or widespread distributions. These species may have had a much broader range of distribution than today, which has subsequently been fragmented, or perhaps their distribution is continuous. Still, they have not been collected (generally, the number of specimens is low). Such species are *Prunus crassistyla* (Tonkin Vietnam, absent from Annam and Cochinchine, Cambodia), *P. lancilimba* (Tonkin Vietnam, Upper Myanmar, not found in China), *P. vandebultii* (Upper Myanmar, Northern Thailand), and *P. ridleyi* (Upper Myanmar, Peninsular Thailand, and Malesian region, absent from central Myanmar).

Field experience shows two influential groups may be recognized: 'hill plants' and 'plains plants' (**Appendix 3**). The first group comprises northern species, reported chiefly from localities above 500 m altitude (usually occurring at alt. 1,000–4,300 m) and in Lower Montane, Upper Montane, and Alpine Forest. The majority of this group are cultivated species belonging to subg. *Amygdalus*, *Armeniaca*, *Cerasus*, and *Prunus* are the most widely distributed species in subg. *Maddenia,* and *Padus.* Their distributions stretch from northern Indo-Burmese and Sino-Himalayan to Indo-Chinese regions. The second group contains some widespread taxa, but the majority belong to subgenus *Laurocerasus*, both sects. *Laurocerasus* and *Mesopygeum*. They are distributed in the southern Indo-Burma, Indo-China, and Malaysian regions.



Map 5.1. The distribution of *Prunus* species included in this thesis by subgenera/sections: *Amygdalus*, *Armeniaca, Cerasus*, *Laurocerasus* (sect. *Laurocerasus*, *Mesopygeum*), *Maddenia*, *Padus*, in continental Southeast Asia and nearby. Points represent samples studied in this thesis.

5.4. Distribution by subgenera/sections

Map 5.1 shows the *Prunus* subgenera/sections distribution in continental Southeast Asia and nearby based on this study. From this map, it is clear that in continental Southeast Asia, the region with the highest concentration of subgenera and taxa is Doi Inthanon National Park in Northern Thailand because almost all subgenera (except for subg. *Maddenia*) of Asian *Prunus,* including *P.* "inthannoensis," the sterile specimens I suspect to belong to subg. *Padus* occurs in this region (**Map 5.1**). Very few *Prunus* are found in Cambodia and Laos, with 12 and 13 species, respectively. The high concentration of species in Thailand and Doi Inthanon may be an artifact, as other countries in the immediate region have not been well-botanized. I still do not have enough information about the occurrence of *Prunus* taxa in this region.

Subgenus *Maddenia*

Subgenus *Maddenia* contains approximately 40 species (Backer and Bakhuizen van den Brink 1963). Their distribution ranges from the central Himalayas to Northern India, Bhutan, Tibet, Nepal, Sikkim, N. Myanmar, and China. About seven species (five endemics) are restricted to China (Lu et al., 2003). In this study, in the region roughly between 25ºN and 40ºN and between 85ºE and 110ºE, there are two species from this subgenus in the study region (**Map 5.1**): *P. himalayana* and *P. gongshanensis* (**Map 4.1**). These highland and likely cold temperature species occur in open areas, shady valleys, or on the edges of Lower Montane and Upper Montane to Alpine Forest, 1,500–4,200 m.

Subgenus *Amygdalus*

Subgenus *Amygdalus* contains approximately 40 species and occurs in Central, Eastern, and Southwestern Asia (Lu et al., 2003). Many species and cultivars are grown for their edible fruit or as garden ornamentals, and a few species are also grown for their edible seeds. In this study, there is only one species, *P. persica,* in the region, and it grows roughly between 10°N and 30°N and between 95°E and 115°E (**Map 4.2; Map 5.1**). *Prunus persica* is native to India (Assam, East Himalaya, East Bengal), China (Yunnan), and Myanmar, and is cultivated in orchards in temperate regions and on tropical mountains and may escape from cultivation along roadsides, field borders, forest edges, grasslands, waste fields, and hills and mountainsides. It grows at elevations between (300–)1,000–3,000 m.

Subgenus *Prunus*

Subgenus *Prunus* contains approximately 30 species. It occurs in Asia, Europe, and North America. It may be found roughly between 15°N and 30°N and 85°E and 120°E (Map 4.3). Many plum species are cultivated for their edible fruit and some for their flowers (Lu et al., 2003). Many species are used as garden ornamentals; a few are grown for their edible seed. In this study, only one species, *P. salicina*, exists in the region (**Map 5.1**). These species are native to the S. Russian Far East, China, Vietnam, Taiwan, and Japan. They have been introduced (cultivated) in temperate regions and on tropical mountains of Myanmar, Thailand, Laos, and Korea. They occur over a broad range of altitudes (300–) 800–2,600 m but significantly above 800 m along forest edges or in forest openings, along mountain trails, and streamsides in valleys.

Subgenus *Armeniaca*

Subgenus *Armeniaca* contains approximately 11 species. It is distributed in East to Southwest Asia (Lu et al., 2003). Many species and cultivars are grown for their edible fruit or as garden ornamentals, and a few species are also grown for their edible seed. In this study, only one species, *P. mume,* occurs in the region (**Map 5.1**). It grows between 17°N and 40°N and 95°E and 140°E (**Map 4.4**). It is native to South-Central China but has been introduced into North-Central China, Southeast China, Hainan, Mongolia, Japan, Korea, Manchuria, Taiwan, Tibet and Xinjiang, Myanmar, Thailand, Laos, Vietnam and is widely cultivated in orchards in temperate regions and on tropical mountains. In my study, I found this species in a broad range of altitudes (100–)1,000–3,200 m. on forest slopes, open areas, streamsides, slopes along trails and mountains, and also commonly cultivated.

Subgenus *Cerasus*

Subgenus *Cerasus* contains approximately 150 species. Many species and cultivars of this subgenus are grown for their edible fruit or as garden ornamentals. A few species are also grown for their edible fruit in temperate Asia, Europe, and North (Lu et al., 2003). In this study, I have recorded seven species of this subgenus: *P. campanulata, P. cearasoides, P. mugus, P. pseudocerasus, P. serrula, P. trichantha,* and *P. trichostoma* (**Map 5.1**). These species may all be found between 2°N and 40°N and 75°E and 145°E (**Map 4.5**). These species are native to temperate Himalaya, China, Pakistan, Sri Lanka, India (Assam, Himalaya), S. Myanmar, China, Thailand, N. Laos, Cambodia, N. Vietnam, Taiwan, and Japan. Some species have been introduced into continental Southeast Asia, Alabama, Nansei-Shoto, and New Zealand and cultivated in orchards in temperate regions and tropical mountains. In my study, I found that they occur in subtropical forests, on sunny mountain slopes, and along the sides of ravines, between (300–) 800–2,000 (–4,300) m.

Subgenus *Padus*

Subgenus *Padus* contains approximately 20 species. Many species and cultivars are grown for their edible fruit or as garden ornamentals. Most are native to north-temperate regions (Lu et al., 2003) (**Map 5.1**). I have recorded six species of this subgenus in this study: *P.* "inthanonensis"*, P. brachypoda, P. bracteopadus, P. buergeriana, P. cornuta, and P. napaulensis.* They may be found between 17°N and 40°N and 75°E and 115°E (**Map 4.13**). Their native distribution is the Northern Temperate region: India (Assam, West Himalaya), Nepal, Myanmar, China Tibet, China East Himalaya southeast to Central China, China North-Central, China South-Central, China Southeast, East Himalaya, Japan, and Korea. They occur in subtropical Lower Montane Forest to Upper Montane Forest, in shaded or open areas, along trails, slopes, valleys, and sides of ravines, between (300–) 600–2,000 (–3,200) m.

Subgenus *Laurocerasus,* section *Laurocerasus*

Section *Laurocerasus* contains approximately 80 species. These occur in tropical Asia, Europe, New Guinea, and North and South America (Lu et al., 2003). An incredible density of species of this section of Subgenus *Laurocerasus* is found in southern China and other countries (Assam, Myanmar, Thailand, Vietnam, and the Malesian region) (**Map 5.1**). In this study, I recognized fourteen species from this section in Asia, including five species in continental Southeast Asia: *P. fordiana*, *P. jenkinsii*, *P. phaeosticta*, *P. wallichii*, and *P. zippeliana.* Their native distribution in Asia is the Northern Temperate region: they may be found throughout Asia, the Himalayas, India (Assam et al.), Nepal, Myanmar, Japan, and Korea through the Malesian region. They grow in subtropical forests, in shaded or open areas, along trails, slopes, valleys, and the sides of ravines in Evergreen Forests, Tropical Rain Forest, Dry Seasonal Evergreen Forest, Lower Montane Forest to Upper Montane Forest, between (300–) 600–2,000 (–3,200) m. They may be found from 10(N to 40°N and between 75°E and 140°E.

Subgenus *Laurocerasus* sect. *Mesopygeum*

Section *Mesopygeum* contains approximately 40 species, of which 22 occur in continental Southeast Asia. Their native distribution ranges from Africa and the Pacific Islands to tropical Asia from India to New Guinea and the Solomon Islands, with one species in Queensland (Australia) (Kalkman, 1965; Lu et al., 2003); (**Map 5.1**). In this study, I have found that they occur throughout Asia, roughly between 10°N and 40° N and between 70°E and 150°E. Their native distribution in Asia is the Northern Temperate region: they may be found throughout Asthe Himalayaslaya, India (Assam et al.), Nepal, Myanmar, Japan, and Korea through the Malesian region (**Map 5.1**). They grow in a subtropical forest, shaded or open areas, along trails, slopes, valleys, and sides of ravines in Evergreen Forests: Tropical Rain Forest, Dry Seasonal Evergreen Forest, Lower Montane Forest to Upper Montane Forest, from 0–2,800 m altitude. This section appears to be most species-rich in Malesia rather than Indo-Burma and Indo-China. Moreover, I believe that more species of this section, new to science, will likely be found at low altitudes rather than in the highlands on mountains.

In comparison, Kalkman (1965) reported 34 species of sect. *Mesopygeum* is from the Asiatic region, with only four species north of the Thai-Burmese Peninsula. By contrast, this study recorded 22 species from continental Southeast Asia, with 14 species north of the Thai-Burmese Peninsula. In continental Southeast Asia, Myanmar has 6 species (two *comb. nom.* as in *P. indochinensis* and *P. latifructa*). Thailand has 13 species (3 sterile species, four *comb. nov*. as in *P. indochinensis*, *P. koehnei*, *P. latifructa*, *P. poilanei,* one new record (*P. kalkmanii* and *P. ridleyi*) and two new species (*P. bokorensis* and *P. santisukii*): Laos has 4 species (three new combinations): Cambodia has 5 species (three new combinations, and one new species (*P. bokorensis*)): Vietnam has 10 species (six new combinations, and two new species (*P. latistipulaceae*, and P. *taganei*)).

There is a crossover in any analysis between the distribution of *Prunus* by floristic region and by political entity: both are considered below.

