THESIS

TAXONOMY OF THE GENUS *ACTINODAPHNE* NEES (LAURACEAE) IN THAILAND

MONTRI TANAROS

Graduate School, Kasetsart University
2008

THESIS APPROVAL

GRADUATE SCHOOL, KASETSART UNIVERSITY

Master of Science (Botany)
DEGREE

Botany	Botany
FIELD	**DEPARTMENT**

TITLE: Taxonomy of the Genus *Actinodaphne* Nees (Lauraceae) in Thailand

NAME: Mr. Montri Tanaros

THIS THESIS HAS BEEN ACCEPTED BY

Srunya Vajrodaya — **THESIS ADVISOR**
(Associate Professor Srunya Vajrodaya, Dr.rer.nat.)

K. Chayamarit — **COMMITTEE MEMBER**
(Mrs. Kongkanda Chayamarit, D.Sc.)

Dokrak Marod — **COMMITTEE MEMBER**
(Associate Professor Dokrak Marod, D.Sci.)

Sureeya Tantiwiwat — **DEPARTMENT HEAD**
(Associate Professor Sureeya Tantiwiwat, Ph.D.)

APPROVED BY THE GRADUATE SCHOOL ON 20 May 2022

Gunjana Theeragool — **DEAN**
(Associate Professor Gunjana Theeragool, D.Agr.)

THESIS

TAXONOMY OF THE GENUS *ACTINODAPHNE* NEES (LAURACEAE) IN THAILAND

MONTRI TANAROS

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
Master of Science (Botany)
Graduate School, Kasetsart University
2008

Montri Tanaros 2008: Taxonomy of the Genus *Actinodaphne* Nees (Lauraceae) in Thailand. Master of Science (Botany), Major Field: Botany, Department of Botany. Thesis Advisor: Associate Professor Srunya Vajrodaya, Dr.rer.nat. 104 pages.

Taxonomic revision of the genus *Actinodaphne* Nees (Lauraceae) in Thailand was conducted between March 2005 to March 2008. Species diversity, morphological characters, distribution and ecological data were examined. Field collections and phenological observation of *Actinodaphne* were made throughout the country. The herbarium specimens available in Thai herbaria were thoroughly studied and identified by consulting the taxonomic literatures and comparing with photographs of some type specimens from Thai and foreign herbaria.

Key to species based on flowering, fruiting and significante vegetative characters were constructed. Full descriptions of each species were provided supported by line drawings and photographs.

Eleven species of Thai *Actinodaphne* were enumerated as *Actinodaphne amabilis* Kosterm., *A. angustifolia* (Blume) Nees, *A. cupularis* (Hemsl.) Gamble, *A. glomerata* (Blume) Nees, *A. henryi* Gamble, *A. montana* Gamble, *A. omeiensis* (H. Liu) C.K. Allen, *A. perglabra* Kosterm., *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec., *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen, *A. sikkimensis* Meisn. and *Actinodaphne* sp.1.

A. sesquipedalis var. *cambodiana* and *A. sesquipedalis* var. *glabra* are newly recorded for Thailand. *Actinodaphne* sp.1 can not be indentified into species and expected to be new to science.

Montri Tanaros
Student's signature

Srunya Vajrodaya 30/Apr/2008
Thesis Advisor's signature

ACKNOWLEDGEMENTS

I am deeply grateful to Associate Professor Dr. Srunya Vajrodaya, my thesis advisor, for her valuable advices and providing me many useful things during the course of my thesis.

I wish to extend my thanks to Dr. Kongkanda Chayamarit and Associate Professor Dr. Dokrak Marod, the thesis committee members, for their kind suggestions and encouragements. I wish to express my deep gratitude to Associate Professor Savitree Malaipan, the Graduate School representatives, for this guidance and suggestions for my thesis

I gratefully acknowledge Dr. Rachun Pooma, Dr. Somran Suddee for their support, Mr. Manop Poopath, Mr. Theradet Wichianchan, Miss Kanokon Bunpha, Mr. Thammarat Putthai, Mr. Pakorn Tippayasri and Miss Orporn Pukeklay for photographs from field works and the staff in the Forest Herbarium, Bangkok for spending their time for me. Special thanks is extended to my family for their warm support and encouragement.

My field work was supported by TRF/BIOTEC Special Program for Biodiversity and Training grants BRT R_146008 (Study on Thai Lauraceae: Taxonomy Distribution and Economic uses headed by Dr. Kongkanda Chayamarit).

Montri Tanaros

April, 2008

TABLE OF CONTENTS

Page

TABLE OF CONTENTS	i
LIST OF TABLES	ii
LIST OF FIGURES	iii
LIST OF ABBREVIATIONS	v
INTRODUCTION	1
OBJECTIVES	3
LITERATURE REVIEW	4
MATERIALS AND METHODS	10
Materials	10
Methods	10
RESULTS AND DISCUSSION	12
Result	12
Discussion	72
CONCLUSION AND RECOMMENDATION	76
Conclusion	76
Recommendation	77
LITERATURE CITED	78
APPENDIX	81
CURRICULUM VITAE	104

LIST OF TABLES

Table		Page
1	Study on the genus *Actinodaphne* in several countries	7
2	Distribution of *Actinodaphne* in each Floristic region of Thailand	70
3	Ecological distribution of *Actinodaphne* spp. in Thailand	71

LIST OF FIGURES

Figure		Page
1	Terminal buds	16
2	Leaf variation	16
3	Flowers and Floral part	16
4	Habit	17
5	Bark	18
6	Inflorescences	19
7	Fruit shape	20
8	*A. amabilis* Kosterm.	26
9	Photographs of *A. amabilis* Kosterm.	27
10	*A. angustifolia* (Blume) Nees	30
11	Photographs of *A. angustifolia* (Blume) Nees	31
12	*A. cupularis* (Hemsl.) Gamble	34
13	Photographs of *A. cupularis* (Hemsl.) Gamble	35
14	*A. glomerata* (Blume) Nees	38
15	Photographs of *A. glomerata* (Blume) Nees	39
16	*A. henryi* Gamble	42
17	Photographs of *A. henryi* Gamble	43
18	*A. montana* Gamble	46
19	Photographs of *A. montana* Gamble	47
20	*A. omeiensis* (H. Liu) C.K. Allen	49
21	Photographs of *A. omeiensis* (H. Liu) C.K. Allen	50
22	*A. perglabra* Kosterm.	52
23	Photographs of *A. perglabra* Kosterm.	53
24	*A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.	57
25	Photographs of *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.	58

LIST OF FIGURES (Continued)

Figure		Page
26	*A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen	61
27	Photographs of *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen	62
28	*A. sikkimensis* Meisn.	65
29	Photographs of *A. sikkimensis* Meisn.	66
30	*Actinodaphne* sp. 1	68
31	Photographs of *Actinodaphne* sp. 1	69

Appendix Figure

1	Floristic regions and Provinces of Thailand	88
2	Plant surveys in Thailand	89
3	Distribution of *Actinodaphne* Nee in each region of Thailand	90
4	Type photograph of *A. amabilis* Kosterm.	93
5	Type photograph of *A. angustifolia* (Blume) Nees	94
6	Type photograph of *A. cupularis* (Hemsl.) Gamble	95
7	Type photograph of *A. glomerata* (Blume) Nees	96
8	Type photograph of *A. henryi* Gamble	97
9	Type photograph of *A. montana* Gamble	98
10	Type photograph of *A. omeiensis* (H. Liu) C.K. Allen	99
11	Type photograph of *A. perglabra* Kosterm.	100
12	Type photograph of *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.	101
13	Type photograph of *A. sikkimensis* Meisn.	102
14	Tertiary veins in genus *Actinodaphne* Nees	103

LIST OF ABBREVIATIONS

BK	=	The Bangkok Forest Herbarium, Department of Agriculture, Bangkok, Thailand
BKF	=	The Forest Herbarium, Department of National Park, Wildlife and Plant Conservation, Bangkok, Thailand
BM	=	The Natural History Museum, London, UK
K	=	Kew Herbarium, Royal Botanic Garden, London, UK
diam.	=	diameter
dbh	=	diameter breast high
ca., c.	=	circa (about)
i.e.	=	id est (that is)
e.g.	=	exempli gratia (for example)
et al.	=	et. alli (and others)

TAXONOMY OF THE GENUS *ACTINODAPHNE* NEES (LAURACEAE) IN THAILAND

INTRODUCTION

Thailand is located in a hot and humid climatic zone. The area is covered with various vegetation types ranging from the moist tropical evergreen forest in the south to the deciduous and upper montane forest towards the north. Thailand occupies the geographical center of the plants from Indo-Burmese elements, Indo-Chinese elements and Malesian elements, where the species richness is high of the estimated 10,000 species of vascular plants. Then, Thailand is one of the countries richest natural resources, supporting a huge diversity of plants and wildlife, and providing forest products to support the local livelihoods.

Currently, less than 50 percents of the plants of the whole country have been studied. For this reason, taxonomic revision is necessary to complete the Flora of Thailand, which will be enable to identify plants by using key and plant descriptions. The data which consists of botanical characteristics, distribution, ecology and utilization would aid successful study on conservation and plant resources management in Thailand.

Lauraceae is one of the important family, composed of about 35 genera and 2,500 species throughout the world, of which 17 genera, ca. 136 species occurred in Thailand. The family consists of plants which have economic importance as agricultural and industrial products as well as the values in medicinal plants. As the study on Lauraceae has not yet completed in Thailand so there are still some confusions of classification, taxonomic revision of the individual genera in this family, thus, this study will support the taxonomic clarification of the family.

Actinodaphne Nees is one of the genera in the family Lauraceae. It has an economic importance in forest products as timber, pharmaceutical products as herbal

medicine etc. At present, there is still no tools for identification the genus *Actinodaphne* Nees in Thailand. Therefore, taxonomic revision of *Actinodaphne* Nees in Thailand was considered to be done for constructing key for plant identification. Moreover, the result of this study can be supported the flora revision in Thailand and to other fields of ecology, forest production and for conservation planning.

OBJECTIVES

1. To conduct taxonomic revision of the genus *Actinodaphne* Nees in Thailand including its distribution and ecology.

2. To construct a key to species of the genus *Actinodaphne* Nees in Thailand for plant identification.

LITERATURE REVIEW

The genus *Actinodaphne* Nees was established by C. G. Nees von Esenbeck in 1831 based on *A. pruinosa* from Peninsular Malaysia. Since then, a total of 150 binominals have been published by various authors (Julia, 2005).

The name of the genus *Actinodaphne* Nees come from Greek: *aktinos* means ray and *daphne* means laurel which alluding to the arrangement of leaves in star-shaped whorls (Kochummen, 1989).

Takhtajan (1997) classified *Actinodaphne* Nees as follows:

Division Magnoliophyta
Class Magnoliopsida
Subclass Magnoliidae
Superorder Lauranae
Order Laurales
Suborder Laurineae
Family Lauraceae
Subfamily Lauroideae
Genus *Actinodaphne* Nees

The Characters of the Genus *Actinodaphne* Nees

1. Habitat

The plant is evergreen appeared in shrubs or small to medium-size tree (Li, 1963; Ridley, 1967) which the shoot with conspicuous terminal vegetative buds (Long, 1984). The bark is smooth to cracking (Kochummen, 1989).

2. Leave

The leaves are simple, subverticillate (Hooker, 1885; Rohwer, 1993), verticillate (Dassanayake *et al*., 1995; Kostermans, 1957; Ridley, 1967), subopposite (Gandhi, 1976), opposite (Kanjilal *et al*., 1940; Malla *et al*., 1986) or spiral [*Actinodaphne sphaerocarpa* (Blume) Nees] (Kochummen, 1989). The texture is coriaceous (Kanjilal *et al*.,1940; Ridley, 1967), with dark green above, glaucous or bluish-grey beneath (Backer and Brink, 1963), pinnately veined (Gandhi, 1976) or rarely triplinerve (Dassanayake *et al*., 1995) and exstipulate (Kochummen, 1989).

3. Inflorescences

Young inflorescences are enveloped by imbricate scales (psuedoinvolucre) (Backer and Brink, 1963) or non (Rohwer, 1993). The shortened racemes appear as pseudo-umbels surrounded by deciduous bracts (Kochummen, 1989).

4. Flowers

The flowers are small, trimerous (Rohwer, 1993), dioecious (Kostermans, 1957; Li, 1963; Gandhi, 1976) and presence of deciduous involucral bracts when young (Malla *et al*., 1986).

5. Perianth

The perianths is 6 lobes equal (Kostermans, 1957; Rohwer, 1993). The lobes is equal or subequal (Dassanayake *et al*., 1995), rarely persistent (Hooker, 1885; Li, 1963) villous outside (Kochummen, 1989). Sometimes perianth is persistent and envelop base (Long, 1954; Malla *et al*., 1986; Gandhi, 1976). The perianth tube is short (Backer and Brink, 1963; Kanjilal *et al*., 1940; Ridley, 1967) usually small and funnel-shaped (Dassanayake *et al*., 1995).