5.5 The distribution of *Prunus* by floristic regions and countries

5.5.1 *Prunus* in the continental Southeast Asian and Chinese floristic regions

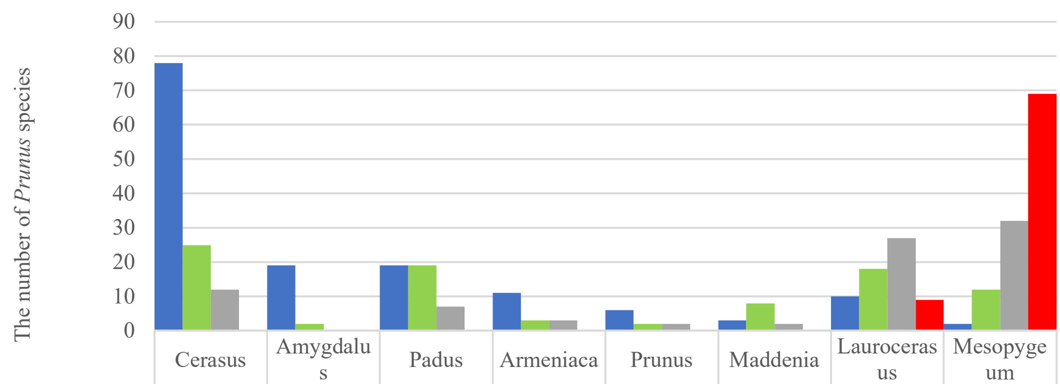
Several *Prunus* accounts for South Asia, South China, and Malesian regions have been published (e.g., **Indo-Burmese region**: Enumeration of the Flowering Plants of Nepal (Hara et al., 1978), Flora of Bhutan (Grierson and Long, 1983), Flora of British India (Hooker, 1878), Flora of Ceylon (Tirvengadum, 1981), Forest Flora of British Burma (Kurz, 1877) and Checklist of Myanmar (Burma) Plants Published (Kress et al., 2003), The Flora of Eastern Himalaya (Hara & Williams, 1979); **Indochinese region**: Flora of China (Lu et al., 2003), Flore Generale de L'Indo-Chine (Cardot, 1920), Flora of Thailand (Vidal, 1970), Flore du Cambodia du Laos et du Vietnam (Vidal, 1968); **Malesian region**: Flora Malesiana (Kalkman, 1993), Tree Flora of Malaya (Prance & Whitmore, 1972), etc.), and have been previously studied from various researchers (*e.g.,* Kalkman, 1965, 1993; Vidal, 1968, 1970; Wen et al., 2012; Zhao, 2018). Based on present information, the 28 taxa which probably entered continental Southeast Asia from the north, northwest, or west include *P. arborea*, *P. brachypoda*, *P. bracteopadus*, *P. buergeriana*, *P. cearasoides*, *P. cornuta*, P. *gongshanensis*, *P. himalayana*, *P. indochinensis*, *P. javanica*, *P. jenkinsii*, *P. lancilimba*, *P. latifructa*, *P. maingayi*, *P. mugus*, *P. mume*, *P. napaulensis*, *P. persica*, *P. phaeosticta*, *P. pygeoides*, *P. ridleyi*, *P. salicina*, *P. serrula*, *P. trichantha*, *P. trichostoma*, *P. undulata*, *P. vandebultii*, and *P. zippeliana*.

Indo-China species

Indo-China is one of the most diverse regions for *Prunus,* with 39 species concentrated in this location. The following are undoubtedly Indo-Chinese taxa: *P.* "inthanonensis," *P.* "nanensis", *P.* "yalaensis", *P. apiculata*, *P. arborea*, *P. bokorensis*, *P. campanulata*, *P. cearasoides*, *P. crassistyla*, *P. ferrea*, *P. fordiana*, *P. hongiaoensis*, *P. indochinensis*, *P. javanica, P. kaengkrachanensis*, *P. kalkmanii*, *P. koehnei*, *P. lanceifolia, P. lancilimba*, *P. latifructa*, *P. latistipulacea*, *P. longistyla*, *P. maingayi*, *P. mume*, *P. persica*, *P. phaeosticta*, *P. poilanei*, *P. pseudocerasus*, *P. pygeoides*, *P. racemopilosa*, *P. ridleyi*, *P. salicina*, *P. santisukii*, *P. serrula*, *P. taganei*, *P. trichostoma*, *P. undulata*, *P. vandebultii*, and *P. zippeliana*. The Tenasserim range acts as the western barrier for many Indo-Chinese species, *e.g.,* for members of subg. *Laurocerasus,* as in *P. jenkinsii,* and almost all subg. *Padus* as in *P. brachypoda, P. bracteopadus, P. buergeriana, P. cornuta, P. mugus, P. napaulensis.* I fully agree with Suddee (2001) that these species occur in Indo-Burma and do not cross this range with their westmost distribution around Kanchanaburi, a western province of Thailand. Information about the flora of the Tenasserim area is still very scanty. There are few recent collections as the areas along the Thai-Burmese border are complex and potentially dangerous to access.

Malesian species

Kalkman (1993) recognized 34 species from the Malesian region, eight of which are distributed in the Malay Peninsula. There are a total of 13 species of *Prunus* in the Malay Peninsula, namely *P. arborea*, *P. glabifolia*, *P. javanica*, *P. hendersosnii* J.Wen, *P. kalkmanii*, *P. lamponga* (Miq.) Kalkman, *P. maingayi* (Hook.f.) J.Wen, *P. malayana* Kalkman, *P. ridleyi* J.Wen, *P. ruthii* J.Wen, *P. patens* (Ridl.) J.Wen, *P. polyatachya*, and *P. undulata* (Wen et al., in press). These species include the vast majority of intensively studied *Prunus* in this region (*e.g*., Kalkman 1965, 1993; Zhao, 2018, and Wen & Potter, in press). A summary of the distribution of *Prunus s.l.* taxa studied in this thesis in continental Southeast Asia as divided by subgenera or sections, including the distribution by altitude, is given in **Appendix 3.**



	Cerasus	Amygdalus	Padus	Armeniaca	Prunus	Maddenia	Laurocerasus	Mesopygeum
China	78	19	19	11	6	3	10	2
Indo-Burmese	25	2	19	3	2	8	18	12
Indochinese	12	0	7	3	2	2	27	32
Malesian	0	0	0	0	0	0	9	69

Figure 5.1 compares the distribution of the native *Prunus* species divided by subgenera or sections into four floristic regions.

A comparative bar chart representing the number of native *Prunus* species divided into subgenera/sections and by floristic region is presented in **Figure 5.1**. Each category usually has four colored bars next to each other, one for each floristic region. The Chinese region usually dominates in subg. *Cerasus, Amygdalus, Padus*, and *Armeniaca* have 78, 19, 19, and 11 species, respectively. In other words, these are not only distributed at high latitudes but are also more found at higher altitudes than the rest of the subgenera (see discussion below). There is a similar proportion of *Prunus* species in Indo-Burmese and Indochinese regions—only trees in sect. *Laurocersus* and *Mesopygeum* occur in the Malesian floristic region. In addition, *Mesopygeum* has spread more significantly than *Laurocerasus* in the Malesian region. Over continental Southeast Asia, most species occur in the Indochinese region. The dominant *Prunus* species are members of section *Mesopygeum,* followed by *Laurocersus,* with 32 and 27 species, respectively. There are no native species of subg. *Amygdalus* in this region. On the other hand, subg. *Cerasus* is more commonly distributed than the rest of the subgenera, with 12 species.

5.5.2 Testing the distributions of the sections/subgenera in relation to latitude, longitude, and altitude

It is clear from Section 5.5.1 above that the different sections/subgenera of *Prunus* are not evenly distributed over the floristic regions of continental SE Asia. In this section, I explore the differences further and attempt to see if the sections differ from each other in terms of three factors: latitude, longitude, and altitude.

Altitudinal zonation (or elevation zonation in mountainous regions) describes ecosystems' natural layering at distinct elevations due to varying environmental conditions. In addition, the temperature of a place decreases with increasing altitude from the earth's surface. As a result, the pattern of variation of plant species reflects in part elevation. *Prunus* species can be found above mean sea level up to near the uppermost limit of growth of plants. The characteristic morphology is significantly different, changing gradually at different elevations. For example, leaves are usually entire in lowland species, <2,500 m (vs. serrate in high altitude species, > 2,000 m), and the indumentum, which can cover and be dense on the twigs, leaves, or young parts, may almost or absent in the same species, the terminal bud of a twig may lack scales (or lack winter buds) (vs. terminal bud with scales or winter buds present in high altitude species), inflorescence a short single raceme or 2–6-bundles, and erect (vs. inflorescence of single flowers, fascicles, compound corymbs, often pendulous in high altitude species), usually entomophilous (vs. usually anemophilous in high altitude species, my notice). It appeared to me that altitude is one of the most significant factors affecting the distribution of *Prunus* species composition in continental Southeast Asia.

Table 5.1. A nonparametric test comparing all eight subgenera/sections based on three different factors, latitude (Y), longitude (X), and altitude (m), using the Kruskal-Wallis test.

Test Statistics

	Y	X	Alt.
Kruskal-Wallis H	686.274	171.705	475.589
df	7	7	7
Asymp. Sig.	< 0.001	< 0.001	< 0.001

Table 5.1 clearly shows that there are significant differences overall in terms of the latitude, longitude, and altitude of the sections/subgenera. This, therefore, allowed a Mann-Whitney U test to be performed for the differences between pairs of two groups (**Table 5.2**).

In terms of longitudinal factors

Table 5.2 shows that the distribution of *Prunus* in continental Southeast Asia can be divided into two main groups based on longitude.

1. A Himalayan group containing *Prunus* species in subg. *Maddenia* and *Padus* are restricted to low latitudes, in the Himalayan mountains, throughout the upper Indo-Burmese region, and in Southwestern China. However, there are significantly different elevations between subg—*Maddenia* and *Padus*, around 91.61±4.28˚E and 97.61±14.55˚E.

2. A group of diverse regions. This second group occurs between 95˚E and 125˚E. Even though they are not significantly different in latitudinal distribution, subg. *Cerasus* contains the native species and is commonly found at low longitude (100.57±11.34˚E). More species occur in Indo-Burmese and Southwest China than in the Eastern China region. In comparison, subg. *Armeniaca* has a significantly different longitudinal distribution from the other subgenera, around 113.31±15.80˚E; more found in Eastern China than Western China.

In terms of latitudinal factors

Table 5.2 shows that the distribution of *Prunus* sections/subgenera in continental Southeast Asia can be divided into three groups based on latitude.

1. Low latitude sections/subgenera: *Prunus* species in Sections *Mesopygeum* and *Laurocerasus* are distributed near the equator. However, the test results show that sections significantly differ in distribution. Sect. *Mesopygeum* has the lowest altitude distribution with (10.95±7.61°N), while sect. *Laurocerasus* is distributed at 19.3±6.6°N.

2. Middle latitude sections/subgenera: There are four subgenera/sections, *Amygdalus*, *Cerasus*, *Prunus,* and *Armeniaca*, with an average latitudinal distribution of about 23.35±5.46°N, 23.35±5.46°N, 25.08±5.57°N, and 25.48±6.57°N, respectively.

3. High latitude sections/subgenera: Some *Prunus* sections/subgenera occur far from the equator; The Mann-Whitney U test showed the *Prunus* in subg. *Padus* and *Maddenia* do not have significantly different distributions, and their average distribution in high latitudes is about 27.04±4.38N and 27.61±1.14°N.

Table 5.2 The average ($\bar{x} \pm$ SD) and min-max coordinates of latitude, longitude, and altitude (msl) by subgenera/ section of *Prunus* in continental Southeast Asia.

Group	Section	Y (Longitude)	X (Latitude)	Alt (m)
1	*Maddenia*	$27.61±1.14^{a}$	$91.61±4.28^{a}$	$2735.73±390.7^{a}$
		(25.55–31.71)	(87.6–98.72)	(1647–3453)
2	*Padus*	$27.04±4.38^{ac}$	$97.61±14.55^{b}$	$2064.24±628.45^{b}$
		(18.53–37.38)	(76.38–138.83)	(163–3600)
3	*Cerasus*	$23.35±5.46^{be}$	$100.57±11.34^{c}$	$1802.43±929.47^{c}$
		(1.4–39.78)	(78.46–140.16)	(121–4333)
4	*Prunus*	$25.08±5.57^{cf}$	$107.1±10^{d}$	$1209.83±328.62^{de}$
		(15.08–36.51)	(89.69–138.47)	(355–1800)
5	*Amygdalus*	$20.95±4.6^{d}$	$104.25±9.04^{e}$	$1132.22±355.78^{ef}$
		(6.98–38.35)	(80.78–140.9)	(300–2500)
6	*Armeniaca*	$25.48±6.57^{ef}$	$113.31±15.8^{d}$	$847.17±622.51^{fg}$
		(19.37–36.47)	(97.27–137)	(57–3200)
7	*Laurocerasus*	$19.3±6.6^{g}$	$103.73±9.41^{e}$	$1111.46±544.08^{e}$
		(-7.18–36.03)	(77.65–140.6)	(48–2833)
8	*Mesopygeum*	$10.95±7.61^{h}$	$102.12±9.11^{e}$	$798.12±523.14^{g}$
		(-9.57–27.82)	(73.45–148.93)	(5–2500)

Remark: In each column, the same superscript indicates no difference between the values at 95 % according to the Mann-Whitney U test for the difference between the two groups.

In terms of altitudinal factors

Based on **Table 5.2,** *Prunus* species in sections/subgenera can be divided into three groups based on altitude as follows:

1. Low-altitude species occurring on average at 750–1,200 m. The members of this group are *Mesopygeum, Armeniaca, Laurocerasus*, and *Amygdlus*, with distributions around 798.12 m±523.14 m, 847.17m±622.51 m, 1,111.46 m±544.08 m, and 1132.22 m±355.78 m, respectively. As a result, sect. *Mesopygeum* has the lowest altitudinal distribution. By comparison, there is a significant difference in altitudinal distribution between two major groups, *Mesopygeum* and *Laurocerasus,* the member species in the sect. *Mesopygeum* are found at a lower altitude distribution than sect. *Laurocerasus*.
2. Medium altitude species: This group is recorded around 1,200–2,000 m on average. In this case, the dominant *Prunus* usually have serrated leaves, and winter buds, e.g., subg, are typically present. *Amygdalus, Armeniaca, Cerasus,* and *Prunus,*
3. High-altitude species: This group occurs on average at high altitudes (about 2,000–3,200 m) and relatively cold temperatures. The dominant *Prunus* species usually belong to the subgenus *Cerasus*, *Padus*, and *Maddenia*, with an average altitude (m) around 1802.43m ±929.47 m, 2064.24 m±628.45 m, and 2064.24 m±628.45 m, respectively, which are significantly different from each other (**Table 5.2**).

5.5.3 *Prunus* in the countries of SE Asia

Many, perhaps most, accounts of *Prunus* in SE Asia are directly and easily relatable not to floristic regions but to political entities, and this section explores the differences between them.

Unfortunately, any consideration of distribution by country is tricky as there are several insufficiently known regions for *Prunus* in continental Southeast Asia within individual countries and entire countries that are poorly botanically explored.

In Vietnam, the central highland, the Dalat area in Annam, with its mountain massifs or plateaus, is probably the center of *Prunus'* diversity and may house some undiscovered endemic taxa. The Massif du Fa Tsi Pan contains the most endemic taxa in the northern highlands and may have more. In Cambodia, the Dong Rek Range along the Thai-Cambodia border and the southwestern part of Cambodia near the Thai border, the Cardamom Mountains, and the Elephant Range are potentially the most interesting from the point of view of the discovery of new *Prunus* species. Much more field work needs to be undertaken in these regions.

In Thailand, the areas along the borders are considered under-collected (Suddee, 2001), especially along the Tenasserim Range; *P. kaengkrachanensis* is not known elsewhere apart from a few collections from the Thai-Myanmar border. There are also several limestone outcrops and high mountains around the country. Perhaps these are areas containing some endemic *Prunus.* The center of peninsular Thailand, the highest peak in the Khao Luang NP, Nakhon Si Thammarat province, and Khao Pawta Laung Kaew NP**,** Phang Nga province, are also most exciting areas, as some new combinations and new species in *P. ferra* and *P. santisukii* have been found there respectively. There are also several species, 7 (about 54), found both in Peninsular Thailand and the Malay Peninsula, such as *P. arborea, P. javanica, P. kalkmanii, P. maingayi, P. polystachya, P. ridleyi,* and *P. undulata*.

Furthermore, as mentioned earlier, there are entire countries, notably Laos and Myanmar, whose floras are insufficiently known due to the low collection rate. Myanmar is the most worrying aspect of this under-collection, especially as only 0.6 % of the land surface is legally protected (Suddee, 2001). In addition, the country is not a party to any international convention concerned with protecting natural areas (Mill, 1995). As a whole, more exploration is much needed in all these under-collected areas.

Table 5.3 A comparison of the number of *Prunus s.l.* Taxa between previously studied and present records in continental Southeast Asia and nearby countries (2023). (CN = China; MS = Malaysia; MY = Myanmar; TH = Thailand; CM = Cambodia; LA = Laos; VN = Vietnam).

Countries	CN	MS	MY	TH	LA	CM	VN
Author	Lingdi et al.	Kalkman	Kress et al.	Vidal,	Vidal	Vidal	Vidal
Year	2003	1993	2003	1970	1968	1968	1968
Previous (taxa)	110	41	36	8	7	7	16
Present (taxa)	110	46	27	25	13	12	23
Change (%)	0.0	+12.2	−25.0	+212.5	+85.7	+71.4	+43.7

As far as the data allow (see proceeding discussion), Table 5.3 compares the change (in number and percentage) of *Prunus* taxa (predominantly species) reported in continental Southeast Asia between previous studies (e.g., Kalkman, 1993; Lu et al., 2003; Kress et al., 2003; Vidal, 1986, 1970) and current levels in 2023 as determined in this thesis. Three patterns are apparent: significant increase, decrease, or no change.

There has been a significant increase in the number of taxa recognized in almost all countries, with the most considerable shift in Thailand. In Thailand, species increased dramatically from 8 to 25 taxa (212.5 %), followed by smaller increases for Laos, Cambodia, and Vietnam at 85.7%, 71.4%, and 43.7%, respectively. Kalkman (1993) recognized 41 species from the Malesian region. Recent evidence indicates that it is likely that there will be an increase of 5 species or about a 12.2 percent increase in that number (Wen & Potter, in press). By comparison, the number of *Prunus* taxa has not changed in China, though this may be because of a lack of data records at present.

There has been a slight decrease in *Prunus* taxa currently recognized in Myanmar at –25.0% compared with Kress et al. (2003), who identified 36 species. In comparison to this, I recognized 27 taxa. Some of those reported by Kress et al. (2003) are cultivated (*P. et al.*, *P. avium* (L.) L., and *P. dulcis* (Mill.) D.A. Webb (synonym of *P. amygdalus* Batsch)) and as I cannot investigate further and have not seen specimens in any herbaria, they are excluded from this study. My revision recognizes three species, *P. hosseusii* Diels, *P. majestica* Koehne, and *P. puddum* Roxb. ex Wall., previously treated within *P. cerasoides*. One species, *P. rufa* Wall. I treat it as a synonym of *P. trichantha*. Three taxa, *P. kingdonwardii* Merr., *P. latidentata* Koehne, and *P. latidentata* var. *trichocalyx* Merr., are treated within *P. trochostoma.* In addition, there is one ambiguous species, *Prunus litigiosa* Koehne (synonym of *P. clarofolia* C. K. Schneider), of which I have not seen specimens from Myanmar in any herbaria. There are few recent collections because the areas along the Thai-Burmese border are difficult to access.

Table 5.4 The Sørensen Coefficient similarity index (blue) is based on the number of individuals of species common to two communities, the number of species in the individual country (red), and the number of species common to both communities (black).

Countries	Myanmar	Thailand	Vietnam	Laos	Cambodia
Myanmar	25	11	8	5	4
Thailand	44.00	25	8	6	6
Vietnam	34.00	34.04	22	8	7
Laos	30.30	36.36	53.33	8	6
Cambodia	24.24	36.36	46.67	75.00	8

Remark: Cultivated or non-naturalized species are excluded.

The Sørensen coefficient shows that the number of species shared among both countries does not necessarily reflect the number of *Prunus* species occurring in individual countries in the study area (**Table 5.4**). As a result, Myanmar and Thailand broadly differ (Sørensen Coefficient 44.00) in native *Prunus* species richness and have considerably more species than other countries, with 25 species, followed by Vietnam, with 22 species. By comparison, Cambodia and Laos have fewer species than other countries, with 8 species, but these are very similar (Sørensen Coefficient 75.00).

5.5.4 Trying to combine distributional *Prunus* from the countries of SE Asia with phytogeographic regions

1 used NMDS to try to understand how, if at all, the phytogeographic regions recognized in Section 5.5.1 relate to the region's countries (Section 5.5.2), as revealed by *Prunus*.

A 2-dimensional NMDS solution revealed several groups.

The four countries from the Indo-China region (red circle) plot close together, reflecting that the overall composition of their *Prunus* species is similar. This circle also overlaps with the yellow circle, which is formed by the Indian or Himalayan group: these regions do not appear easily separable in this plot. Figure 5.3 also places the Myanmar *Prunus* species at the intersection of the red and yellow circles, perhaps indicating that Myanmar can be a member of the Indo-Burmese floristic region. The Malesian region (green circle) (**Figure 5.2)**, Korea and Japan (dark blue circle), and China (light blue circle) all form separate groups. China stands alone due to its sheer physical size, and the large number of *Prunus* species it contains is probably due to the variety of its forest types.