6. Staminate flower

The staminate flower has 6 or 9 fertile stamens (Hooker, 1885; Li, 1963; Long, 1984), rarely more or fewer (Rohwer, 1993). The 1st and 2nd series of the filament are eglandular, while the 3rd series has 2 glands at the base, lanceolate (Hooker, 1885; Li, 1963). The filament is slender (Kanjilal *et al*., 1940) with 4-celled anthers which are all introrse (Backer and Brink, 1963; Hooker, 1885; Long, 1984; Ridley, 1967).

7. Pistillate flower

The pistillate flower has 9 staminodes (Hooker, 1885; Kostermans, 1957; Gandhi, 1976) which are linear or spathulate in 1st or 2nd row and without gland while there are 2 glands in the 3rd row (Kanjilal *et al*., 1940; Ridley, 1967). The style is erect (Gandhi, 1976), attenuate (Kanjilal *et al*., 1940) and narrow (Kochummen, 1989). The stigma is dilate (Kanjilal *et al*., 1940; Li, 1963; Ridley, 1967; Gandhi, 1976), peltate (Backer and Brink, 1963; Kostermans, 1957) or cordate (Kochummen, 1989). The ovary is superior (Backer and Brink, 1963) and ovoid shape (Kanjilal *et al*, 1940; Kochummen, 1989; Gandhi, 1976).

8. Fruit

The fruit is drupe (Kochummen, 1989; Ridley, 1967), berry (Malla *et al*., 1986; Gandhi, 1976), globose (Dassanayake *et al*., 1995), subglobose or ellipsoid (Long, 1984). The fruit is seated on the enlaged flat or concave perianth-tube (Hooker, 1885; Kanjilal *et al*., 1940; Kochummen, 1989; Ridley, 1967).

9. Distribution

The genus *Actinodaphne* Nees comprises about 100 recognized species (Kostermans, 1957; Rohwer, 1993; van der Werff, 2001), and distributed from India and Sri Lanka to Myanmar, Thailand, Indo-China, Korea, Japan, Malaysia and The Solomon Islands.

The report on *Actinodaphne* Nees in Thailand are as follows:

Kostermans (1974) found 2 new species, i.e. *Actinodaphne amabilis* Kosterm., *A. perglabra* Kosterm. and Smitinand's Thai Plant Names (The Forest Herbarium, 2001) reported that 3 species of *Actinodaphne* can be found i.e. *A. angustifolia* (Blume) Nees, *A. henryi* Gamble and *A. montana* Gamble. The study on *Actinodaphne* in other countries is shown in Table 1.

Table 1 Study on the genus *Actinodaphne* in several countries.

Authors / Year	**Study site**	**Number of species**
Hooker (1885)	India	24
Kanjilal *et al.* (1940)	Assam	4
Backer and Bakh.f. (1963)	Java	6
Li (1963)	Taiwan	5
Ridley (1967)	Malay Peninsula	15
Kostermans (1974)	Thailand	2
Brandis (1978)	India	15
Long (1984)	Bhutan	4
Kochummen (1989)	Malaya	19
Keng (1990)	Singapore	5
Hô (1991)	Vietnam	6
Dassanayake *et al.* (1995)	Ceylon	9
Beaman *et al.* (2001)	Kinabalu	8
Thai plant name (2001)	Thailand	3
Julia (2005)	Sabah and Sarawak	20

10. Ecology

In Borneo, the species of *Actinodaphne* Nees occured in various forest types in different soils, including mixed dipterocarp forest, peat swamp forest, kerangas forest, riparian forest and forest on limestone and ultrabasic soilds, at altitude from sea level to 2,400 m (Julia, 2005). In Thailand, ecological data was rarely recored, excepted the rough notes about the types of the forest from specimens in the Herbarium. Most of the types of the forest that *Actinodaphne* occurred are tropical rain forest, dry evergreen forest, lower montane rain forest and mixed decidous forest. The so-called types of the forest are followed Santisuk (2006).

11. Uses

Several species of the genus *Actinodaphne* Nees are occasionally used and some species are poisonous. In China; tea made from the bruised leaves of *A. cupularis* (Hemsl.) Gamble is a remedy for trauma. Indo-China used the infusion of the leaves of *A. pilosa* (Lour.) Merr. as a natives drink and to treated stomachache. In Malay Peninsula; the fruits of *A. sesquipedalis* (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. are said to be stupefying, but they are eaten by birds. The leaves, stems, roots, and barks are all considered to contain alkaloids. *A. perakensis* (Gamble) Kosterm. is a poisonous species. In Indonesia; they used the crushed or ground young leaves of *A. moluccana* Blume to smeared on boils as a maturative, also on wounds in which splinters from spears remain. In New Guinea; the wood of an unnamed collection of *Actinodaphne* Nees, after charring, is used as an astringent (Perry, 1980). Moreover, timber of *Actinodaphne* has been used for light construction, interior furnish, furniture, beam and boat building. Bruised leaves of *A. moluccana* have been applied externally against sores and splinters (Sambus and Sosef, 1998).

The different between *Actinodaphne, Lindera, Litsea, Neolitsea*

These genera were readily distinguished from the foregoing by the arrangement of the flowers. From each other they differ fundamentally only in minute

details of the stamens. However, the arrangement of the leaves is a rather useful in vegetative parts.

In *Actinodaphne*, the leaves appear to be arranged in whorls separated by long leafless portions of stem so that they recall the arrangement in the *Alstonia* (Apocynaceae), but actually they are arranged in a very compressed spiral. In most species of *Litsea* and *Neolitsea* the leaves are cleary arranged in a spiral, often crowded at the ends of the twigs but never appeared to be whorled. But a few species of *Litsea* agree with *Lindera* have the leaves apparently alternate, actually they are in a very drawn out spiral with the leaves on the upper or lower side of the twig twisted to the right or the left.

What seen at first sight flower-buds in these genera are really the flower-heads. When they open, the tiny bracts which cover them curl back and display the true flower-buds inside. The group of flower-heads in the leaf-axis or on the twigs suggesting the flower-buds of some of the wild Nutmegs (as *Knema*), and when the fruit takes the place of the flower, the group of oblong one-seeded fruits set on the stalks of the original flower-heads recall the fruit-clusters which developed from a single flower as in the case of the family Annonaceae. The absence of red sap distinguishes these Laurels from the Nutmegs and the presence of a calyx-cup at the base of each fruit separates them from the Annonaceae.

The fruits of most species look like acorns in their cups (*Quercus*), or as little eggs in egg-cups, but the cups are never marked or scaly like those of the acorns and the fruits themselves have a pulpy rind. The fruit may be seated on the cup or partly or wholly immersed in it. When the fruits are clustered on the twigs, they often suggest those of a wild Fig-tree (Corner, 1988).

MATERIALS AND METHODS

Materials

1. Plant press, pruning knife, plastic bags, newspapers, corrugated cardboards, ropes, tags, field book, pencil, altimeter, camera, color films of both printing and slides.

2. Materials for preserving and mounting specimens comprised of alcohol 70% various sizes of bottles, deep freezer for preserving specimens from insects and fungi, mounting papers (papers of 300 gram of 42 x 26.5 cm, covers of 42 x 27 cm, brown covers of 42 x 27.5 cm), needle and thread, labels of 13.5 x 10 cm and glue.

3. Instruments for identifying specimens comprised of stereo microscope together with scale, ruler, caliper, petri dish, dissecting needle and razor blade.

Methods

1. Data of *Actinodaphne* from literatures, such as floras, journals and reports on the survey of this genus in various sites were collected and compiled. The herbarium specimens deposited in the Forest Herbarium (BKF), National Park, Wildlife and Plants Conservation Department and Bangkok Herbarium (BK), Department of Agriculture were also studied.

2. Collections of *Actinodaphne* were made in sets of five to ten, from the natural habitats in various regions of Thailand. Photograph and notes were also taken. The specimens were mounted as in herbarium sheet and some flowers and fruits were preserved in alcohol 70 % for further study.

3. Morphological characteristics of *Actinodaphne* spp. were observed from the fresh materials and several herbarium specimens deposited in BK and BKF.

Flowers were dissected and examined under stereo microscope and also photographs as well as measurement of various parts of plants were taken.

4. Identification of plants into species were done by observing morphological characteristics, checking references and comparing with herbarium specimens at BK, BKF and loaned specimens from Kew Herbarium. Then, the names were verified to the correct botanical names by way of taxonomic study. The detailed description of each species as well as line drawing were done, followed by the construction key to species.

5. The identified specimens were kept as references at BKF and BK for future study and research.

Places and Duration

Places

This studies covered several places as follows;

1. Natural forests in various regions of Thailand.
2. Botany Department, Faculty of Science, Kasetsart University.
3. Forest Herbarium, National Park Wildlife and Plants Conservation Department, BKF.
4. Bangkok Herbarium, Department of Agriculture, BK.

Duration

The studies was done from March 2005 to March 2008.

RESULTS AND DISCUSSION

Result

Field and Morphological Characters

1. Habit

All plants in the genus *Actinodaphne* in Thailand are usually small to medium size trees. The trunks are often bole straight and sometimes small buttresses are found in *Actinodaphne sesquipedalis* var. *cambodiana* and *A. sesquiepedalis* var. *glabra*. From natural observation the trees of *Actinodaphne* can be divided into 2 groups: small tree (the height is not more than 5 m) and medium-sized tree (the height is around 11-20 m)(Figure 4).

The small tree are seen in *A. amabilis* and *A. omeiensis*.

The medium-sized trees are seen in *Actinodaphne montana* and *Actinodaphne* sp. 1.

However, the plants can be found as small to medium-sized trees which are seen in *A. angustifolia*, *A. cupularis*, *A. glomerata*, *A. henryi*, *A. sesquipedalis* var. *cambodiana*, *A. sesquipedalis* var. *glabra* and *A. sikkimensis*.

2. Habitat

The ecological range of plants in this genus is widely from mixed deciduous forest, tropical evergreen rain forest, dry evergreen forest and lower montane rain forest. Most species occur in lower montane rain forest, such as *Actinodaphne amabilis, A. cupularis, A. glomerata, A. henryi, A. montana, A. omeiensis, A. sikkimensis* and *Actinodaphne* sp. 1. Some species are found only in tropical evergreen rain forest, such as *A. glomerata, A. sesquipedalis* var. *cambodiana*

and *A. sesquipedalis* var. *glabra*. While *A. angustifolia* can be found from the dry evergreen forest to the mixed deciduous forest (Santisuk, 2006).

3. Bark

The bark of *Actinodaphne* is generally rather smooth and occasionally lenticillate, except *A. henryi* which are furrowed and *A. sikkimensis* which are cracked. The colour of outer bark is greynish-brown to darkish brown or reddish-brown, with green or white patches. Inner bark is yellowish-orange to yellow (Figure 5).

4. Terminal Buds

Characteristics of terminal buds in this genus can be separated into two groups. The first group is the species with small to large terminal buds which are perulate with imbricate scales in ellipsoid to ovoid, oblong, lanceolate shape and acute apex, with glabrous to tomentose indumentums, such as *Actinodaphne amabilis*, *A. angustifolia*, *A. cupularis*, *A. henryi*, *A. montana*, *A. omeiensis* and *A. sikkimensis*. The second group is terminal buds covered with large green leaf-like scale, with the shape of narrowly elliptic-oblong, elliptic-ovate, narrowly lanceolate-narrowly elliptic, glabrous to tomentose indumentums, such as *A. glomerata*, *A. sesquipedalis* var. *cambodiana*, *A. sesquipedalis* var. *glabra* and *Actinodaphne* sp. 1. The scales usually fall down/off after buds elongate and present distinct scar at the base (Figure 1).

5. Leaves

The leaves are simple; verticillate, subverticillate or alternate, chartaceous or thinly coriaceous to coriaceous, shining green or dull dark green above, glaucous beneath. Petiole is slender to stout, of 0.3-5.5 cm long, glabrous to tomentose. Leaf apex is acute, acuminate, caudate or cuspidate. The base is cuneate, attenuate or oblique. Leaf margin is usually entire. The leaves are penninerved, midrib and

secondary veins arching and looping near margin and obscure to slightly distinct or prominent on both surfaces. The tertiary veins are usually scalariform or reticulate-scalariform, except in *Actinodaphne perglabra* which is finely reticulate. The leaves is usually aromatic when crushed (Figure 2).

6. Inflorescences

The inflorescences of *Actinodaphne* are fasiculate (*A. amabilis, A. angustifolia, A. cupularis* and *A. perglabra*), umbellate on short peduncles (*A. sesquipedalis* var. *cambodiana, A. sequipedalis* var. *glabra* and *Actinodaphne* sp.1), cymose (*A. glomerata*) or umbel arranged in raceme (*A. henryi* and *A. montana*). The inflorescences are axillary or borne along twigs between whorls of leaves or both characters in one plant. The involucral bract is caducous and will leaves distinct scars at the base of the inflorescences when falling off (Figure 6).

7. Flowers and Floral Parts

Flowers of the genus *Actinodaphne* are trimerous, unisexual and dioecious. They are about the same size, usually 0.3-1 cm in diameter, greenish white or yellow, fragrant. Number of perianth lobes is usually 6, equal to subequal, imbricate, inner lobes glabrous, while the outer lobes are glabrous to tomentose. The texture of perianth lobes is membranaceous. Perianth lobes have 3-5 veins inside, with elliptic, ovate or oblong shape and acute apex.

Most species in staminate flowers have 9 fertile stamens, except 10 in *A. sikkimensis*. The stamens arrange in 3 whorls, The 1st and 2nd whorl are non-glandular, while 2 glands on each side at base in the 3rd whorl. The glands are usually globose except cordate or saggittate shape in *A. henryi*. The stamen in the 1st, 2nd and 3rd whorls are the same size except in *A. angustifolia* and *A. cupularis* which stamen with glands shorter than the stamen without glands. The anthers are 4-celled, all are introrse, the filaments are slender, 0.3-7.2 mm long. The filament may longer or shorter than the anther (*A. glomerata*), with glabrous to hairy.

Most species in pistillate flowers have 9 staminodes arrange in 3 whorls. The 1st and 2nd whorl stamen has no gland, while the 3rd whorl stamen has two glands on each side at the base. Staminode shapes are elliptic, spathulate, linear (*A. cupularis*) or 3-lobes (*A. sikkimensis*), 0.5-2 mm long. It is glabrous to hairy at base, with superior, ellipsoid to globose ovary, with or without hair. The stigma is peltate or 4-lobes (*A. sesquipedalis* var. *glabra* and *Actinodaphne* sp.1) with slender to stout style, 0.5-2 mm long, with or without hair (Figure 3).

8. Fruits

The fruits of *Actinodaphne* are drupe, seated on the enlarged disc-shaped, cup shaped perianth tube partly enclosing the fruits, margin entire or undulate (*A. henryi*). Colour of young fruit is light to dark green, slightly shining, with white mottle. The ripening fruit is dark purpulish-reddish to black. The apex is apiculate, persistent or caducous. Perianth which is persistent or caducous when fruiting have distinct scar on the perianth tube. The shaped of fruit is globose, subglobose or ellipsoid (*A. sikkimensis*). The fruiting pedicels are slender, thick, usually 0.5-1.5 cm long, glabrous to tomentose (Figure 7).

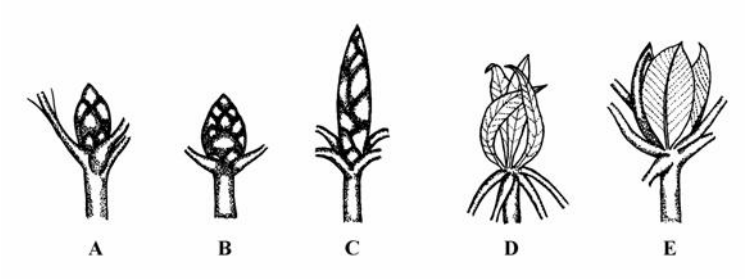


Figure 1 Terminal buds: A. *Actinodaphne amabilis*; B. *Actinodaphne angustifolia*; C. *Actinodaphne cupularis*; D. *Actinodaphne sesquipedalis* var. *cambodiana*; E. *Actinodaphne sesquipedalis* var. *glabra*.

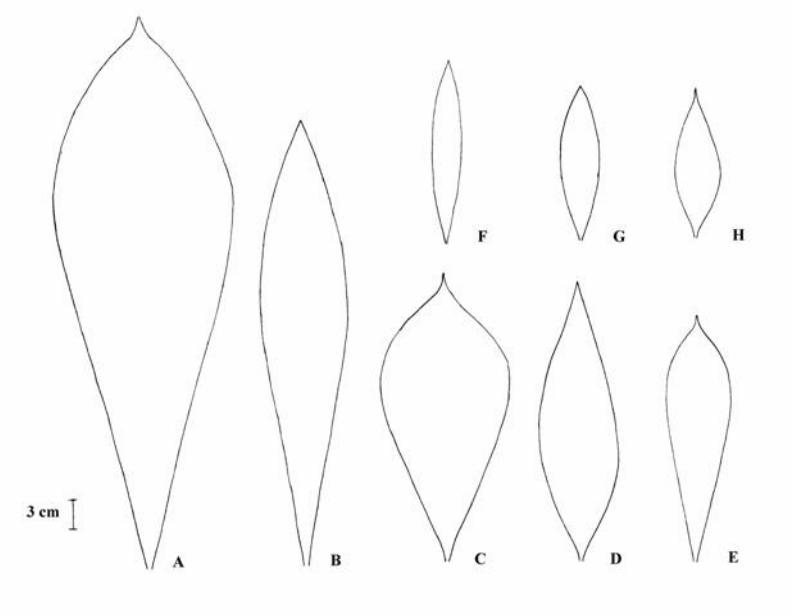


Figure 2 Leaf variation: A. *Actinodaphne sesquipedalis* var. *glabra*; B. *A. sesquipedalis* var. *cambodiana*; C. *A. glomerata*; D. *A. henryi*; E. *A. angustifolia*; F. *A. amabilis*; G. *A. omeiensis*; H. *A. sikkimensis*.

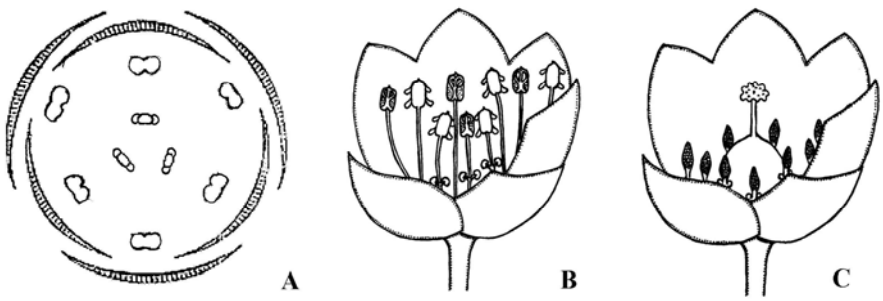


Figure 3 Flower and Floral part: A. floral diagram; B. staminate flower; C. pistillate flower.

Figure 4 Habit small to medium-sized tree: A. *Actinodaphne sikkimensis*; B. *A. sesquipedalis* var. *cambodiana*; C. *A. henryi*; D. *A angustifolia* (sampling); E. *A. angustifolia* (small tree).

Figure 5 Outter bark and inner bark: A. *Actinodaphne angustifolia*; B. *A. sesquipedalis* var. *glabra*; C. *A. sikkimensis*; D. *A. sesquipedalis* var. *cambodiana*; E. *A. henryi*; F. *A. montana*.

Figure 6 Inflorescences: A-B. *Actinodaphne sesquipedalis* var. *cambodiana* (umbellate on short peduncle); C. *A. henryi* (umbel arranged in raceme); D. *A. glomerata* (cymose); E-F. *A. sikkimensis* (fasiculate).

Figure 7 Fruit: A. *Actinodaphne sikkimensis* (ellipsoid); B. *A. amabilis* (globose); C. *A. sesquipedalis* var. *glabra* (globose); D. *A. sesquipedalis* var. *cambodiana* (globose); E. *A. montana* (subglobose); F. *Actinodaphne* sp.1 (globose); G. *A. cupularis* (globose); H. *A. angustifolia* (subglobose).

Taxonomic History of the Genus *Actinodaphne* Nees

***Actinodaphne* Nees**, Wall., Pl. Asiat. Rar. 2: 61, 68. 1831; Hook. f., Fl. Brit. India. 5: 147. 1886; Gamble, J. As. Soc. Beng. 75, 1 (1912) 112; Kanjilal *et al*., Fl. Assam 4: 76. 1940; Ridl., Fl. Mal. Pen. 3: 107. 1967; Kosterman, Comm. For. Res. Inst. Bogor (1957) 42; Li, Woody Fl. Taiwan: 197. 1963; Backer & Bakh. f., Fl. Java 1: 124. 1963; Gandhi in Saldanha and Nicolson, Fl. Hassan District: 45. 1976; Brandis, Ind. Trees: 534. 1978; D.G. Long, Fl. Bhutan 1 (2): 280. 1984; Malla *et al*., Fl. Kathmandu Valley: 597. 1986; Coner, Ways. Tree Mal. 1: 345. 1940, 3rd ed. 382. 1988; Kochumen, Tree Fl. Mal. 4: 102. 1989; Rohwer, Families and Genera Vascular Plants 2: 366. 1993; Kosterm., Rev. Handbook Fl. Ceylon 9: 134. 1995; Turner, Gard. Bull. Sing. 47 (1995) 273; Sambus, E.N. & M.S.M. Sosef, Plant Resources of South-East Asia 5(3). Timber Trees: Lesser-known timbers: 45. 1998; Beaman *et al.*, Pl. Mt. Kinabalu (2001) 393; Van de Werff, Blumea 46 (1): 125. 2001; Julia, S., Garden. Bull. Sing. 57 (2005) 70.

Type species.— *Actinodaphne pruinosa* Nees

Synonyms:— *Iozoste* Nees, Wall., Pl. Asiat. Rar. 2: 61. 1831.

Evergreen, dioecious, small to medium-sized tree; bole straight to moderately straight, sometimes with small steep buttresses up to 1 m high; **Bark** generally nearly smooth, furrowed or cracking and occasionally lenticillate, outter bark greynish-brown to darkish-brown or reddish-brown, with green or white patches; inner bark yellowish-orange to yellow. **Terminal bud** perulate with imbricate scales, ellipsoid to ovoid, oblong or lanceolate; apex acute, glabrous to tomentose, sometimes covered with large green leaf-like scale, narrowly elliptic-oblong, elliptic-ovate, narrowly lanceolate-elliptic, glabrous to tomentose, rarely no scale. The falling scale leave distinct scar just above the whorls of leaves. **Leaves** simple, verticillate or subverticillate, apex acute, acuminate, caudate or cuspidate. base cuneate, attenuate or oblique. Margin usually entire; chartaceous or thinly coriaceous to coriaceous, shining green or dull dark green above, glaucous beneath, midrib and secondary veins arching

and looping near margin and obscure to slightly distinct or prominent on both surfaces; tertiary veins scalariform or reticulate-scalariform. Petiole slender to stout, 0.3-5.5 cm long, glabrous to tomentose. **Inflorescences** axillary or/and borne along twigs between whorls of leaves, fasiculate, cymose, umbel arranged in raceme or umbellate on short peduncles, 5-8- flowered per umble; involucral bracts caducous, leave distinct scars at base of inflorescence. **Flower** trimerous, unisexual, usually 0.3-1 cm in diam., greenish-white or yellow, fragant; perianth lobes 6, equal to subequal, imbricate, inner lobes glabrous, outer lobes glabrous to tomentose, membranaceous, 3-5 veins inside, elliptic, ovate or oblong, apex acute. **Staminate flower:** fertile stamen usually 9(-10), arranged in 3 whorls, the first and second whorls eglandular, third whorl with two glands on each side at the base, glands usually globose, cordate or saggittate shape; filament slender, 0.3-7.2 mm, longer or shorter than anther, glabrous to hairy; **anther** elliptic to oblong, apex acute, 0.8-2.5 mm long, 4-locular, the locules all introrse. **Pistillate flower:** staminodes 9(-10), elliptic, spathulate, linear or 3-lobes, 0.5-2 mm long, glabrous to hairy at the base; ovary superior, narrowed toward the style, ellipsoid to globose, glabrous to hairy, stigma peltate or 4-lobes, style slender to stout, 0.5-2 mm long, glabrous to hairy. **Infructescences** each bearing 1-5 fruits. **Fruits** drupe, globose, subglobose or ellipsoid, seated on enlarge perianth tube partly enclosing the fruits, the tube disc-shaped or cup-shape, 0.3-1 cm in diameter, glabrous to puberulous within, without hairy, margin entire or undulate; young fruit light to dark green, slightly shinning, with white mottle, when ripe dark purpulish-red to black; fruit apex apiculate, persistent or caducous, perianth which is persistent or caducous when fruiting have distinct scar on the perianth tube; pedicels slender, thickened, usually 0.5-1.5 cm long, glabrous to tomentose.

A dichotomous key to species of the genus *Actinodaphne* Nees in Thailand was constructed from this study for plant identification.