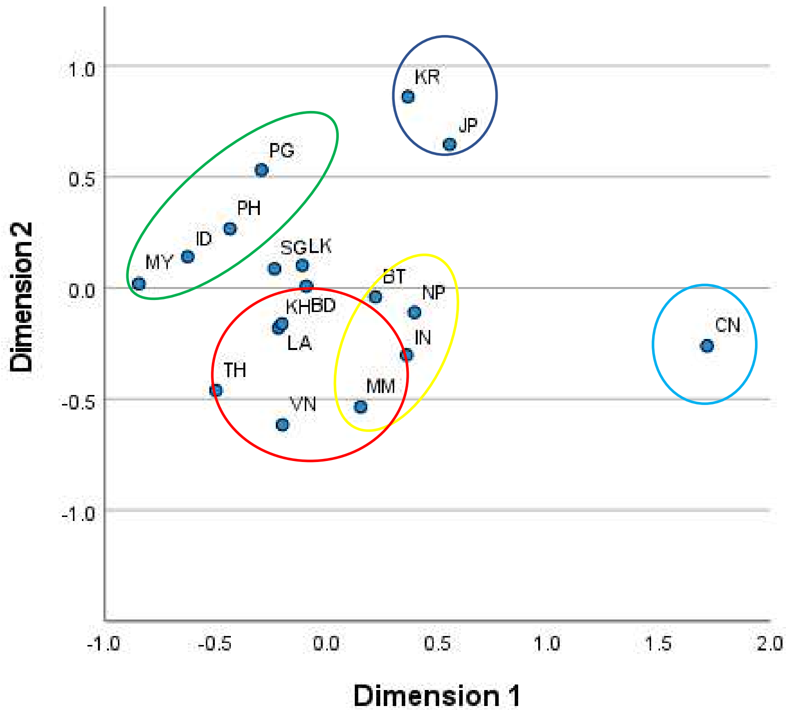


Figure 5.2. A plot of a 2-dimensional Non-Metric Multidimensional Scaling analysis of *Prunus* taxa recorded in Southeast Asia and nearby countries (Stress value = 0.053). (BD = Bangladesh; BT = Bhutan; CN = China; HK = Hong Kong; ID = India; IN = Indonesia; JP = Japan; KH = Cambodia; KR = Korea; LA = Laos; LK = Sri Lanka; MM = Myanmar; MY = Malaysia; NP = Nepal; PG = Papua New Guinea; PH = Philippines; SG = Singapore; TH = Thailand; VN = Vietnam). Based on 185 *Prunus* taxa, cultivated or non-naturalized species were excluded.

5.6 The distribution of endemic or widespread taxa

In total, 50 *Prunus* taxa are found in continental Southeast Asia, and 12 (24%) are endemic to the study area (Myanmar, Thailand, Laos, Cambodia, and Vietnam) and are usually members of subg— *Laurocerasus* in both sections *Laurocerasus* and *Mesopygeum*. *Prunus*'s foremost centers of diversity in continental Southeast Asia are in Myanmar, Thailand, and Vietnam (27, 25, and 23 species, respectively). However, for neighboring Myanmar, no endemic Prunus species have been recorded (**Appendix 4**). By contrast, Thailand and Vietnam have fewer *Prunus* species than Myanmar; each contains 6 endemic species (**Table 5.4**).

Table 5.4. Table of endemic and widespread species of *Prunus s.l.* They are divided into subgenera or sections.

Status	Subgenus/section	Name
Endemic to Thailand	*Laurocerasus*	*P. vandebultii* Rueangr., J.Parn. & Hodk.
(6 species)	*Mesopygeum*	*P. kaengkrachanensis* Nagam., Tagane & Suddee
	Mesopygeum	*P.* "nanensis"
	Mesopygeum	*P. santisukii* Rueangr., J.Parn. & Hodk.
	Mesopygeum	*P.* "yalaensis"
	Padus	*P.* "inthanonensis"
Endemic to Vietnam	*Laurocerasus*	*P. racemopilosa* (Vidal) Rueangr., J.Parn. & Hodk.
(6 species)	*Mesopygeum*	*P. apiculata* (Vidal) Rueangr., J.Parn. & Hodk.
	Mesopygeum	*P. hongiaoensis* Tagane & Yahara
	Mesopygeum	*P. lanceifolia* (Merr.) Rueangr., J.Parn. & Hodk.
	Mesopygeum	*P. longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk.
	Mesopygeum	*P. taganei* Rueangr., J.Parn. & Hodk.
Widespread species	*Amygdalus*	*P. persica* (L.) Batsch
(8 species)	*Armeniaca*	*P. mume* (Siebold) Siebold & Zucc.
	Cerasus	*P. cearasoides* Buch.-Ham. D. Don
	Laurocerasus	*P. javanica* (Teijsm. & Binn.) Miq.
	Laurocerasus	*P. undulata* Buch.-Ham. ex D.Don
	Laurocerasus	*P. zippeliana* Miq.
	Mesopygeum	*P. indochinensis* (Hook.f.) Rueangr., J.Parn. & Hodk.
	Mesopygeum	*P. maingayi* (Hook.f.) J.Wen

This difference probably results from Thailand and Vietnam's higher collecting density than Myanmar's. The 6 endemic species to Thailand are *P. vandebultii*, *P. kaengkrachanensis*, *P.* "nanensis", *P. santisukii*, *P.* "yalaensis", and *P.* "inthanonensis". The 6 taxa endemic species to Vietnam are *P. racemopilosa*, *P. apiculate, P. hongiaoensis, P. lanceifolia, P. longistyla,* and *P. taganei.* Unlike most of Thailand's endemic species, these are known only from a single site. Again, this may reflect Thailand's higher collecting density than Vietnam's. The distribution ranges of these endemic taxa are shown in maps of individual species in Chapter 4. In general, collections of some endemic species are very limited in herbaria. However, these herbarium specimens cannot accurately reflect such species' distribution. One endemic to Thailand, *P. santisukii,* and three taxa from Vietnam, *P. lancifolia, P. longistyla,* and *P. racemopilosa,* are known only from type collections. However, even though our knowledge of distributions is limited, it is essential to discuss the patterns of endemism based on the available information to determine which areas need protection and where to collect more material. All endemic species are, by definition, of restricted and narrow distribution, some more so than others. The reason for the restriction may well be specialized niche requirements. These species are often rare, so their habitats must be protected for conservation. This is especially the case nowadays since the plant formation and floristic composition on summits and ridges of mountains have been changing rapidly due to an increasing number of human activities, e.g., deforestation for agricultural purposes represents one of the most significant issues in global land use, forest fire, undisciplined trekkers, and includes natural effects such as forest fire and global warming.

However, some of these endemic species are probably not endemic to that particular country (some species have also been found near a country's border) and will probably also be found in the adjacent country(ies) if more exploration is undertaken, *e.g., P. racemopilosa*, an endemic species to Vietnam, has also been found near the Vietnam-Chinese border, and probably occurs as well on high altitude mountains of China. The other endemic taxa are recorded from more than one country in the region of study (**Appendix 3**).

The eight widespread species of *Prunus* (**Table 5.4**) can be placed in one of two groups. The first group contains economic fruits or ornamental species such as *P. persica* (peach), *P. mume* (Chinese plum), and *P. ceramides* (wild Himalayan cherry). The second group comprises wild species that almost all belong to subg. *Laurocerasus,* with 3 species in sect. *Larucerasus* (*P. javanica*, *P. undulata*, and *P. zippeliana*), and two species in sect. *Mesopygeum* (*P. indochinensis* and *P. maingayi)*. Of all the species of *Prunus* found in the study area, *P. cerasoides* is the pantropical ornamental tree most commonly seen by the roadside, pathway, and stream bank, in cultivation or wild in a subtropical forest, montane forest in high altitudes above 500 m from (300–)1,000–3,000 m and in areas that are relatively cool or cold. This species' great, fast-growing, beautiful shape and colorful flowers explain why it is so frequently cultivated in the highlands of all continental Southeast Asian countries. In addition, the most common species of *Prunus* seen in the wild is *P. indochinensis*, distributed from Indo-Burmese through Indo-China elements. In this study, I found it in various habitats, including Evergreen Forests, Dry Seasonal Evergreen Forest, Mixed Deciduous Forest, and Lower Montane Forest, from 0–2,000 m. altitude.

5.7 The phytogeographic regions of Thailand and *Prunus*

An NMDS analysis of the native *Prunus* species in Thailand is shown in **Figure 5.3**. This figure uses eight phytogeographic regions, seven of which were used in the Flora of Thailand project, following Smitinand (1958), and another one - Peninsular Malaysia (PM).

Based on **Figure 5.3**, I propose to recognize only five floristic areas that are all discontinuous, thereby more accurately depicting the natural borders of the areas and the presence of *Prunus* indicator species.

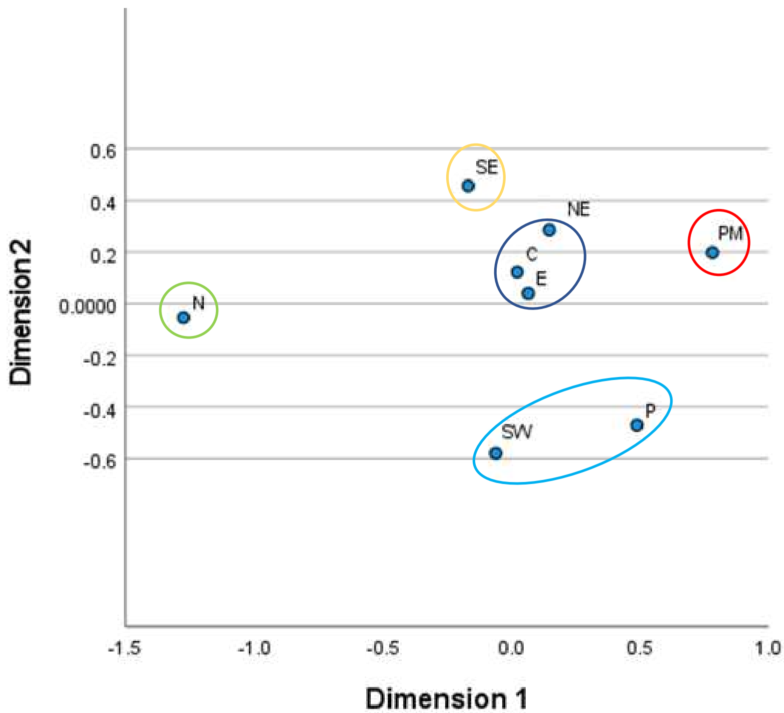


Figure 5.3. A plot of dimensions 1 and 2 from a two-dimensional Non-Metric Multidimensional Scaling (Stress value = 0.018) analysis of *Prunus s.l.* Taxa present in Thailand by phytogeographic region. C = Central; E = Eastern; N = Northern; NE = Northeastern; P = Peninsula; PM = Peninsular Malaysia; SE = Southeastern; SW = Southwestern).

Phytogeographic areas I recognize:

Northern Region

Typically, this area contains high land, and discontinuous mountains can be divided into two groups. Firstly, the evergreen *Prunus* species are mainly distributed in the evergreen forest, as Lower Montane Forest (usually these are species in sect. *Laurocerasus* such as *P. javanica, P. phaeosticta, P. pygeoides, P. undulata, P. vandebultii, P. zippeliana).* The second group contains the dominant species distributed in highland deciduous forests, e.g., Pine Forest and Mixed Deciduous Forest, usually comprising deciduous *Prunus* species in sect. *Mesopygeum*, e.g., *P. indochinensis*, *P. latifructa, P.* "nanensis" and the member of subg. *Cerasua* as *P. cerasoides*.

Southeastern region (SE)

Yongyuth et al. (2011) recognized the "Southeast SE" flora as the same as the "Peninsular region because the SE region has similar weather to the P region, for example, high humidity and plenty of rain, especially in Chanthaburi and Trat (both provinces are among the wettest provinces of Thailand

and climatically similar to an area of the Peninsula). The Southeastern region has 3 central provinces: Chantaburi, Rayong, and Trat.