Key to species of the Genus *Actinodaphne* Nees in Thailand

1. Shoot apex with terminal buds covered with large green scale leaves like under-sized foliage leaves, glabrous to hairy
   2. Inflorescences cymose, terminal buds glabrous_____**4. *A. glomerata***
   2. Inflorescences umbellate on short peduncles or fasiculate, terminal buds glabrous to tomentose
      3. Petiole slender, glabrous, 1-2 cm long_____**11. *Actinodaphne* sp.1**
      3. Petiole stout, glabrous or yellowish hairy, 2-5 cm long
         4. Foliage leaves of terminal buds narrowly elliptic-oblong, 4-5 cm long; leaf blade narrowly elliptic-oblong or narrowly lanceolate, 22-45 by 3-9 cm; petiole yellowish hairy, 2.0-4.0 cm long _____**9a. *A. sesquipedalis* var. *cambodaina***
         4. Foliage leaves of terminal buds elliptic-ovate, 2-4 cm long, leaf blade elliptic-oblanceolate, 30-60 by 9-18.5 cm, petiole glabrous, 3.5-5.5 cm long _____**9b. *A. sesquipedalis* var. *glabra***
1. Shoot apex with terminal buds perulate with imbricate scale or not, glabrous to hairy
   5. Inflorescences umbel arranged in raceme
      6. Petiole slender, glabrous to puberulous, 1-2 cm long. Perianth tube deeply cup-shaped, margin entire, 3-4 mm in diam., within glabrous. Bark smooth _____**6. *A. montana***
      6. Petiole stout, puberulous to tomentose, 2-4 cm long. Perianth tube shallowly cup-shaped, margin entire or undulate, 7-8 mm in diam., within puberulous. Bark furrowed_____**5. *A. henryi***
   5. Inflorescences umbellate on short peduncles or fasiculate
      7. Tertiary veins finely reticulate, leaves subverticillate above, alternate below_____**8. *A. perglabra***
      7. Tertiary veins scalariform or reticulate-scalariform, leaves verticillate or subverticillate
         8. Fruit ellipsoid_____**10. *A. sikkimensis***
         8. Fruit globose or subglobose

9. Inflorescences umbellate on short peduncles
    10. Perianth tube deeply cup-shaped, 0.4-0.5 cm in diam., 6-7 flowered per umble. Petiole 0.5-1 cm long._____**3. *A. cupularis***
    10. Perianth tube shallowly disc-shaped or undulate cup-shaped, 0.5-0.6 cm in diam., 7-8 flowered per umble. Petiole 1.6-1.8 cm long. _____**7. *A. omeiensis***
9. Inflorescences fasiculate
    11. Juvenile shoots whitish wooly. Inflorescences borne along twigs between whorls of leaves; perianth tube shallowly cup-shaped, 0.7-0.8 cm in diam._____**1. *A. amabilis***
    11. Juvenile shoots rusty tomemtose. Inflorescences axillary and on twigs between whorls of leaves; perianth tube small disc-shaped, 0.4-0.5 cm in diam._____**2. *A. angustifolia***

1. Actinodaphne amabilis Kosterm. in Nat. Hist. Bull Siam Soc., 25(3-4): 29. 1974. Type: Thailand, Loei Phu Kradueng, *Kerr* 16931 (BM, K). Figure 8, 9.

Small tree, c. 10 m high. *Twigs* slender, dense minutely sub-woolly, juvenile shoots densely white-woolly. *Terminal buds* perulate with imbricate scale, elliptic to ovate, 5-6 mm, tomentose. *Leaves* verticillate of 4-5 leaves; blade elliptic-oblong to narrow lanceolate, 9.5-19 by 2-3 cm; apex acute to acuminate; base cuneate to attenuate; margin entire; chartaceous, shining green above, densely whitish-wooly when young, glabrous on both surfaces when old, glaucous beneath; midrib raised on both surfaces, prominent beneath, glabrous; lateral veins 6-10 pairs, at an angle of 45º-60º from the midrib, sunken above, raised beneath, arching and looping near margin; tertiary veins scalariform, obscure or slightly distinct on both surfaces. *Petiole* slender, 1-1.5 cm long, puberulous. *Inflorescences* fasiculate, many nodes laid upon small minutely tomentose, 5-7 mm in diam., tomentose, borne along twigs between whorls of leaves; *Staminate flower*: not seen. *Pistillate flower*: pedicel 2 mm long, whitish pilose; perianth lobes 6, oblong-elliptic, 2-2.5 by 0.5-1 mm, velutinous outside, glabrous inside; ovary ellipsoid-ovoid, c. 1 by 0.5 mm, glabrous, style stout, 1 mm long, pilose at the base, stigma peltate; staminode 9, spathulate, 1.0 mm long,

pilose at the base. *Infructescences* each bearing 3-4 fruits. *Fruit* globose, 0.7-0.8 cm in diam.; apex apiculate; drying black; seated on enlarge perianth tube, perianth tube shallowly cup-shaped, 0.7-0.8 cm in diam., puberulous on both side; pedicels slender, 0.5 cm long, whitish pilose.

Thailand.— NORTHEASTERN: Loei (Phu Kradueng National Park); PENINSULAR: Phangnga (Khao Phota Luang Kaeo).

Distribution.— Thailand (type).

Ecology.— Lower montane rain forest; altitude:1,000-1,300 m. flowering: November; fruiting: February.

Vernancular.— Tong Lat Khon Khao (ตองลาดขนขาว)(The name is given by the author).

Note.— Description of this species was refered to Kosterm. in Nat. Hist. Bull. Siam Soc. 25(3-4): 29. 1974.

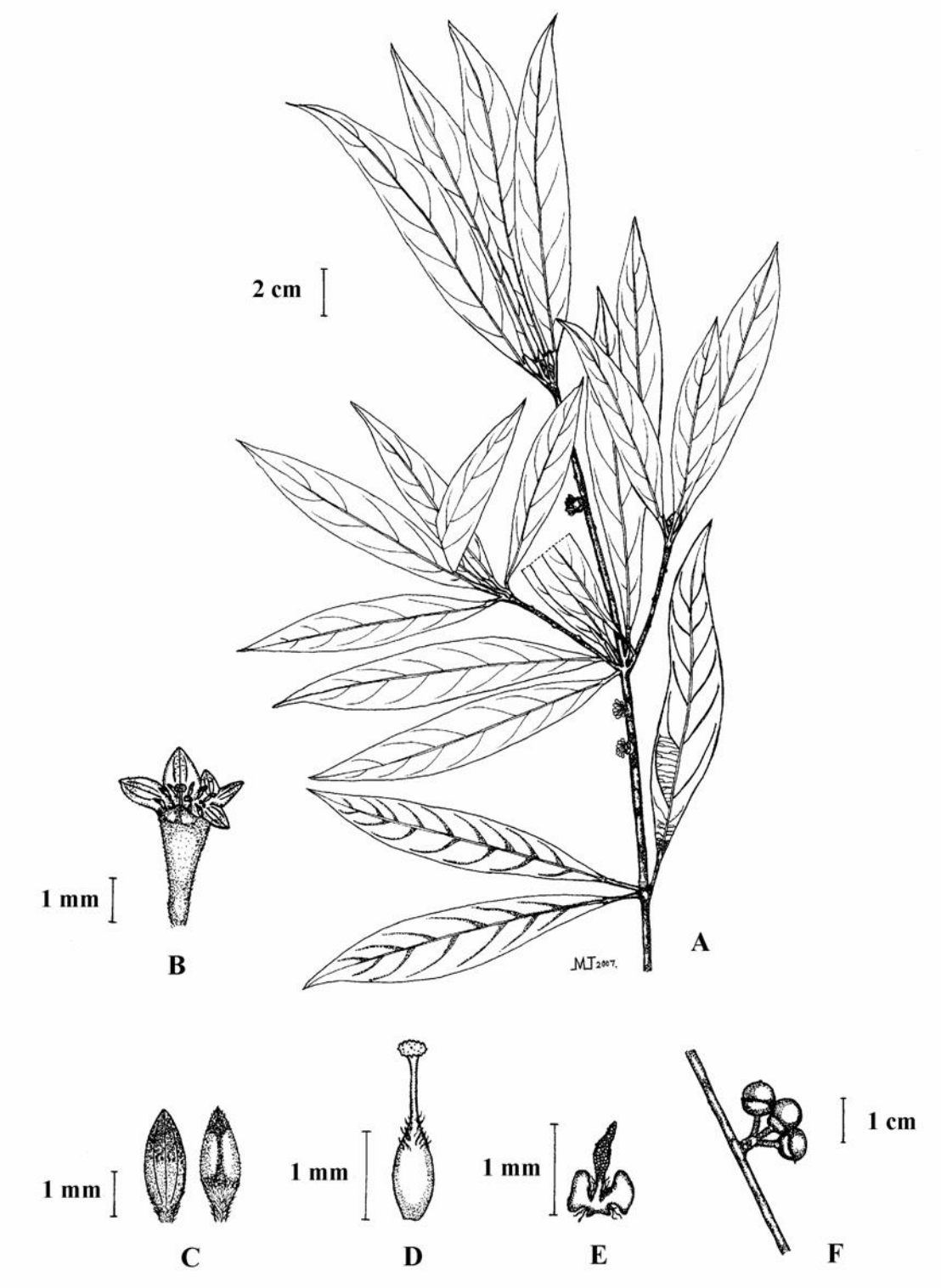


Figure 8 *Actinodaphne amabilis* Kosterm.: A. flowering twig; B. pistillate flower; C. perianth lobes; D. pistil; E. staminode; F. fruiting twig.

Figure 9 Photographs of *Actinodaphne amabilis* Kosterm.: A. fruiting twig; B. terminal buds; C. juvenile shoot; D. flowering twig; E. fruits; F. pistillate flower; G. staminode; H. pistil; I. perianth inside (left), outside (right).

2. Actinodaphne angustifolia (Blume) Nees in Wallich, Pl. As. rar. 3: 31. 1832; Hook. f., Fl. Brit. India 5: 152. 1885; Meissner in DC., Prodr. 15(1): 214. 1864; Backer & Bakh. *f*., Fl. Java 1: 125. 1963; Brandis, Indian Trees 535. 1906; Craib, Contr. Fl. Siam 176. 1912; Kanjilal *et al*., Fl. Assam 4: 76. 1940; Kostermans in J. sci. Res. Indon. 1(5): 1952; D.G. Long, Fl. Bhutan 1, 2: 280. 1984; Sambus, E.N. and M.S.N. Sosef, Plant Resource of South-East Asia 5(3). Timber Trees: Leaves-known timbers: 46. 1998.— *Litsea angustifolia* Blume, Bijdr. Fl. Ned. Ind. 11: 566. 1826. Figure 10, 11.

Small to medium-sized tree, c. 10-12 m high. dbh 10-15 cm. *Twigs* rough, juvenile shoot rusty-tomentose. *Bark* reddish-brown with green patches, lenticels grey, inner bark brownish-yellow. *Terminal buds* perulate with imbricate scale, elliptic-ovate, 4-7 mm, glabrous. *Leaves* verticillate of 3-6 leaves; blade elliptic-oblanceolate, 9-25 by 2.3-5 cm; apex acute to acuminate; base cuneate; margin entire; chartaceous, shining green above, glabrous on both surfaces, glaucous beneath, midrib flat or raised above, raised beneath, yellowish tomentose when young, glabrous on both surfaces when old, lateral veins 7-10 pairs, at an angle of 50º-60º from the midrib, sunken above, raised beneath, arching and looping near margin, tertiary veins scalariform, obscure or slightly distinct above, prominent beneath. *Petiole* slender, 0.5-1.3 cm long, glabrous to puberulous. *Inflorescences* fasiculate, 1-1.7 cm in diam., axillary or borne along twigs between whorls of leaves. *Staminate flower*: pedicel 2-3 mm long, glabrous to puberulous; perianth lobes 6, ovate-elliptic, 2-2.5 by 1.5-2 mm, puberulous outside, glabrous inside; stamen 9, anther ovate-elliptic, 0.8-1.2 mm long, filament 1-1.2 mm long, sparsely hairy along filament. *Pistillate flower*: not seen. *Infructescences* each bearing 2-3 fruits. *Fruit* subglobose, 0.7-0.8 cm in diam.; drying dark red; seated on enlarge perianth tube, perianth tube small disc-shaped, 0.4-0.5 cm in diam., puberulous within, puberulous without; pedicel slender, 0.3-0.4 cm long, glabrous.

Thailand.— EASTERN: Nakhon Ratchasima (Khao Yai National Park); SOUTHEASTERN: Chanthaburi (Trok Nong Waterfall Substation and Nam Tok Phlio National Park), Trat (Chang Kluea), Rayong (Ban Phe); PENINSULAR: Trang

(Khao Chong), Krabi (Dan Chumpon), Ranong (Khao Phota Laung Kaeo), Pattani (Banang-Sata), Narathiwat (Hala-Bala Wildlife Santuary).

Distribution.— India, Malay Peninsula, Java.

Ecology.— Mixed deciduous forest to dry evergreen forest; altitude: 450-700 m. flowering: November; fruiting: Febuary.

Vernancular.— Ka that (กาทัด) (Rayong), Ka thit nu (กาทิดหนู) (Trat), Rom Khao (ร่มเข้า) (Ranong).

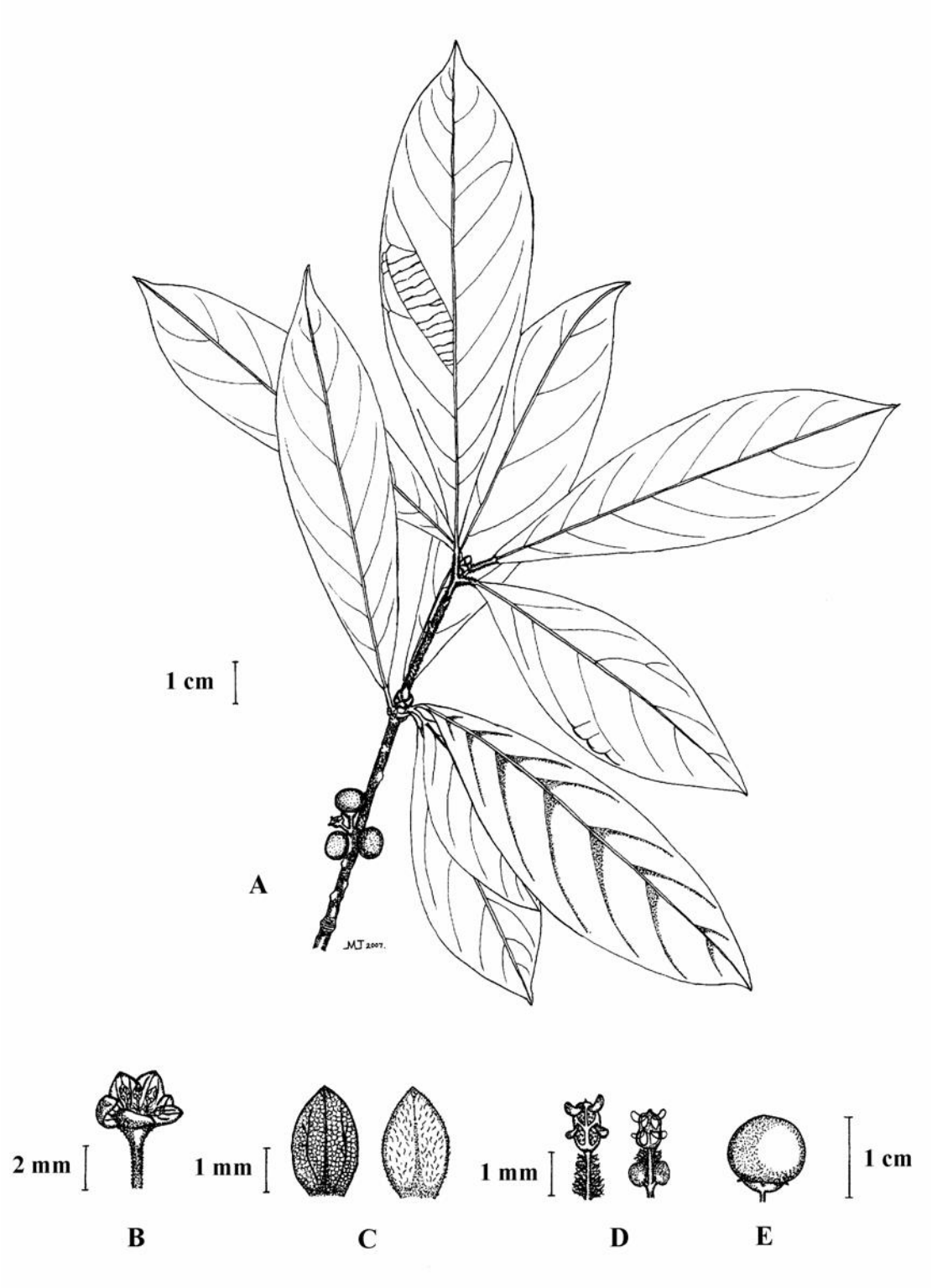


Figure 10 *Actinodaphne angustifolia* (Blume) Nees: A. fruiting twig; B. staminate flower; C. perianth lobes; D. stamen; E. fruit.

Figure 11 Photographs of *Actinodaphne angustifolia* (Blume) Nees: A. habit; B. fruiting twig; C. terminal bud; D. staminate flowers; E. stamen; F. perianth lobes.

3. Actinodaphne cupularis (Hemsl.) Gamble in Sargent, Pl. Wilson. 2: 75. 1914; Liou Ho, Laur. Chine et Indochine 160; Allen in Ann. Missouri Bot. Gard. 25: 405. 1938.—*Litsea cupularis* Hemsl. in J. Linn. Soc. 26: 380. 1891. Figure 12, 13.

Small to medium-sized tree, c. 3-12 m high. *Twigs* slender, juvenile shoot puberulent. *Terminal buds* perulate with imbricate scale, elliptic to lanceolate, 1.5-2 cm, peberulous. *Leaves* subverticillate of 5-6 leaves, blade elliptic, 8.5-19 by 2-5 cm; apex acute; base cuneate; margin entire; chartaceous or thinly coriaceous, shining green above, glabrous on both surfaces, glaucous beneath; midrib sunken above, raised beneath, glabrous or puberulent beneath when young, glabrous on both surfaces when old, lateral veins 6-12 pairs, at an angle of 45º-60º from the midrib, flat above, raised beneath, arching and looping near margin, tertiary veins scalariform to reticulate, obscure or slightly distinct above, prominent beneath. *Petiole* slender, 0.5-1 cm long, glabrous to puberulous. *Inflorescences* umbellate on short peduncles, 1-1.5 cm in diam., densely tomentose, 6-7 flowered per umbel, axillary and borne along twigs between whorls of leaves. *Staminate flower*: pedicel 3-4 mm long, yellowish tomentose; perianth lobes 6, elliptic, 2.8-3.5 by 0.5-1.5 mm, velutinous outside, glabrous inside; stamen 9, anther oblong, 1-1.5 mm long, filament 4-5.5 mm long, villous at the base. *Pistillate flower*: pedicel 3-4 mm long, yellowish tomentose; perianth lobes 6, elliptic, 2.8-3.5 by 0.5-1.5 mm, velutinous outside, glabrous inside; ovary ovoid, c. 1 by 0.5 mm, glabrous, style slender 1 mm long, glabrous, stigma peltate; staminode 9, linear, 1-1.5 mm long, glabrous. *Infructescences* each bearing 1-3 fruits. *Fruit* globose, 1.2-1.4 cm in diam.; apex apiculate; drying dark red, red when mature; seated on enlarge perianth tube, perianth tube deeply cup-shaped, 0.5-1 cm in diam., glabrous within, velutinous without; pedicels slender, 0.7-1.5 cm long, velutinous.

Thailand.— NORTHERN: Chiang Mai (Doi Chiang Dao Wildlife Santuary), NORTHEASTERN: Loei (Phu Kradueng National Park), EASTERN: Nakhon Ratchasima (Khao Laem).

Distribution.— South China (Yunnan).

Ecology.— Lower montane rain forest; altitude: 1,300-1,500 m. flowering: October-November; fruiting: August-September.

Vernancular.— Tong Lat Doi Chiang Dao (ตองลาดดอยเชียงดาว)(The name is given by the author).

Use.— Seeds contain oils which are the material for making and lubricant. The roots and leaves are used as folk medicine for curing Hong Kong foot, burn and piles.

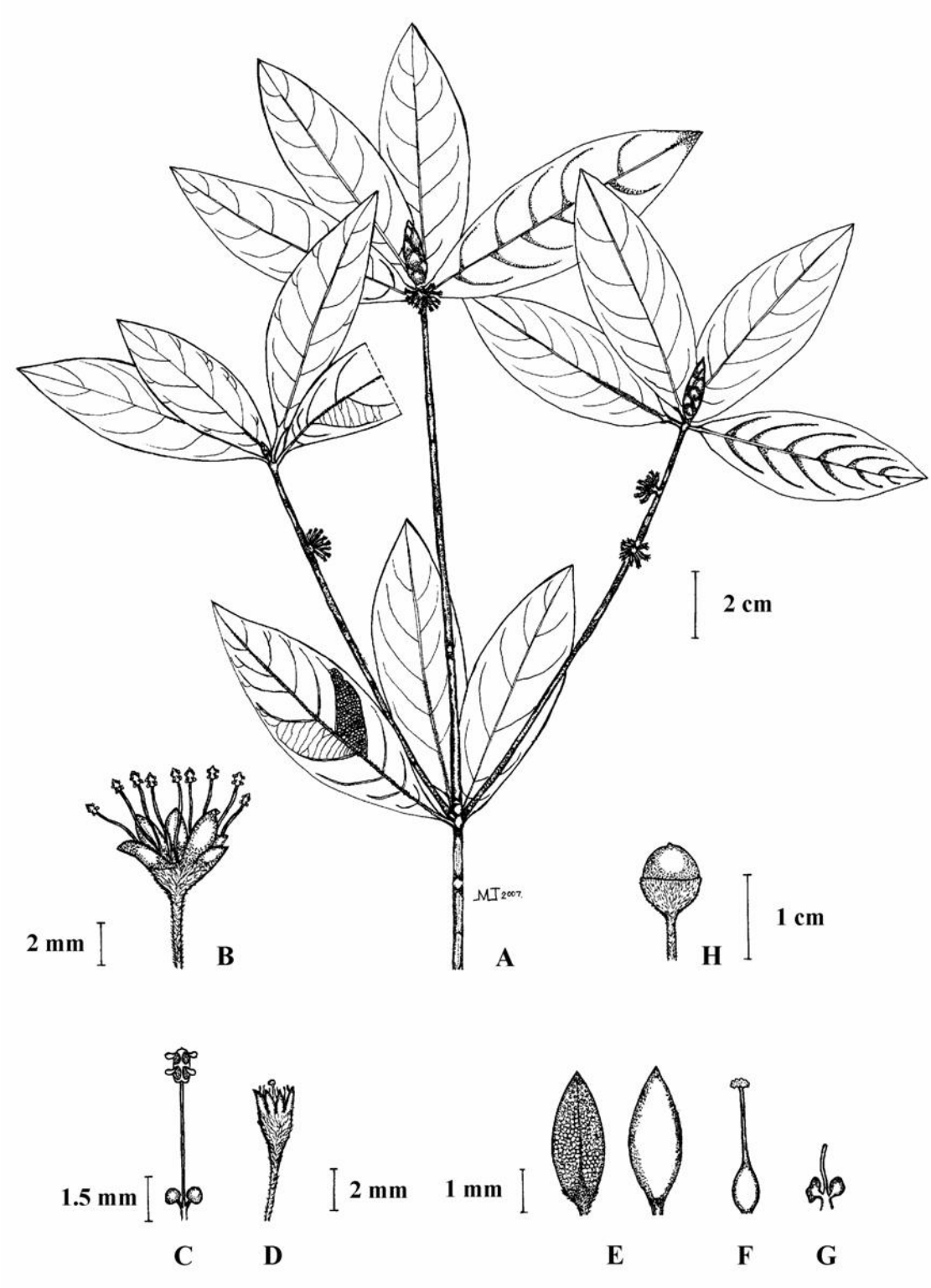


Figure 12 *Actinodaphne cupularis* (Hemsl.) Gamble: A. flowering twig; B. staminate flower; C. stamen; D. pistillate flower; E. perianth lobes; F. pistil; G. staminode; H. fruit.

Figure 13 Photographs of *Actinodaphne cupularis* (Hemsl.) Gamble: A. flowering twig; B. terminal bud; C. staminate flowers; D. fruits; E. pistillate flower; F. stamen; G. staminode; H. pistil.

4. Actinodaphne glomerata (Blume) Nees, Syst. Layr. 597. 1836; Burkill & Henderson in Gard. Bull. S.S. 3: 415. 1925; Backer & Bakh. *f.*, Fl. Java 1: 124. 1963; Ridl., Fl. Mal. Pen. 3: 108. 1967; Sambus, E.N. and M.S.M. Sosef, Plant Resources of South-East Asia 5(3). Timber Trees: Lesser-known timbers; 46. 1998; Beaman *et al*., Pl. Mt. Kinabalu (2001) 393.— *Laurus glomerata* Blume, Catal. Gewassen Lands Pl. tuin Buitenzorg 66. 1823 (In adnot.). Figure 14, 15.

Small to medium-sized tree, c. 10-18 m high. *Twigs* slender, juvenile shoot reddish minutely pubescent. *Bark* smooth, lenticillate, dark grey. *Terminal buds* covered with large green scale leaves like under-sized foliage leaves, elliptic-ovate, 1-2.5 cm, glabrous. *Leaves* verticillate of 4-7 leaves; blade ovate-obovate, 13-28 by 5.5-14 cm; apex cuspidate; base oblique; margin entire; coriaceous, dark green above, reddish minutely pubescent when young, glabrous on both surfaces when old, glaucous beneath; midrib raised on both surfaces, glabrous above, minutely pubescent beneath, lateral veins 11-13 pairs, at an angle of 30º-40º from the midrib, raised on both surfaces, arching and looping near margin, tertiary veins scalariform, prominent on both surfaces. *Petiole* slender, 1-2(-3) cm long, glabrous to pubescent. *Inflorescences* cymose, 1-2 cm in diam., borne along twigs between whorls of leaves, peduncle 0.5-0.7 cm, minutely pubescent. *Staminate flower*: pedicel 3-5 mm long, pubescent; perianth lobes elliptic-ovate, 2.5-3 by 2 mm, velutinous outside, glabrous inside, stamen 9, anther ovate-elliptic, 1-1.3 mm long, filament 0.3-0.5 mm long, yellow-reddish villous at the base. *Pitillate flower*: not seen. *Infructescences* not seen.