From my point of view, the forest type in the SE region is Dry Seasonal Evergreen Forest. The Dipterocarpaceae in this region usually comprise deciduous species different from the Dipterocarps in the Peninsula region. In addition, *Prunus* species represent the Southeast species significantly different from the Peninsular species in the sect. *P. javanica and P. undulata dominate Laurocerasus.* While sect. *Mesopygeum* consists of deciduous *Prunus* species such as *P. borkorensis, P. indochiensis, P. koehnei, P. maingayi,* and *P. poilanei*. As a result, the *Prunus* species in the Southeastern region is much more similar to the Cardamom mountain region from Cambodia than the Peninsular Thailand species.

Central, Eastern, and Northeastern region (CEN)

Three possible floristic regions are grouped: Central, part of the Eastern and Northeastern regions (CEN). I recognize this large region, which comprises the Central Lowlands throughout the Northeastern Lowlands. Typically, this whole area contains discontinuous mountains. The site is usually dominated by deciduous vegetation, e.g., Mixed Deciduous Forest and Dry Deciduous Dipterocarp Forest. Moreover, the Dry Seasonal Evergreen Forest can be found in the Lowlands along the river and on the foothill. A few *Prunus* species are distributed in this area. Moreover, a few common species from surrounding regions were found here, e.g., *P. indochinensis, P. javanica,* and *P. koehnei.*

Peninsula and Southwestern Region (PSW)

The PSW region comprises the Peninsula region (from Satun province through the Isthmus of Kra and throughout Petchaburi (Kangkrachan NP), together with the Southwestern region. The Three Pagodas Fault forms the uppermost limit of the Thai-Malay Peninsula. Sedimentary rock and granite mountains dominate the PSW. Typical forest types are dominated by evergreen forests called Tropical Rain Forest and the Lower Montane Forest (upper 800–1,000 m). The evergreen *Prunus* species composition is dominant in this region. Sects usually dominate the Lower Montane Forest. *Laurocerasus* are *P. javanica*, *P. undulata*, and *P. zippeliana*, and some high-altitude species in the sect. *Mesopygeum* such as *P. ferrea, P. maingayi.* and *P. santisukii.* By comparison, the low altitude (Tropical et al.) is dominated by sect. *Mesopygeum*, with species such as *P. kaengkrachanensis, P. maingayi*, *P. ridleyi.* The most common species in the PSW region is *P. maingayi*, distributed in low and high altitudes.

Peninsular Malaysia region (PM)

The Peninsular Malaysia region, comprising Hui Sai Khaw and Satun Province, is dominated by sedimentary rock and granite mountains. The typical forest type is tropical Rainforest. The Dipterocarpaceae dominates the species composition in the top canopy layer, with *Shorea* such as *Shorea assamica* Dyer, *S. curtisii* Dyer ex King, *S. leprosula* Miq., and *S. parvifolia* Dyer which never occur in upper Peninsular Thailand. Likewise, many evergreen *Prunus,* such as *P. arborea, P. kalkmanii, P. polystachy,* and *P.* "yalaensis" are associated with the PM region, except for *Prunus ridleyi,* common species such as *P. javanica*, *P. maingayi*, and *P. undulata* are found in Peninsular Malaysia and Thailand and from Sumatra throughout Southern China.

5.8 The floristic regions in Thailand and the Changwats

An NMDS analysis of the native *Prunus* in Thailand by province is presented in **Figure 5.4.**

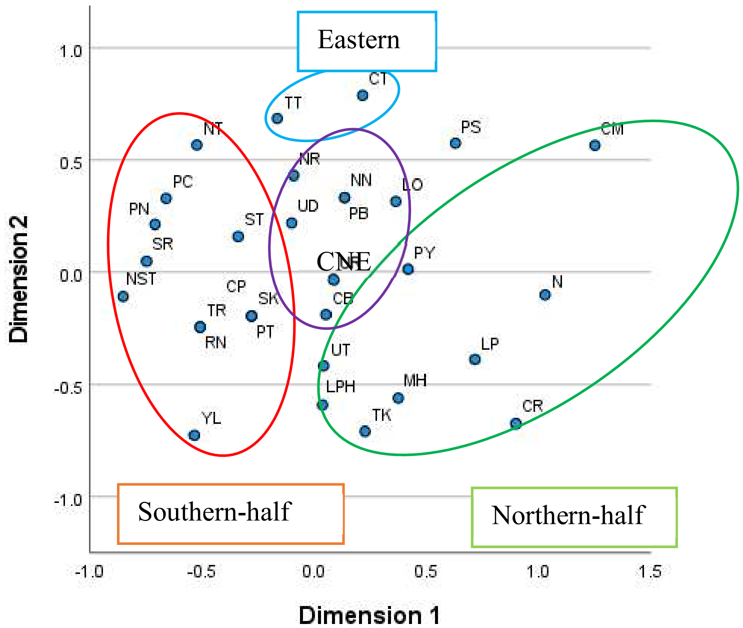


Figure 5.4. A plot of dimensions 1 and 2 from a two-dimensional Non-Metric Multidimensional Scaling analysis of *Prunus* taxa recorded in Thailand by province (Stress value = 0.030). (CB = Chonburi; CM = Chiang Mai; CP = Chumphon; CR = Chiang Rai; CT = Chantaburi; LO = Loei; LP = Lampang; LPH = Lamphun; MH = Mae Hong Son; NN = Nakhon Nayok; N = Nan; NR = Nakhon Ratchasima; NST = Nakhon Si Thammarat; NT = Narathiwat; PB = Prachin Buri; PC = Phetchaburi; PN = Phang Nga; PS = Phitsanulok; PT = Phatthalung; PY = Pa Yao; RN = Ranong; SK = Songkhla; SR = Surat Thani; ST = Satun; TK = Tak; TR = Trang; TT = Trat; UD = Udon Thani; UR = Ubon Ratchathani; UT = Uthai Thani; YL = Yala).

It is evident from **Figure 5.4** that the occurrence of *Prunus* species in Changwat (province) does not follow the phytogeographic regions of Smitinand (1958). It is also unclear that the phytogeographic sections recognized in Section 5.8 (above) are reflected in this analysis. This may, perhaps, be because insufficient *Prunus* data were recorded from any individual Changwat. However, the trend of the NMDS plot above allows for the separation of two main groups of *Prunus*: a Southern half and a Northern half.

In addition, the provinces from Central, Northeastern, and Eastern (CNE), such as Chonburi, Loei, Nakhon Nayok, Nakhon Ratchasima, Prachin Buri, Udon Thani, and Ubon Ratchathani are positioned in-between the South-half and North-half and may represent a transition zone. In comparison, Phitsanulok province's position may likely represent a transition between the CNE group and the Northern half.

Interestingly, the Southeastern region, Trat, and Chantaburi groups are close and would probably group with the Southern half. This reflects a phytogeography pattern in Thailand seen in many studies, e.g., Trisurat et al. (2011), Van Welzen (2011), and Parnell (2013).

A few provinces appear to be missing, including large areas from the Northeastern region, such as Buri Ram, Chaiyaphum, Nakhon Phanom, Surin, and Sisaket. This absence is because I have no records of *Prunus* from these provinces (a lack of data). The absence of these provinces from the analysis may affect the pattern of NMDS, so collecting in these provinces is a priority.

5.9 Overall conclusions

Prunus is worth noting that the genus may have originated in the early Miocene (30 Myr) (Tiffney, 1985). *Prunus* is wildly distributed throughout Asia from India to New Guinea and the Solomon Islands, Europe, North America, Central America, and South America, with only a few species in Australia and Africa (Kalkman, 1965; Wen et al., 2008; Zhao et al., 2018).

The *Prunus* species grow in diverse habitats at various altitudes, from sea level to 4,300 m. They are found in dry, moist, cold temperature environments, in shade or open areas, by stream banks, roadsides, or path-sides in various forest types, on sandy soil, and multiple bedrocks, though mainly limestone and across multiple forest types (Tropical Evergreen, Dry Seasonal Evergreen, Mixed Deciduous, Lower Montane, Upper Montane, and Alpine). Only one species, *Prunus indochinensis*, appears confined to a single habitat type - Dry Deciduous Dipterocarp Forests. *Prunus undulata* is the most widespread distribution. These species can be found near the mean sea level and distributed from Evergreen forest, Montane forest to subalpine forest, alt. 300–3,600 m. Distribution ranges from Indonesia (Sumatra) to Bhutan.

The distribution recognized: 'hill plants' and 'plains plants.' The first group comprises northern species, reported mostly from localities above 500 m altitude (usually occurring at alt. 1,000–4,300 m) and in Lower Montane, Upper Montane, and Alpine Forest. The majority of this group are cultivated species belonging to subg. *Amygdalus*, *Armeniaca*, *Cerasus*, and *Prunus* are the most widely distributed species in subg. *Maddenia*, and *Padus*. The second group contains some widespread taxa, but the majority belong to subgenus *Laurocerasus*, both sects. *Laurocerasus* and *Mesopygeum*. They are distributed in the southern Indo-Burma, Indo-China, and Malaysian regions.

Several *Prunus* accounts for continental Southeast Asia consist of 3 floristic regions: Indo-Burmese, Indo-China, and Malaysian element. Indo-China is one of the most diverse regions for *Prunus*, with 39 species concentrated in this location. The species occur in Indo-Burma and do not cross this range with their westmost distribution around Kanchanaburi, a western province of Thailand. Malesian species Kalkman (1993) recognized 34 species from the Malesian region, eight of which are distributed in the Malay Peninsula. There are a total of 13 species of *Prunus* in the Malay Peninsula. This is a summary of the distribution of *Prunus* Taxa studied in this thesis in continental Southeast Asia, divided by subgenera or sections, including the distribution by altitude.

The Chinese region usually dominates in subg. *Cerasus*, *Amygdalus*, *Padus* and *Armeniaca*. The Indo-Burmese and Indochinese regions. Only trees in sect. Laurocersus and *Mesopygeum* occur in the Malesian floristic region. In addition, *Mesopygeum* is more significantly spread than *Laurocerasus* in the Malesian region. Over continental Southeast Asia, most species occur in the Indochinese region. The dominant *Prunus* species are members of section *Mesopygeum*, followed by *Laurocersus*, with 32 and 27 species, respectively.

The distributions of the sections/subgenera relate significantly to the geographical factors of latitude, longitude, and altitude. The distribution of *Prunus* in continental Southeast Asia can be divided into two main groups based on longitude. 1) A Himalayan group containing *Prunus* species in subg. *Maddenia* and *Padus* are restricted to low latitudes, in the Himalayan mountains, throughout the upper Indo-Burmese region, and in Southwestern China. 2) A group of diverse regions. Altitude is one of the most significant factors affecting the distribution of *Prunus* species composition in continental Southeast Asia: 1) The low-altitude species is dominated by two major groups, *Mesopygeum* and *Laurocerasus*. 2) The medium altitude species are typically present. *Amygdalus*, *Armeniaca*, *Cerasus*, and *Prunus*. 3) The high-altitude species usually belong to subgenus *Cerasus*, *Padus*, and *Maddenia*.

In Vietnam, the central highland, the Dalat area in Annam, with its mountain massifs or plateaus, is the center of *Prunus*' diversity and may house some undiscovered endemic taxa. In Cambodia, the Cardamom Mountains and the Elephant Range are potentially interesting from the point of view of discovering new *Prunus* species. In Thailand, the Thai-Myanmar border. There are many more attractive discoveries in the science of *Prunus*. In Laos and Myanmar, the floras are insufficiently known due to the low rate of collection. Myanmar is the most worrying aspect of this under-collection.