Thailand.— PENINSULAR: Ranong

Distribution.— India, Malay Peninsula, Java, Sumatra.

Ecology.— Tropical rain forest to lower montane rain forest; altitude: 600-1,000 m. flowering: September.

Vernancular.— Tong Lat Bai Kai Klab (ตองลาดใบไข่กลับ)(The name is given by the author).

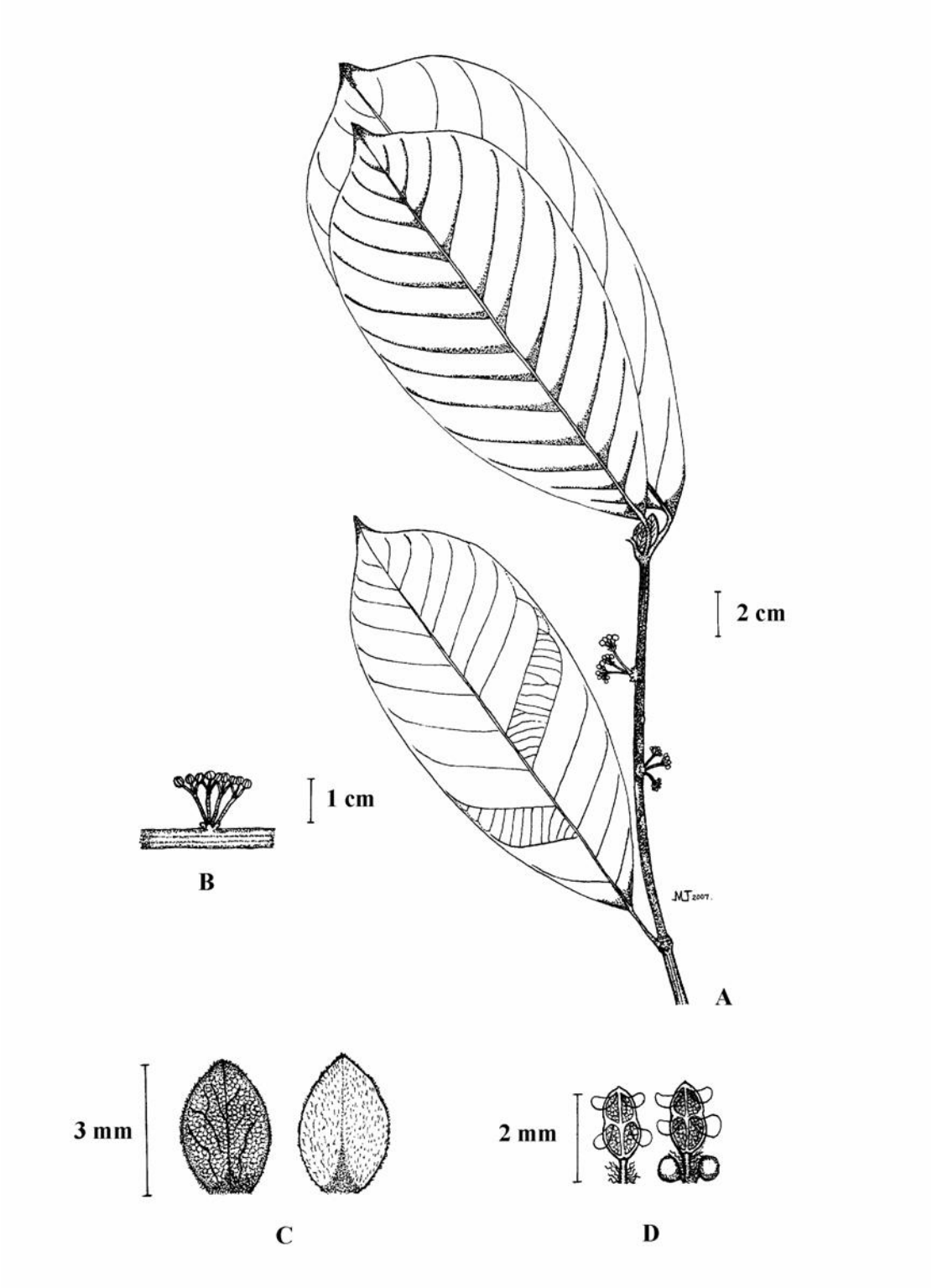


Figure 14 *Actinodaphne glomerata* (Blume) Nees: A. flowering twig; B. staminate flower; C. perianth lobes; D. stamen.

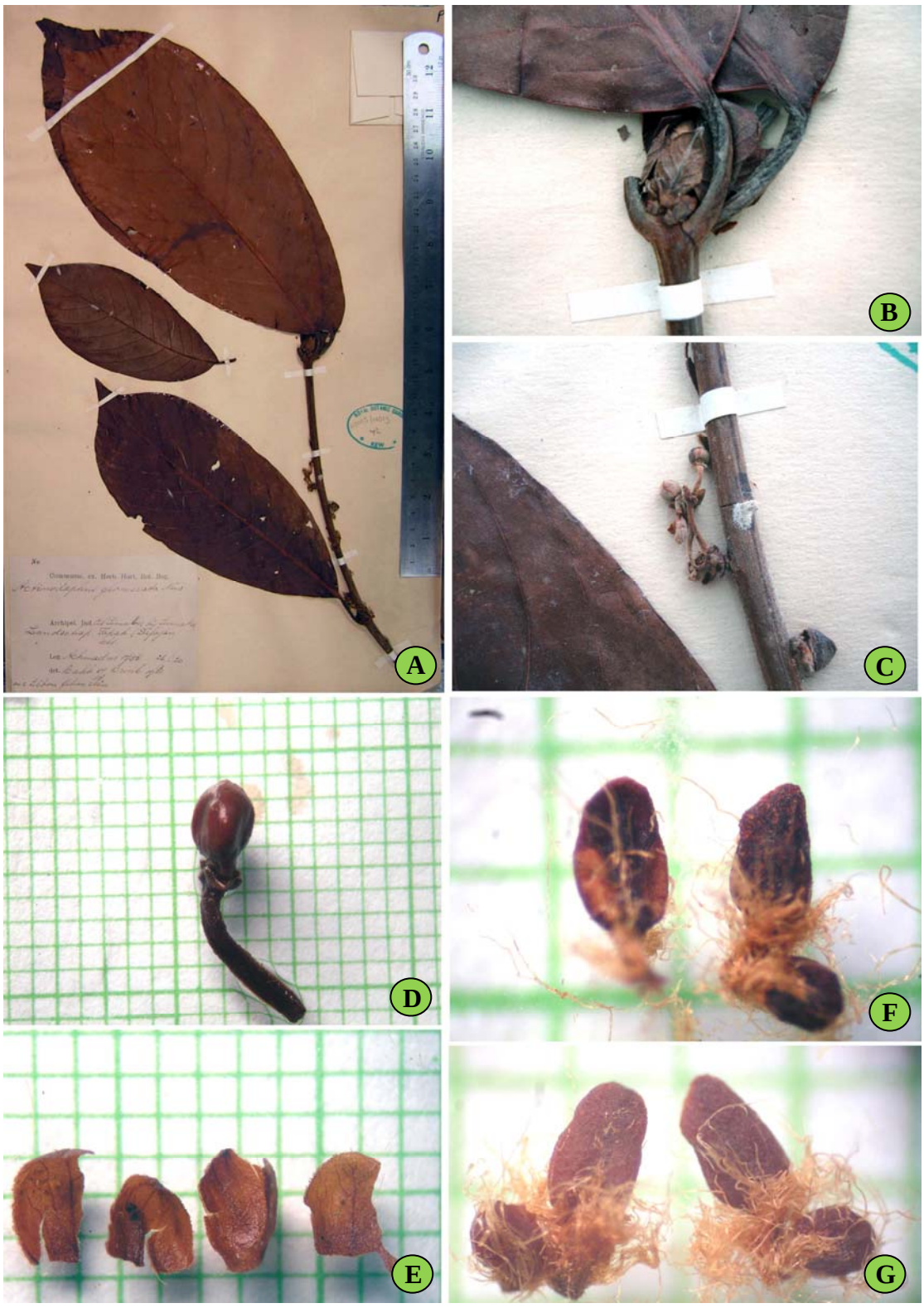


Figure 15 Photographs of *Actinodaphne glomerata* (Blume) Nees: A. flowering twig; B. terminal bud; C-D. staminate flower; E. perianth lobes; F. stamen (front view); G. stamen (back view).

5. Actinodaphne henryi Gamble in Kew Bull. 1913: 265; Hooker f., Fl. Brit. India 5: 154. 1886; Gamble, Man. Ind. Timb., ed. 2: 569. 1902; Brandis, Ind. Trees 535. 1906. Figure 16, 17.

Small to medium-sized tree, c. 10-20 m high. dbh 15-19 cm. *Twigs* thick, glabrous to pubescent or tomentose, juvenile shoot densely yellowish tomentose. *Bark* furrowed, greyish to brownish, inner bark, yellowish. *Terminal buds* perulate with imbricate scale, oblong, 2-3.5 cm, tomentose. *Leave* subverticillate of 4-6 leaves; blade elliptic-lanceolate, 22-29 (-40) by 5.5-7.5(-10) cm; apex acute to acuminate; base cuneate or oblique; margin entire; coriaceous, dull dark green above, densely yellowish tomentose when young, glabrous on both surfaces when old, greynish-silvery glaucous beneath; midrib raised on both surfaces, glabrous to puberulous on both surfaces, lateral veins 9-12 pairs, at an angle of 40°-60° from the midrib, raised on both surfaces, arching and looping near margin, tertiary veins scalariform, slightly distinct above, finely prominent beneath. *Petiole* stout, 2-4 cm long, puberulous to tomentose. *Inflorescences* umble arranged in raceme, borne along twigs between whorls of leaves, 5-flowered per umbel, peduncle of each umble 0.7-1 cm long, pubescent. *Staminate flower*: pedicel 2-2.5 mm long, yellowish tomentose; perianth lobe 6, elliptic, 2-2.5 by 0.8-1 cm, velutinous outside, glabrous inside, stamen 9, anther oblong, 1.3-1.5 mm long, filament 3.5-4 mm long, villous along filament, the 3rd whorls each with 2 glands at base, cordate or saggittate. *Staminate flower*: pedicel 2-2.5 mm long, yellowish tomentose; perianth lobe 6, elliptic, 2-2.5 by 0.8-1 cm, velutinous outside, glabrous inside; ovary ellipsoid to ovoid, c. 1 by 0.5 mm, glabrous, style stout, 0.3-0.5 mm long, glabrous, stigma peltate; staminode 9, spathulate, 1 mm long, the 3rd whorls each with 2 glands at base, cordate or saggittate. *Infructescences* each bearing 1-3 fruits. *Fruit* globose, 0.8-1 cm in diam., young fruit greenish, red when mature, drying dark red, seated on enlarge perianth tube, shallowly cup-shaped, margin entire or undulate, 0.7-0.8 cm in diam., puberulous within, puberulous without; pedicels slender, 0.5-0.7 cm long, pubescent.

Thailand.— NORTHERN: Chiang Rai (Doi Aung Kha), Chiang Mai (Doi Suthep-Pui National Park and Doi Inthanon National Park), Phitsanulok (Phu Hin

Rong Klao National Park and Thung Salaeng Luang National Park), Nan (Doi Phuka National Park), Sukhothai (Khao Luang), Lampang (Chae Son National Park and Doi Khun Tan National Park); SOUTHWESTERN: Kanchanaburi (Tinuang Forest Protection Units and Thung Yai Naresuan Wildlife Santuary), Uthai Thani (Huai Kha Khaeng Wildlife Santuary); EASTERN: Nakhon Ratchasima (Khao Laem and Khao Yai National Park); SOUTHEASTERN: Chonburi (Khao Khiao).

Distribution.— South China (Yunnan).

Ecology.— Lower montane forests; altitude 600-1,300 m. flowering: December-Febuary; fruiting: July-August.

Vernacular.— Tong Lat (ตองลาด) (Chiang Mai), Ta thip thong (ตาถีบทอง) (Nakhon Ratchasima), Saen ta kla yai (แสนตะกละใหญ่) (Sukhothai).

Use.— The wood is used for construction, furniture and industrial timber.

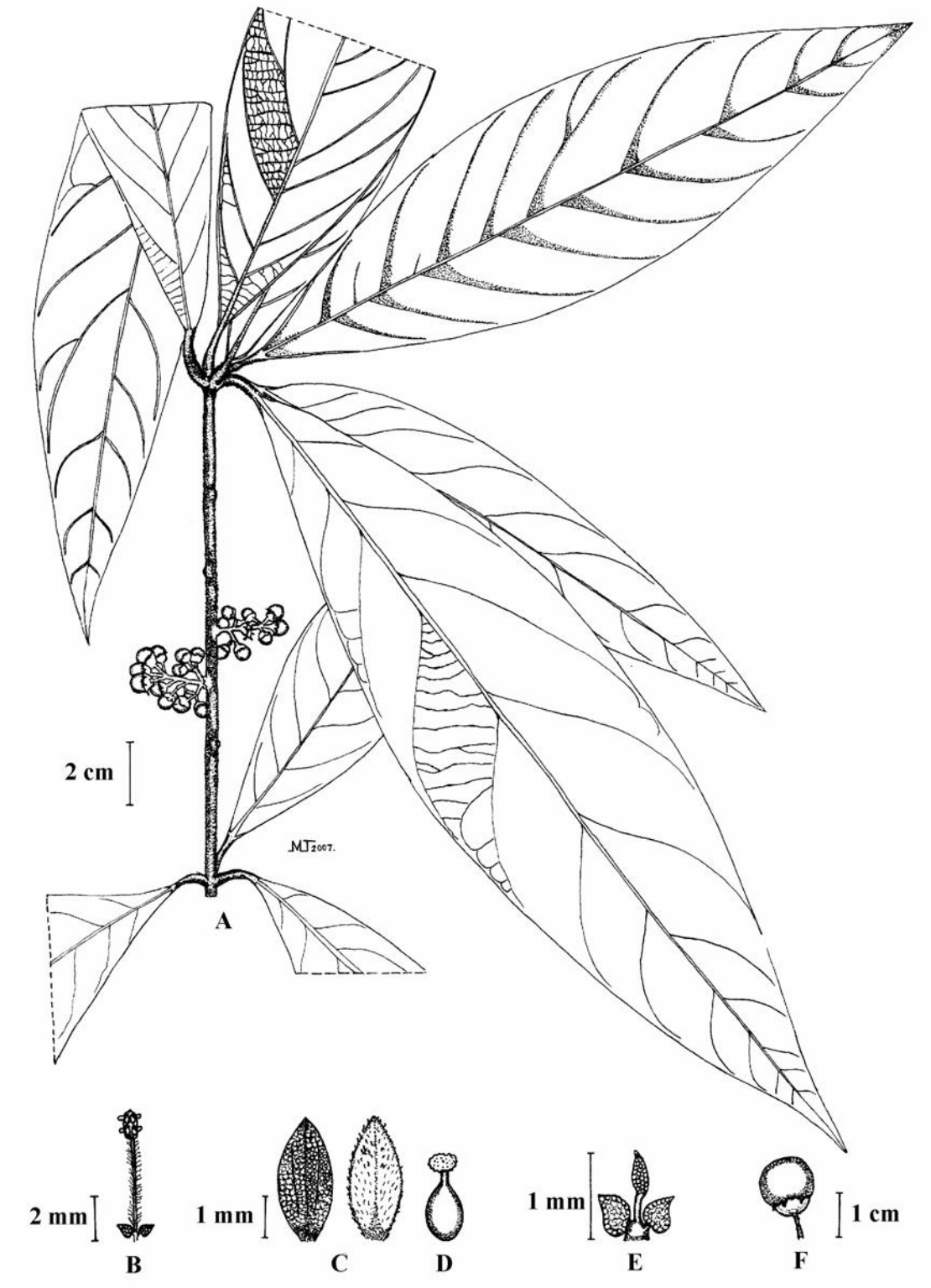


Figure 16 *Actinodaphne henryi* Gamble: A. fruiting twig; B. stamen; C. perianth lobes; D. pistil; E. staminode; F. fruit.

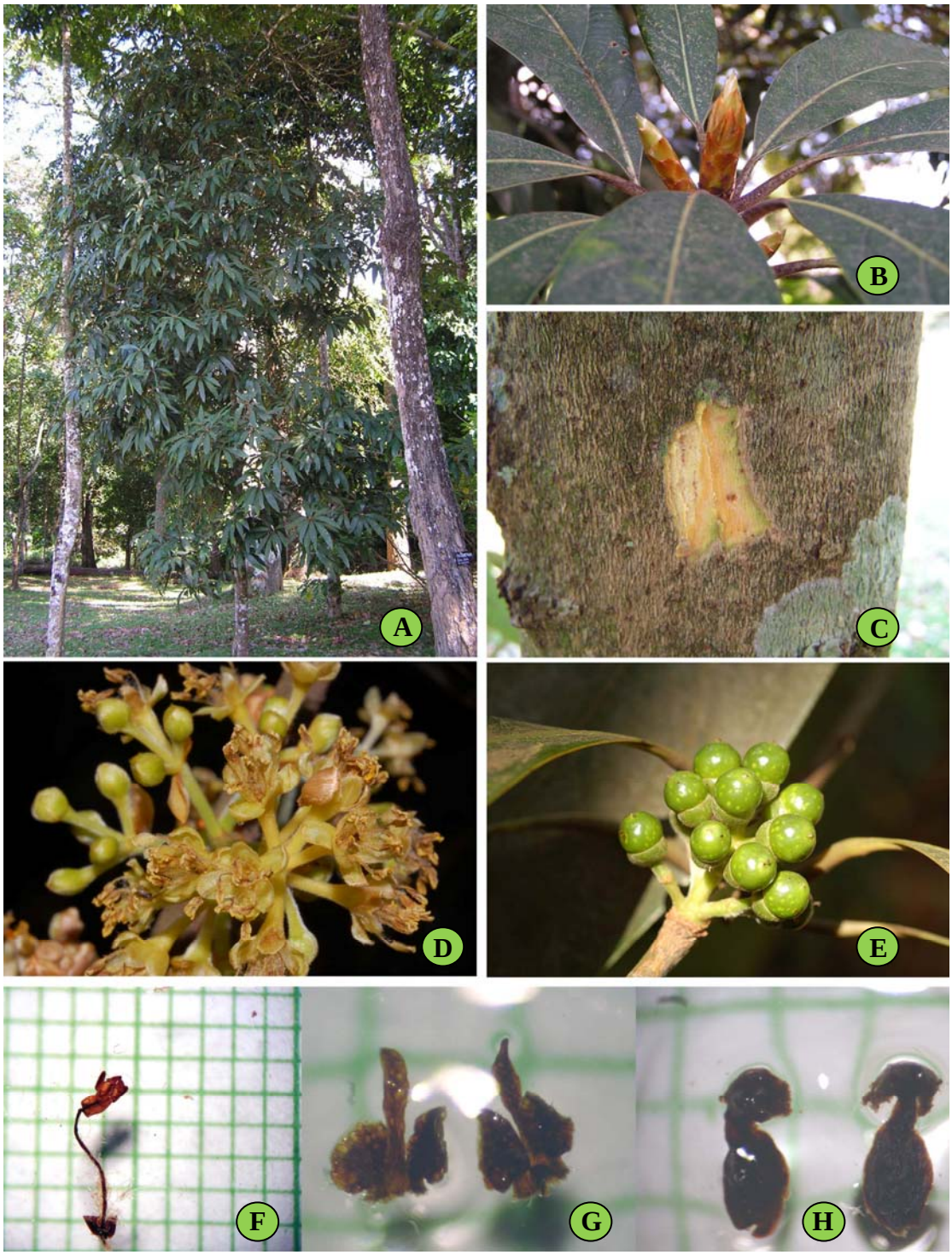


Figure 17 Photographs of *Actinodaphne henryi* Gamble: A. habit; B. terminal buds; C. bark; D. staminate flower; E. fruits; F. stamen; G. staminode; H. pistil.

6. Actinodaphne montana Gamble in Kew Bull. 1910: 312; Ridl., Fl. Mal. Pen. 3: 108. 1924; Burkill & Henderson in Gard. Bull. S.S. 3: 415. 1925; Kochummen, Tree Fl. Malaya 4: 105. 1989. Figure 18, 19.

Medium-sized tree, c. 15-20 m high. dbh 20-30 cm. *Twigs* slender. *Bark* smooth, lenticillate, greyish-brown, inner bark, yellowish-orange. *Terminal buds* perulate with imbricate scale, elliptic, 0.8 cm, tomentose. *Leaves* verticillate of 4-5 leaves; blade oblanceolate-elliptic, 11-19 by 4.5-6.5 cm; apex acuminate to caudate; base cuneate; margin entire; thinly coriaceous, bluish green above, glabrous on both surfaces, glaucous beneath; midrib raised or flat above, raised beneath, glabrous on both surfaces, lateral veins 7-10 pairs, at an angle of 40º-50º from the midrib, flat or sunken above, raised beneath, arching and looping near margin, tertiary veins scalariform, obscure or slightly distinct above, finely prominent beneath. *Petiole* slender 1-2 cm long, glabrous to puberulous. *Inflorescences* umbel arranged in raceme. *Infructescences* each bearing 1-3 fruits, axillary or borne along twigs between whorls of leaves. *Fruit* subglobose, 0.4-0.5 cm in diam.; young fruit green with white dot, drying dark red-black; seated on enlarge perianth tube, perianth tube deeply cup-shaped, 0.3-0.4 cm in diam., glabrous within, puberulous without; pedicels thicken, 0.7-1.5 cm long, puberulous.

Thailand.— PENINSULAR: Pattani (Bachaow), Yala (Betong), Phatthalung, Nakhon Si Thammarat (Khao Nan).

Distribution.— Malay Peninsula.

Ecology.— Lower montane rain forests, rarely on low; altitude: 600-1,500 m. fruiting: July.

Vernacular.— Mae-dae-si-ka (แมแดซิกะ) (Malay-Pattani).

Note.— Description of this species was refered to Kochummen in Tree Fl. Malaya 4: 105. 1989.

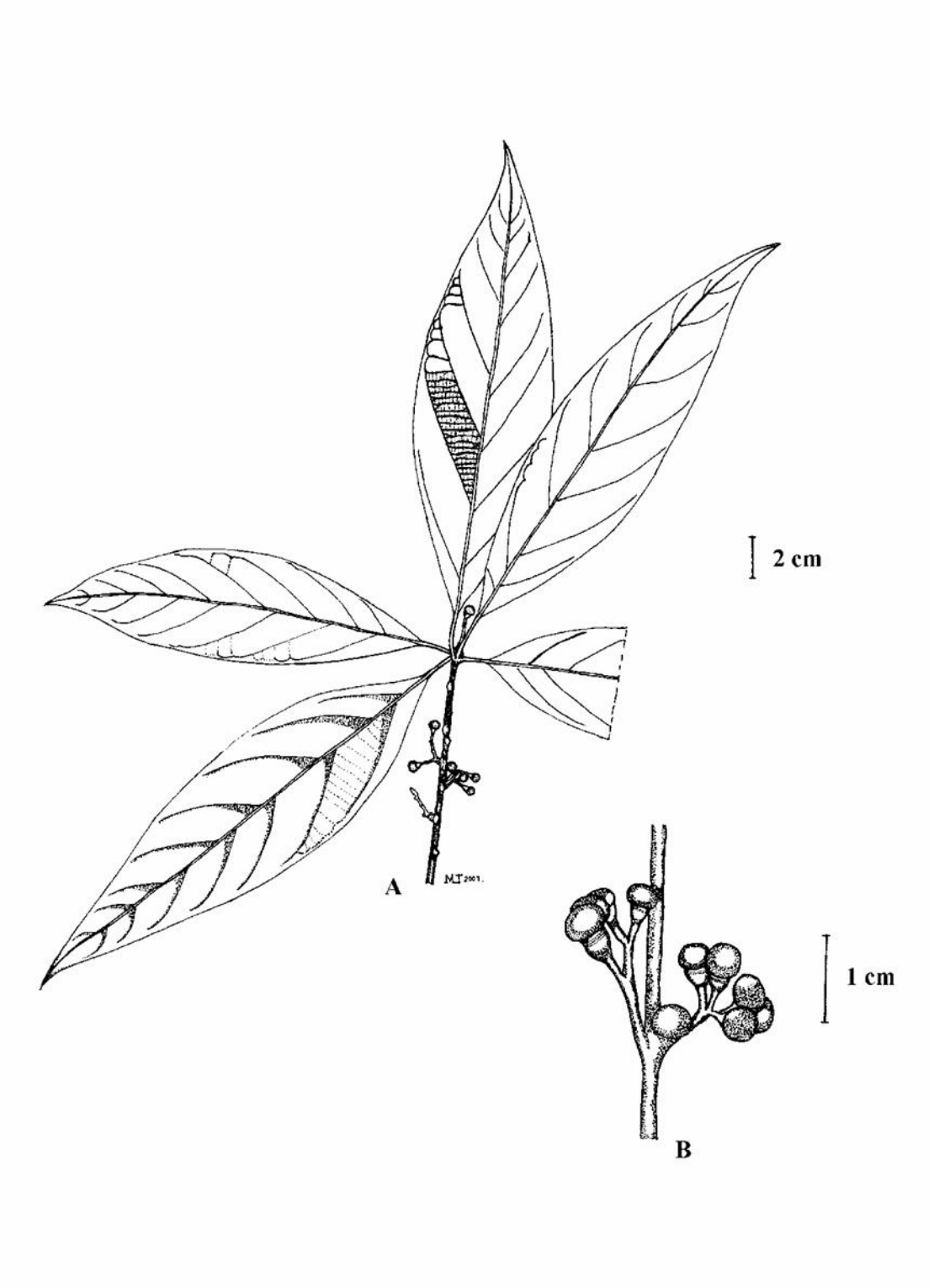


Figure 18 *Actinodaphne montana* Gamble: A. fruiting twig; B. infructescences.