The number of taxa recognized in almost all countries has increased significantly, with the most considerable shift in Thailand. In Thailand, species increased dramatically, followed by smaller increases in Laos, Cambodia, and Vietnam, respectively. The Sørensen coefficient shows that the number of species between Myanmar and Thailand broadly differs considerably more species than in other countries.

The four countries from the Indo-China region reflect that their *Prunus* species' overall composition is similar. The Indian or Himalayan group forms; these regions, therefore, do not appear easily separable in this plot. The Myanmar *Prunus* species is at the intersection, indicating that Myanmar can be a member of the Indo-Burmese floristic region. The Malesian region, Korea, Japan, and China are separate groups. China stands by itself due to its sheer physical size and the large numbers of *Prunus* species it contains, probably due to the variety of its forest types.

In total, 50 *Prunus* taxa are found in continental Southeast Asia, 12 of which are endemic to the area of study, and 6 of which are endemic to Thailand, Laos, Cambodia, and Vietnam). The 6 taxa endemic to Thailand are *P. vandebultii* Rueangr., J.Parn. & Hodk., *P. kaengkrachanensis* Nagam., Tagane & Suddee, *P.* "nanensis", *P. santisukii* Rueangr., *P.* "yalaensis", and *P.* "inthanonensis". The 6 taxa endemic to Vietnam, namely, *P. racemopilosa* (Vidal) Rueangr., J.Parn. & Hodk., *P. apiculata* (Vidal) Rueangr., J.Parn. & Hodk., P. hongiaoensis Tagane & Yahara, P. lanceifolia (Merr.) Rueangr., J.Parn. & Hodk., *P. longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk., and *P. taganei* Rueangr., J.Parn. & Hodk. respectively. In addition, One endemic to Thailand, *P. santisukii*, and three taxa from Vietnam, *P. lancifolia*, *P. longistyla*, and *P. racemopilosa*, are known only from type collections. The most common species of *Prunus* seen in the wild is *P. indochinensis*, distributed from Indo-Burmese through Indo-China elements. In this study, I found it in various habitats, including Evergreen Forests, Dry Seasonal Evergreen Forest, Mixed Deciduous Forest, and Lower Montane Forest, from 0–2,000 m. altitude.

The *Prunus* species distribution supports the phytogeographic regions of Thailand and *Prunus*, eight phytogeographic regions, seven as used in the Flora of Thailand project, following Smitinand (1958) such as Central, Eastern, Northern, Northeastern, Peninsula, Southeastern, and Southwestern, and additional one - Peninsular Malaysia. Moreover, the occurrence of *Prunus* species in Changwat (province) does not follow the phytogeographic regions of Smitinand (1958). This may be because insufficient *Prunus* data were recorded from any individual Changwat. However, the trend of the NMDS plot allows for the separation of two main groups of *Prunus*: a Southern half and a Northern half..

Chapter 6 Conclusions

Almonds, apricots, plums, and peaches, the cash crops of many nations, all fall under the genus *Prunus* (*s.l.*). The complex morphological variations within this group have long posed a challenge for taxonomists. In a significant taxonomic revision, Kalkman (1965) merged the genus *Pygeum* with *Prunus*, leading to a new subdivision of subg. *Laurocerasus* into three sections. However, the species boundaries and infrageneric classification remained a topic of debate among taxonomists, with most of their views shaped by collections from the Malaysian region. This thesis, a pioneering work in the field, breaks new ground by incorporating species from continental Southeast Asia, filling the data gaps, and offering a fresh taxonomic treatment of the group. Furthermore, it delves into the origin of *Prunus*, its evolution, and its dispersal / biogeography in this region, a topic that has not been formally addressed in previous studies.

My research journey was not without its challenges. I embarked on a quest to explore the monophyletic and phylogenetic positions in the *Prunu*s species of Indochina, a task that was met with numerous obstacles. Despite these hurdles, I persevered and was rewarded with a wealth of data. I meticulously described and discussed my findings, supplementing them with illustrations, distribution maps, nomenclatural notes, and a key to the species presented/accepted.

The subgeneric structure of *Prunus* has been the subject of extensive research, and this thesis significantly contributes to this body of knowledge. I recognised seven subgenera, including *Amygdalus, Armeniaca*, *Cerasus*, *Maddenia*, *Padus*, *Prunus*, and *Laurocerasus*, with the latter further divided into sections. Several distinctive morphological traits, such as petal shape, size, and fruit morphology, were instrumental in differentiating these subgenera. Importantly, the molecular phylogenetic studies based on nuclear and plastid DNA sequences consistently supported the monophyly of these subgenera, validating my taxonomic treatment. These findings not only enhance our understanding of *Prunus* systematics but also underscore the crucial role of molecular phylogenetic studies in plant systematics. This has potential implications for agriculture and conservation, as a better understanding of *Prunus* systematics can aid in crop improvement and biodiversity conservation, thereby contributing to the sustainable development of our planet. These practical implications, which include potential advancements in agriculture and conservation, highlight the real-world relevance of my research. The relationship and comparison within subgenus *Laurocerasus*, between sect. *Laurocerasus* and *Mesopygeum* require further investigation because their distinction currently relies on dubious morphological characteristics such as the presentation of glands on the stipule and leaf, calyx, corolla, and fruits. The exact position of sections *Laurocerasus* and *Mesopygeum* within the genus remains unresolved—the sect. *Laurocerasus* is polyphyletic, while the sect. *Mesopygeum* is monophyletic and separated from the sect. *Laurocerasus*. Within subgenus *Laurocerasus*, sect. *Laurocerasus* is closely related to *Mesopygeum*. It is distinguished from *Mesopygeum* by the former's conspicuous difference in both shape and size between calyx and corolla (vs. usually similar calyx and corolla), fruit shapes are usually ellipsoid or oblong (vs. usually didymous transversely ellipsoid) leaves margins are serrate (vs. entire margins)—the status of sect. *Mesopygeum* is a distinct separately with sect. In further phylogenetic studies, of *Laurocerasus* the two sections almost certainly should be raised to the subgeneric rank.

6.1 Reassessment of morphological characters

The description of *Prunus* was updated to consider the diversity brought by including new species in the genus. Several ambiguities and inaccuracies were clarified, notably concerning the habit, phyllotaxis, and types of inflorescences. The perianth, or the floral structure comprised of the calyx and corolla, especially when the two whorls are not distinguishable, cannot be used as a diagnostic character to distinguish species level within subgenus *Mesopygeum*.

After some clarification and recharacterization, the position and structure of the inflorescences were found to be very useful for identifying subgenera and species. On the other hand, the morosity of the flowers, the aestivation of the petals, and the length of staminal filaments, previously used to identify subgenera, were found too inconsistent to be reliable in most cases. They were replaced by characters such as phyllotaxis, leaf texture, density and prominence of secondary and tertiary venation, and fruit shape, size, and drying color, which were found to be relatively stable within subgenera.

The specific-level identification still relies on characters that are unfortunately subject to intraspecific variation in some cases, or that could be affected by the conservation method of herbarium specimens, such as toothing of the leaf margins, leaf shape, size, and drying color, degree of gland conspicuousness, indumentum, relative flower size, and drying color, some are inconsistent (the number of stamens), though this feature is consistent within a single specimen, pedicel length (can only used when the differences are striking, e.g., subsessile vs. pedicellate flowers), sepal shape, and stigma sessile or style length (once again, only used when the differences are marked and seemingly consistent within a species).

Overall, the main challenges linked to using morphology to identify *Prunus* species are the lack of autapomorphies (the overwhelming majority of species are determined through a combination of characters, not a unique character) and the fact that intraspecific variability and sexual dimorphism have often been underestimated in previous works.

6.2 Taxonomic treatment

Species of *Prunus* in continental Southeast Asia were examined and are described and discussed with illustrations, distribution maps, and nomenclatural notes; a key is provided to identify them. In the previous account, *Prunus* reported 8 taxa. By comparison, There was a significant increase in this study, and I recognized 26 taxa. In total, the new revision recognizes seven subgenera and 50 species of *Prunus* in continental Southeast Asia. Among them, the taxonomic positions of 5 species are not resolved because of a lack of data. Three new records, *P. kalkmanii* J.Wen, *P. pygeoides* Koehne, and *P. ridleyi* J.Wen, were discovered for the region. Extensive lectotypification was required, and 296 synonyms were recognized for the 55 accepted species and intraspecific taxa. The work includes:

Three new status and combinations (comb. nov. & stat. nov.), *P. crassistyla* (Card.) Rueangr., J.Parn. & Hodk., *P. racemopilosa* (Vidal) Rueangr., J.Parn. & Hodk., *P. indochinensis* (Hook.f.) Rueangr., J.Parn. & Hodk.; Seven new combinations (comb. nov.); *P. apiculata* (Vidal) Rueangr., J.Parn. & Hodk., *P. acuminata* (Colebr.) Rueangr., J.Parn. & Hodk., *P. ferrea* (Craib) Rueangr., J.Parn. & Hodk., *P. lanceifolia* (Merr.) Rueangr., J.Parn. & Hodk., *P. longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk., *P. koehnei* (Koehne) Rueangr., J.Parn. & Hodk., *P. poilanei* (Vidal) Rueangr., J.Parn. & Hodk.; Eight new species, *P. bokorensis* Rueangr., J.Parn. & Hodk., *P. latistipulacea* Rueangr., J.Parn. & Hodk., *P. polystachya*Rueangr., J.Parn. & Hodk., *P. santisukii* Rueangr., J.Parn. & Hodk., *P. sinbumroongii* Rueangr., J.Parn. & Hodk., *P. taganei* Rueangr., J.Parn. & Hodk., *P. vandebultii* Rueangr., J.Parn. & Hodk., *P. yalaensis* Rueangr., J.Parn. & Hodk.

As a result of **the status of *Prunus* species**, the *Prunus* tree assesses 50 species in the study area. There are 4 species DD ((Data Deficient, amely *P.* "inthanonensis", *P.* longistyla, *P.* "nanensis", and *P. santisukii*.; Least concern 36 species; 5 species Vulnerable, namely *P. apiculata, P. bokorensis*, *P. crassistyla, P. ferrea, P. lanceifolia*. In addition, 6 species are Critically Endangered, namely *P. hongiaoensis*, *P. kaengkrachanensi*s, *P. latistipulacea*, *P. racemopilosa*, *P. vandebultii*, and *P.* "yalaensis" respectively.

6.3 Concluding remarks

The path to a complete revision of *Prunus* is still long, but I expect the present work will make it significantly more straightforward.

The exact status of the sect. *Laurocerasus* lies in its relationship to the sect. *Mesopygeum,* but clarification is essential as splitting the account into sections and raising them to the subgenera level is crucial. Some morphological characters can be used to identify the subgenera correctly. Floral characters must be used with extreme caution to describe new species, and character variability itself can differ from subgenus to subgenus or species to species.

Finally, the first step towards a complete taxonomic revision of the genus has been taken, with the revision of the type of subgenus in Malesia. This taxonomic information will be helpful for the assessment of the conservation status of these species.

By providing a revised and more reliable baseline of the morphology, phylogeny, and taxonomy of *Prunus*, this work opens the way for a variety of research opportunities which, hopefully, will lead to adequately informed strategies for the preservation of this fascinating genus and the ecosystems in which it grows.

6.4 Biogeographical and cological approaches

The *Prunus* species grow in diverse habitats at various altitudes, from sea level to 4,300 m. They are found in dry, moist, cold temperature environments, in shade or open areas, by stream banks, roadsides, or path-sides in various forest types, on sandy soil, and multiple bedrocks, though mainly limestone and across multiple forest types (Tropical Evergreen, Dry Seasonal Evergreen, Mixed Deciduous, Lower Montane, Upper Montane, and Alpine). The distribution recognized: 'hill plants' and 'plains plants.' The first group comprises northern species, reported mostly from localities above 500 m altitude. The majority of this group are cultivated species belonging to subg. *Amygdalus*, *Armeniaca*, *Cerasus*, and *Prunus* are the most widely distributed species in subg. *Maddenia*, and *Padus*. The second group contains some widespread taxa, but the majority belong to subgenus *Laurocerasus*, both sects. *Laurocerasus* and *Mesopygeum*. They are distributed in the southern Indo-Burma, Indo-China, and Malaysian regions.

Several *Prunus* accounts for continental Southeast Asia consist of 3 floristic regions: Indo-Burmese, Indo-China, and Malaysian. The distributions of the sections/subgenera relate significantly to the geographical factors of latitude, longitude, and altitude. Altitude is one of the most significant factors affecting the distribution of *Prunus* species composition in continental Southeast Asia: 1) The low altitude species is dominated by two major groups, *Mesopygeum* and *Laurocerasus*. 2) The medium altitude species are typically present. *Amygdalus*, *Armeniaca*, *Cerasus*, and *Prunus*. 3) The high altitude species usually belong to subgenus *Cerasus*, *Padus*, and *Maddenia*.

In total, 50 *Prunus* taxa are found in continental Southeast Asia, 12 of which are endemic to the area of study, and 6 of which are endemic to Thailand, Laos, Cambodia, and Vietnam). The 6 taxa endemic to Thailand are *P. vandebultii* Rueangr., J.Parn. & Hodk., *P. kaengkrachanensis* Nagam., Tagane & Suddee, *P.* "nanensis", *P. santisukii* Rueangr., *P.* "yalaensis", and *P.* "inthanonensis". The 6 taxa endemic to Vietnam, namely, *P. racemopilosa* (Vidal) Rueangr., J.Parn. & Hodk., *P. apiculata* (Vidal) Rueangr., J.Parn. & Hodk., P. hongiaoensis Tagane & Yahara, P. lanceifolia (Merr.) Rueangr., J.Parn. & Hodk., *P. longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk., and *P. taganei* Rueangr., J.Parn. & Hodk. respectively.

In Vietnam, the central highland is the center of *Prunus*' diversity and may house some undiscovered endemic taxa. The number of taxa recognized in almost all countries has increased significantly, with the most considerable shift in Thailand. The *Prunus* species distribution supports the phytogeographic regions of Thailand and *Prunus*, eight phytogeographic regions, seven as used in the Flora of Thailand project, following Smitinand (1958) such as Central, Eastern, Northern, Northeastern, Peninsula, Southeastern, and Southwestern, and additional one - Peninsular Malaysia.

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Appendix 1 Voucher information and GenBank accession number, outgroup sampled, and the areas in this study.

Taxa	Voucher	Country	Code	ETS	psbA-trnH	rpl16	rps16	trnC-petN
P. mume	SR248	Thailand	Ame_mumeSR248	1	1	1	1	-
P. persica	SR133	Thailand	Amy_persSR133	-	1	1	1	-
P. cerasoides	MY5714	Myanmar	Cer_ceramajMY5714	1	1	1	1	1
P. cerasoides	5474	Thailand	Cer_cerasoi5474	1	1	1	1	1
P. pseudocerasus	SR246	Thailand	Cer_pseudoSR246	1	1	1	1	1
P. crassistyla	7178	Vietnam	Lau_crassi7178	1	1	1	1	-
P. fordiana	L2773	Laos	Lau_fordbalaL2773	1	1	1	1	1
P. fordiana	L3718	Laos	Lau_fordL3718	1	1	1	1	1
P. javanica	5833	Thailand	Lau_java5833	1	1	1	1	1
P. phaeosticta	5501	Thailand	Lau_phae5501_DIN	1	1	1	1	1
P. phaeosticta	V9051	Vietnam	Lau_phaeV9051	1	1	1	1	1
P. pygeoides	5476	Thailand	Lau_pygeoi5476_Tak	1	-	1	1	1
P. javanica	SR251	Thailand	Lau_suddeeSR251	1	1	1	1	-
P. vandebultii	SR245	Thailand	Lau_vandebSR245	1	1	1	1	1
P. undulata	187	Thailand	Lau_undula187	-	1	1	1	1
P. zippeliana	1225	Japan	Lau_zipp1225_JP	1	1	-	1	1
P. zippeliana	SR255	Thailand	Lau_zippSR255_TPP	-	1	1	1	1
P. arborea	SR224	Thailand	Mes_arboreSR224_Hala	1	1	1	1	1
P. ferrea	T4252	Thailand	Mes_ferreaT4252	1	1	1	1	1
P. hongiaoensis	V9338	Vietnam	Mes_hongV9338	1	1	1	1	1
P. indochinensis	7322	Cambodia	Mes_indoch7322	1	1	1	1	1
P. indochinensis	L3298	Laos	Mes_indochL3298	1	1	1	1	1
P. kaengkrachanensis	SR254	Thailand	Mes_kaengSR254	1	1	1	1	1
P. kalkmanii	SR228	Thailand	Mes_kalkmaSR228	1	1	1	1	1
P. latifructa	5480	Thailand	Mes_latifr5480	1	1	1	1	1
P. latifructa	SR242	Thailand	Mes_latifSR242	1	1	1	1	1
P. maingayi	SR238	Thailand	Mes_maingSR238_PY	1	-	1	1	1
P. polystachya	SR230	Thailand	Mes_polystSR230	1	1	1	1	1
P. ridleyi	SR252	Thailand	Mes_ridleyMY433	-	1	-	1	-
P. ridleyi	SR252	Thailand	Mes_ridleySR252	1	1	1	1	1
P. taganei	V9337	Vietnam	Mes_taganeV9337	1	1	1	1	1
P. "yalaensis"	SR233	Thailand	Mes_yalaeSR233	1	1	1	1	1
Outgruop_Pyrus communis				**MN577903.1**	**JQ390743.1**	**DQ860442.1**	**DQ848708.1**	**JQ391855.1**

Appendix 2 The morphological characters and related information matrix for species description

***«genus» «species»* «author name» «var. / subsp./forma» *«species2»* «author name2»**

Citation : «citation»

Description: «lvs. falling», «lvs. falling», «height» m tall, «canojpy layer», «canopy shape». **Stem** «stem», «size» cm indiameter, «buttresses»; *outer bark* «bark colour», «bark type», spine «spines»; inner bark «inner bark colour»; *sap* «exudate-sap»; *smell* «smell». **Branchlets** «branches»; young twigs «young twig colour», with «young twig indumentum»; old twig «old twigs indumentum». Axillary winter bud «axillary winter bud presentatio», «number of buds», «buds shape»; terminal winter bud; terminal winter buds present. **Leaves** «lvs. imple or compound», «compound type» «lvs. no./foliolate» «lvs. compound lenght»«lvs. compound arragement»«lvs.compound petiole_petiolation» «lvs. compound petiole_pulvinate or normal» «lvs. compound petiole_lenght» «lvs. compound petiole_across» «lvs. compound petiole_indumentum and prickles» «lvs. compound petiole_glands» «rachis character» «rachis length» «rachis across» «rachis indumentum/prickle» «rachis_gland» «no. leaflet each side», «levs.plicate or convolute in bud», «lvs.arrange», «laminar shape», «laminar shape lobe» laminar termianal lobe», «laminar basal lobe», «laminar symmetry», «laminar length» by «laminar width" cm long; *apex* «laminar apex angle» angles, «leaf apex»; *margin* «leaf margin», «(tooth) specing», sinus «sinus (shape)», «leaf marginal or tooth apex glands», «leaf margin hair»; *base* "base symmetry», «leaf base shape», «lvs. in young plants»; «young leaf colour»; mature leave «mature laminar colour adaxial/above», «mature laminar colour adaxial/above», «laef colour uper_lower before folling», texture «leaf texture»; *indumentum* young leaves «young leaves indumentum», old leaves «old leaves indumentum», «leaf indumentum», «mature leaf features»; *glands* «glands (present)», "no. of glands» «glands size» «glands shape and features», «other leaf glands»; *midrib* «lvs. midrib_rise/sunken»; *primary venation* «1° veis category»; *secondary venation* «2° veins category», «no. of lateral veins» alternate on either side of the midrib, «2° veins specing», «2° veins_rise/sunken», «2° veins pickles» «2° veins veins angle»; *agrophic vein* «agrophic veins»; *basal nerves* «no. of basal nerves»; *tertiary vanation* «3° veins category», «3° veins course»; *4° veins category* «4° veins category»; 5° *veins category* «5° veins category»; *marginal veins* «marginal veins»; *smell* «crushed lvs. smell», «terminal shape and petiolulate»; *petioles* «petioles character», «petioles length» cm long, «petioles above and across», «petioles indumentum/prickles» «petioles note»; *petiolar glands* «petiolar glands presentation», «no. of petiolar glands», «petiolar glands size», «petiolar glands shape and features», «petiolar glands note». **Stipules** «stipules presentation», «stipules position», «stipules position», «stipules lenght (mm)» by «stipules width (mm)» mm long, «stipules shape», *apex* «stipules apex», *margin* "», *base* «stipules base», «stipules indumentum», «stipules glands, shape and features», «stipules present_note». **Inflorescence** «inflorestcense_compound/simple», «infl. dense/sparse», «nfl./fl. position», «nfl. size length (cm)» cm long, «infl. size width (cm)», «sub. infl. type», «no. of sub. infl», rachises «peduncle indumentum», «infl. bract, no, size, colour, features»«note of peduncle», «infl. note». **Flowers** «sexual», «opening period», «flowes colour», «flowers smell», «flowers shape», «flowers size_lenght (mm)» mm long, «flowers size_across (mm)» mm across; pedicel «pedicellate», «pedicel features», «pedicel indumentum»«pedicel note»; *bracts* «bracteols», «no.of bracteols», «bracteols shape», «bracteols size», «bracteols color», «bracteole indumentum», «bracteols persistent»«bracteole note»; *pedicels* «pedicellate», «pedicels lenght» mm long, "pedicels size, shape, color, feature», «pedicels indumentum»; *«hypanthium»*, «hypanthium shape», «hypanthium length (mm)» by «hypanthium width (mm)» mm long, «hypanthium indumentum outside», «hypanthium indumentum inside»; *«perianth»*, «perianth features», «perianth segments», «periant length (mm)» mm long, «perianth indumentum»; *«calyculus»*, «no. calyx (lobes)», «calyx shape», «calyx size», «calyx length (mm)», by «calyx width (mm)» mm long, «calyx equal/unequal», apex «calyx apex», margin «calyx margin», base «calyx base», «calyx free/adnate at base», «calyx arrangement_in bud», «calyx lobes when mature», «calyx indumentum_outside» outside, «calyx indumentum_inside» inside, «shape of posterior calyx lobes», «posterior calyx note», «no. of antherior calyx lobes», «shape of lateral teeth», «position of lateral teeth», «shape of median Teeth», «calyx throat»,«calyx note». *«corolla/petals»*, «corolla, petals colour», «upright/updown», «corolla tube or free», «corolla tube shape», «shape of posterior corolla lobes», «petals no.»,"petals size», «petals Length (mm)» by «petals width (mm)» mm long, «petals lobes equal/unequal in shape & size», «petals lengh/calyx lobes», «position of lateral petals lobes», «shape of antherior corolla lobes», «petals shape», «petals unguiculate», apex «petals apex», «petals margin», «petals base»,«petals arrange» «petals indumentum outside» outside, «petals indumentum inside» inside «corolla/petals note». *Stamens* «stamens no.», «stamens seriate», «stamens vs. petals length»; filament «filaments shape and note», «filament equally», «filament free or adnate at base», «filament length» mm long, «filament appendage»; anthers «no. of anther cells», «anthers shape», «anther length» mm long, «anther attachment position», «anther opening type»«anther note». *Ovary* «carpels no./ovary (ceclled)», «ovary position», «ovary adnate/free», «ovary indumentum», "no. locular", «ovulate per locule», «ovules type», «carpels position». *Style* «style present»,«style shape», «style length» mm long, «styles free or connate at base», «styles vs stamens length», «style indumentum», «stigma(gland or divided)», «ovary note». *Infructescence* «infructescent length», «infructescent indumentum», «friuts no.». **Fruit** «fruit type»«fruit note», «fruit dehiscent or not», «fruit stalk», «fruit color", «friut colour (ripe)» when ripe, «fruit shape», «fruits length (cm)» by «fruits widht (diameter across, cm)» cm long, «fruit thick (cm)» cm thick, «fruit apex», «young fruit indumentum», «mature fruit indumentum»; *exocarp* «fruit coat/exocarp», «fruit mesocarp / aril»; *mesocarp* «fruit mesocarp / aril feature», «mesocrap/ aril color»; *endocarp* «fruit endocarp», «swollen/ compressed», «endocar surface»; *fruiting calyxs* «calyx persistent», «calyx on fruit»; *style* «note styles on fruit». **Seed** «seed colour», «seeds no.(nutlet)», «compressed or swollen seeds», «nutlet size», «nutlet thickness», «with glabrous or hairy testa», «producing/none producing mucilage on wetting», «endosperm»«seed/ achenes note».

Additional specimens examined.— «additional specimens examined».

Distribution.— «distribution».

Ecology.— «ecology».

Phenology. — «phenology».

Uses.— «uses»

Appendix 3. List of *Prunus s.l.* taxa in continental Southeast Asia divided into subgenera or sections, including the distribution by country and the altitude recorded. (MY = Myanmar; TH = Thailand; CM = Cambodia; LA = Laos; VN = Vietnam).

Subg./sect.	Taxa	altitude (m)	Countries				
			MY	TH	CM	LA	VN
Amygdalus	*P. persica*	(300–)1,000–3,000	1	1	1	1	1
Armeniaca	*P. mume*	(100–)1,000–3,200	1	1	1	1	1
Cerasus	*P. campanulata*	800–1,500		1			1
Cerasus	*P. cearasoides*	(300–) 800–3,000	1	1	1	1	1
Cerasus	*P. mugus*	2,600–4,300	1				
Cerasus	*P. pseudocerasus*	300–1,200		1			
Cerasus	*P. serrula*	1,100–4,000	1				1
Cerasus	*P. trichantha*	2,800–3,900	1				
Cerasus	*P. trichostoma*	2,200–4,000	1				
Laurocerasus	*P. crassistyla*	300–1,400					1
Laurocerasus	*P. fordiana*	(300–)600–1,800			1	1	1
Laurocerasus	*P. javanica*	40–1,400	1	1	1	1	1
Laurocerasus	*P. jenkinsii*	1,000–1,800	1				
Laurocerasus	*P. phaeosticta*	50–2,800	1	1		1	1
Laurocerasus	*P. pygeoides*	700–1,600	1	1			
Laurocerasus	*P. racemopilosa*	ca 1,000					1
Laurocerasus	*P. undulata*	(300–)1,000–3,600	1	1	1	1	1
Laurocerasus	*P. vandebultii*	1,200–1,400	1				
Laurocerasus	*P. zippeliana*	40–1,800 (–3,000)	1	1	1	1	1
Maddenia	*P. gongshanensis*	1,600–3,500	1				
Maddenia	*P. himalayana*	2,000–3,400	1				
Mesopygeum	*P.* "nanensis"	1,320		1			
Mesopygeum	*P.* "yalaensis"	400–1,000					
Mesopygeum	*P. apiculata*	300–1,200					1
Mesopygeum	*P. arborea*	0–1,900	1	1			
Mesopygeum	*P. bokorensis*	300–1,200		1	1		
Mesopygeum	*P. ferrea*	750–1,300		1			
Mesopygeum	*P. hongiaoensis*	1,400–1,800					1
Mesopygeum	*P. indochinensis*	0–2,000	1	1	1	1	1
Mesopygeum	*P. kaengkrachanensis*	800–1,200		1			
Mesopygeum	*P. kalkmanii*	150–2,000		1			
Mesopygeum	*P. koehnei*	100–1,300		1	1	1	1
Mesopygeum	*P. lanceifolia*	1,200–1,600					1
Mesopygeum	*P. lancilimba*	1,200–2,800	1				1
Mesopygeum	*P. latifructa*	600–2,100	1	1			
Mesopygeum	*P. latistipulacea*	900–2,000					1
Mesopygeum	*P. longistyla*	1,200					1
Mesopygeum	*P. maingayi*	0–2,600	1	1	1	1	1
Mesopygeum	*P. poilanei*	20–1,000		1	1	1	1
Mesopygeum	*P. polystachya*	0–600					
Mesopygeum	*P. ridleyi*	0–1,500	1	1			
Mesopygeum	*P. santisukii*	1,300		1			

Appendix 3. (Continued).

Subg./sect.	Taxa	altitude (m)	Countries				
			MY	TH	CM	LA	VN
Mesopygeum	*P. taganei*	900–2,000					
Padus	P. "inthanonensis"	1,200–1,800		1			
Padus	*P. brachypoda*	1,000–2,500	1				
Padus	*P. bracteopadus*	1,500–3,600	1				
Padus	*P. buergeriana*	600–3,000	1				
Padus	*P. cornuta*	800–3,200	1				
Padus	*P. napaulensis*	1,800–3,200	1				
Prunus	*P. salicina*	(300–)800–2,600	1	1		1	1
Summary			**27**	**25**	**12**	**13**	**23**

Appendix 4. Species list and status of *Prunus s.l.* taxa in continental Southeast Asia

no.	Botanical Name	Remark
1	*Prunus apiculata* (Vidal) Rueangr., J.Parn. & Hodk.	comb. nov.
2	*Prunus arborea* (Blume) Kalkman	accepted species
3	*Prunus bokorensis* Rueangr., J.Parn. & Hodk.	sp. nov.
4	*Prunus brachypoda* Batalin	accepted species
5	*Prunus bracteopadus* Koehne	accepted species
6	*Prunus buergeriana* Miq.	accepted species
7	*Prunus campanulata* Max.	accepted species
8	*Prunus cerasoides* Buch.-Ham. D. Don	accepted species
9	*Prunus ceylanica* (Wight) Miq.	not included
10	*Prunus cornuta* (Wall. ex Royle) Steud.	accepted species
11	*Prunus crassistyla* (Card.) Rueangr., J. Parn. & Hodk.	comb. nov. & stat. nov.
12	*Prunus kalkmanii* J.Wen	new record to Thailand
13	*Prunus ferrea* (Craib) Rueangr., J.Parn. & Hodk.	comb. nov.
14	*Prunus fordiana* Dunn	accepted species
15	*Prunus napaulensis* (Ser.) Steud	accepted species
16	*Prunus gongshanensis* J.Wen	accepted species
17	*Prunus himalayana* (Hook.f. & Thomson) J.Wen	accepted species
18	*Prunus hongiaoensis* Tagane & Yahara	accepted species
19	*Prunus* "inthanonensis"	unresolved
20	*Prunus indochinensis* (Hook.f.) Rueangr., J.Parn. & Hodk.	comb. nov. & nom. nov.
21	*Prunus javanica* (Teijsm. & Binn.) Miq.	accepted species
22	*Prunus jenkinsii* Hook.f. & Thomson	accepted species
23	*Prunus kaengkrachanensis* Nagam., Tagane & Suddee	accepted species
24	*Prunus kalkmanii* J.Wen	new record to Thailand

Appendix 4 (Continued).

no.	Botanical Name	Remark
25	*Prunus koehnei* (Koehne) Rueangr., J.Parn. & Hodk.	comb. nov. & nom. nov.
26	*Prunus lanceifolia* (Merr.) Rueangr., J.Parn. & Hodk.	comb. nov. & nom. nov.
27	*Prunus lancilimba* (Merr.) Kalkman	accepted species
28	*Prunus latifructa* (Colebr) Ruengr., J.Parn. & Hodk.	comb. nov. & nom. nov.
29	*Prunus latistipulacea* Rueangr., J.Parn. & Hodk.	sp. nov.
30	*Prunus longistyla* (J.E.Vidal) Rueangr., J.Parn & Hodk.	comb. nov.
31	*Prunus maingayi* (Hook. f.) J.Wen	accepted species
32	*Prunus mugus* Hand.-Mazz.	accepted species
33	*Prunus mume* (Siebold) Siebold & Zucc.	accepted species
34	*Prunus* "nanensis"	unresolved
35	*Prunus napaulensis* (Ser.) Steud.	accepted species
36	*Prunus persica* (L.) Batsch	accepted species
37	*Prunus phaeosticta* (Hance) Maxim.	accepted species
38	*Prunus poilanei* (Vidal) Rueangr., J.Parn. & Hodk.	comb. nov. & nom. nov.
39	*Prunus polystachya* (Hook.f.) Kalkman	new record to Thailand
40	*Prunus pseudocerasus* Lindl.	accepted species
41	*Prunus pygeoides* Koehne	new record to Thailand
42	*Prunus racemopilosa* (Vidal) Rueangr., J. Parn. & Hodk.	comb. nov. & stat. nov.
43	*Prunus ridleyi* (King) J.Wen	new record to Thailand
44	*Prunus salicina* Lindl.	accepted species
45	*Prunus santisukii* Rueangr., J.Parn. & Hodk.	sp. nov.
46	*Prunus serrula* Franch.	accepted species
47	*Prunus taganei* Rueangr., J.Parn. & Hodk.	sp. nov.
48	*Prunus trichantha* Koehne	accepted species
49	*Prunus trichostoma* Koehne	accepted species
50	*Prunus undulata* Buch.-Ham. ex D.Don	accepted species
51	*Prunus vandebultii* Rueangr., J.Parn. & Hodk.	sp. nov.
52	*Prunus* "yalaensis"	unresolved
53	*Prunus zippeliana* Miq.	accepted species