Figure 19 Photographs of *Actinodaphne montana* Gamble: A. fruiting twig; B. outer bark; C-D. infructescences (Photographed by M. poopath).

7. Actinodaphne omeiensis (H. Liu) C.K. Allen in Ann. Missouri Bot. Gard. 25: 411. 1938 (preprint 1937).— *A. reticulata* Meisn. var. *omeiensis* H. Liu, Laur. Chine et Indoch. 159. 1932; C.K. Allen in Ann. Missouri bot. Gard. 25: 411. 1938 (preprint). Figure 20, 21.

Small tree, c. 3-5 m high. *Twigs* villous when young and becoming glabrous. *Terminal buds* perulate with imbricate scale, elliptic, 1.1-2.2 cm, glabrous to tomentose. *Leave* subverticillate of 4-6 leaves, blade oblong to lanceolate, 12-16(-27) by 2-4(-6) cm; apex acute to acuminate; base cuneate to oblique; margin entire; thinly coriaceous, shinning green above, glabrous on both surfaces, silvery glaucous beneath; midrib raised on both surfaces, lateral veins 9-12(-15) pairs, at an angel of 55º-60º from the midrib, sunken above, raised beneath, arching and looping near margin, tertiary veins scalariform to indistinct reticulate, obscure on both surfaces. *Petiole* slender, 1.6-1.8 cm, glabrous. *Inflorescences* umbellate on short peduncles, 7-8 flowers per umbel. *Infructescences* each bearing 1-3 fruits. *Fruit* subglobose, 1.2 cm in diam.; seated on enlarge perianth tube, perianth tube shallowly disc-shaped or cup-shaped, margin entire or undulate, 0.5-0.6 cm in diam., puberulous within, glabrous to puberulous without; pedicels thicken, 0.6-0.7 cm long, glabrous to puberulous.

Thailand.— SOUTHWESTERN: Prachuap Kiri Khan (Khao Luang).

Distribution.— China.

Ecology.— Lower montane rain forest; altitude: 500-1,700 m. flowering: Febuary-March; fruiting: July-September.

Vernancular.— Tong Lat Bai Kahnan (ตองลาดใบขนาน)(The name is given by the author).

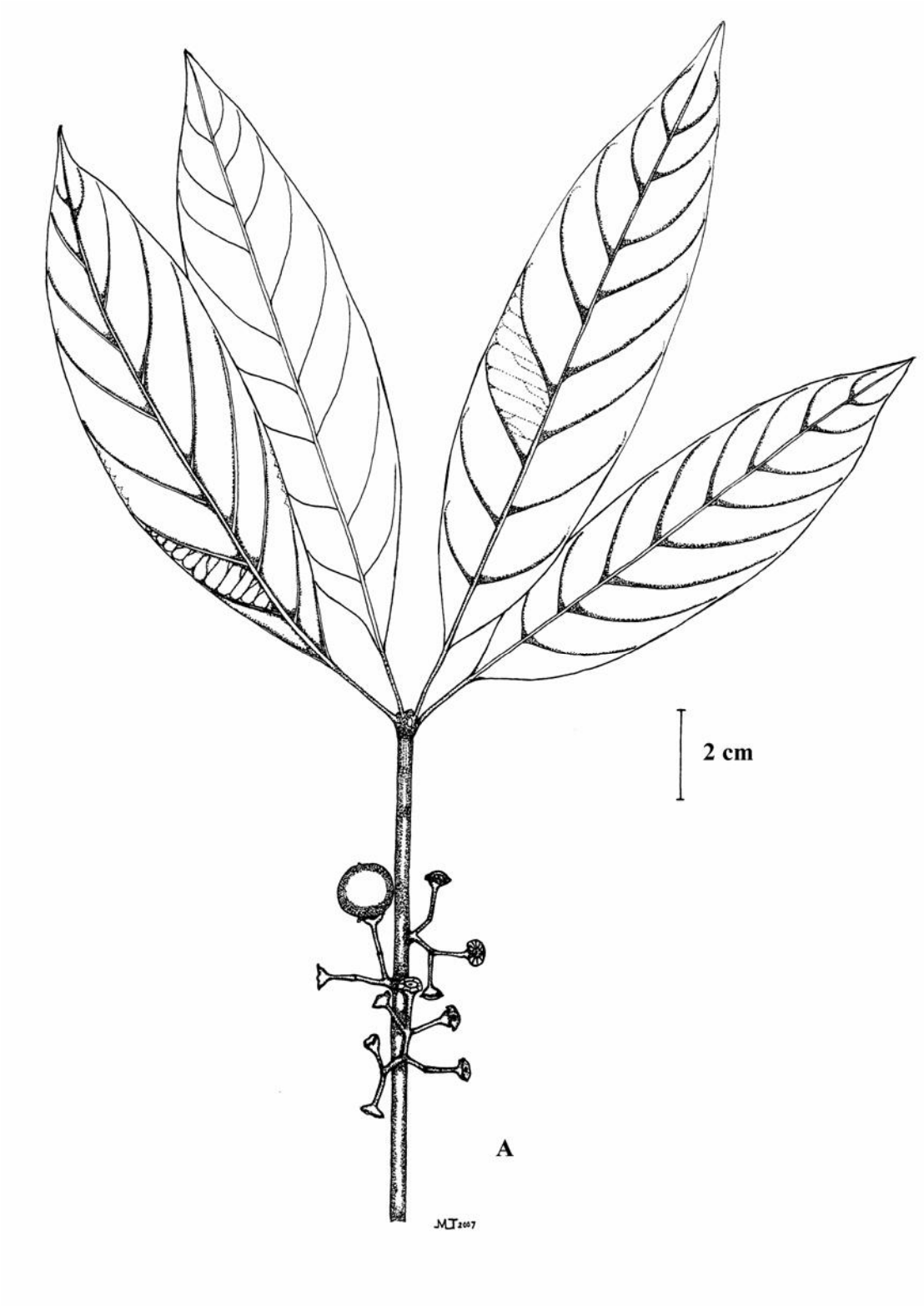


Figure 20 *Actinodaphne omeiensis* (H. Liu) C.K. Allen: A. fruiting twig.

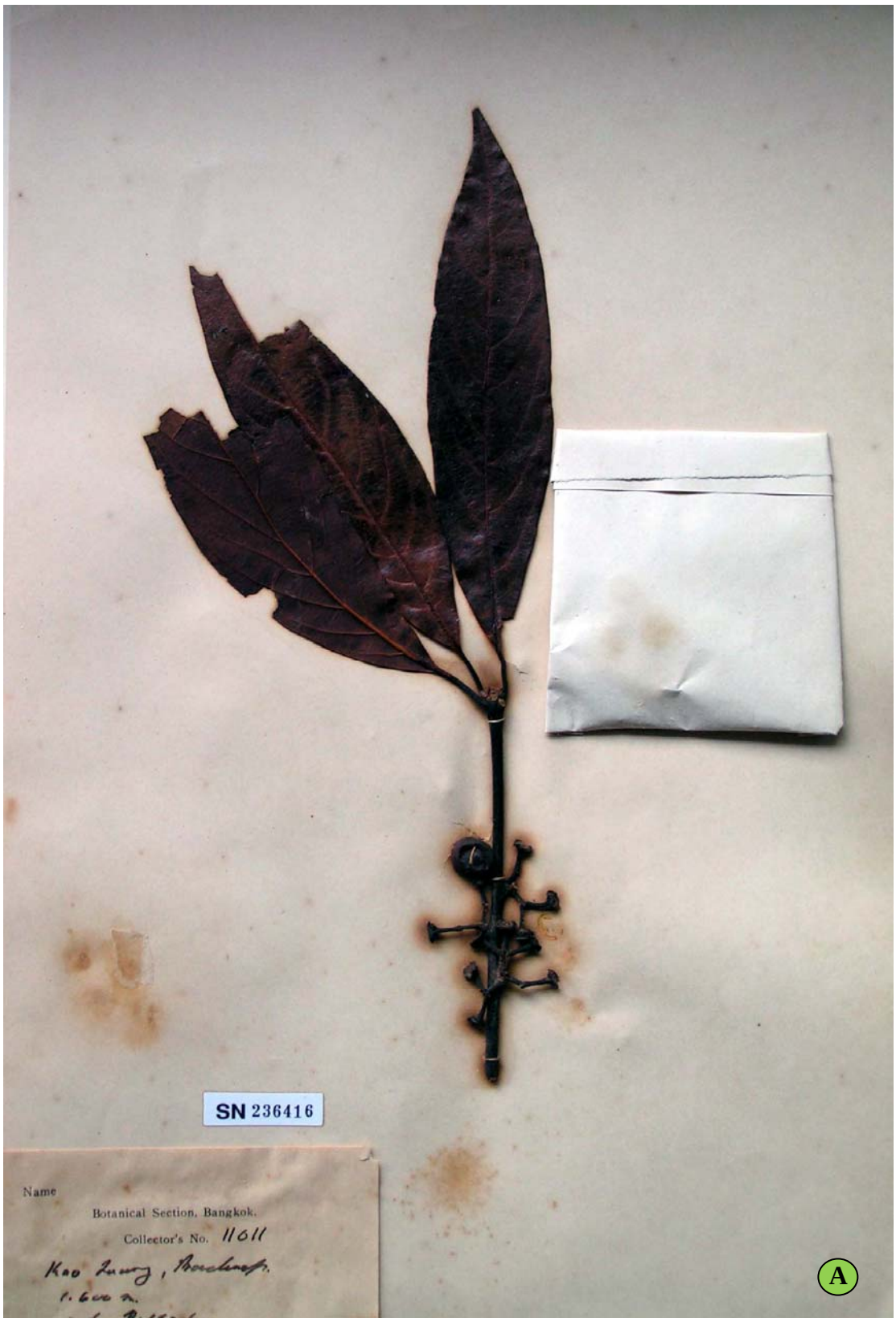


Figure 21 Photographs of *Actinodaphne omeiensis* (H. Liu) C.K. Allen: A. fruiting twig.

8. Actinodaphne perglabra Kosterm. in Nat. Hist. Bull Siam Soc., 25 (3-4): 30. 1975. Type: Thailand, Nakhon Ratchasima, Lat Bua Khao, *Put* 4324 (BM, K) and 4308 (K). Figure 22, 23.

Tree, whole part glabrous. *Twigs* rough, slender. *Terminal buds* not seen. *Leaves* subverticillate of 4 leaves or alternate, blade oblong-elliptic, 7-13 by 2.3-3.5 cm; apex acute to acuminate; base cuneate; margin entire; chartaceous, green polished above, glabrous on both surfaces, glaucous beneath; midrib raised or flat above, puberulous, raised beneath, lateral veins 6-7 pairs, thread-like, at an angle of 30°-40° from the midrib, raised on both surfaces, slightly distinct, arching and looping near margin, tertiary veins finely reticulate, prominent on both surfaces. *Petiole* slender, 0.3-0.5 cm, glabrous. *Inflorescences* fasicualte or umbel, peducle near to internode solitary or branchlet shortly laid upon. *Staminate flower*: not seen. *Pistillate flower*: pedicels 0.3-0.5 mm long; perianth lobes 6, ovate-elliptic, 1-1.5 by 0.5-0.7 mm, glabrous to pilose outside, glabrous inside; ovary ellipsoid, c. 0.5-1 by 0.3-0.5 mm, glabrous, style thick, 1 mm long, glabrous, stigma peltate; staminode not seen. *Infructescences* not seen.

Thailand.— EASTERN: Nakhon Ratchasima (Lat Bua Khao).

Distribution.— Thailand (type).

Ecology.— Dry evergreen forest, elevation not known, flowering: November.

Vernancular.— Tong Lat Bai Kliang (ตองลาดใบเกลี้ยง) (The name is given by the author).

Note.— Description of this species was refered to Kosterm. in Nat. Hist. Bull. Siam Soc. 25(3-4): 30. 1974

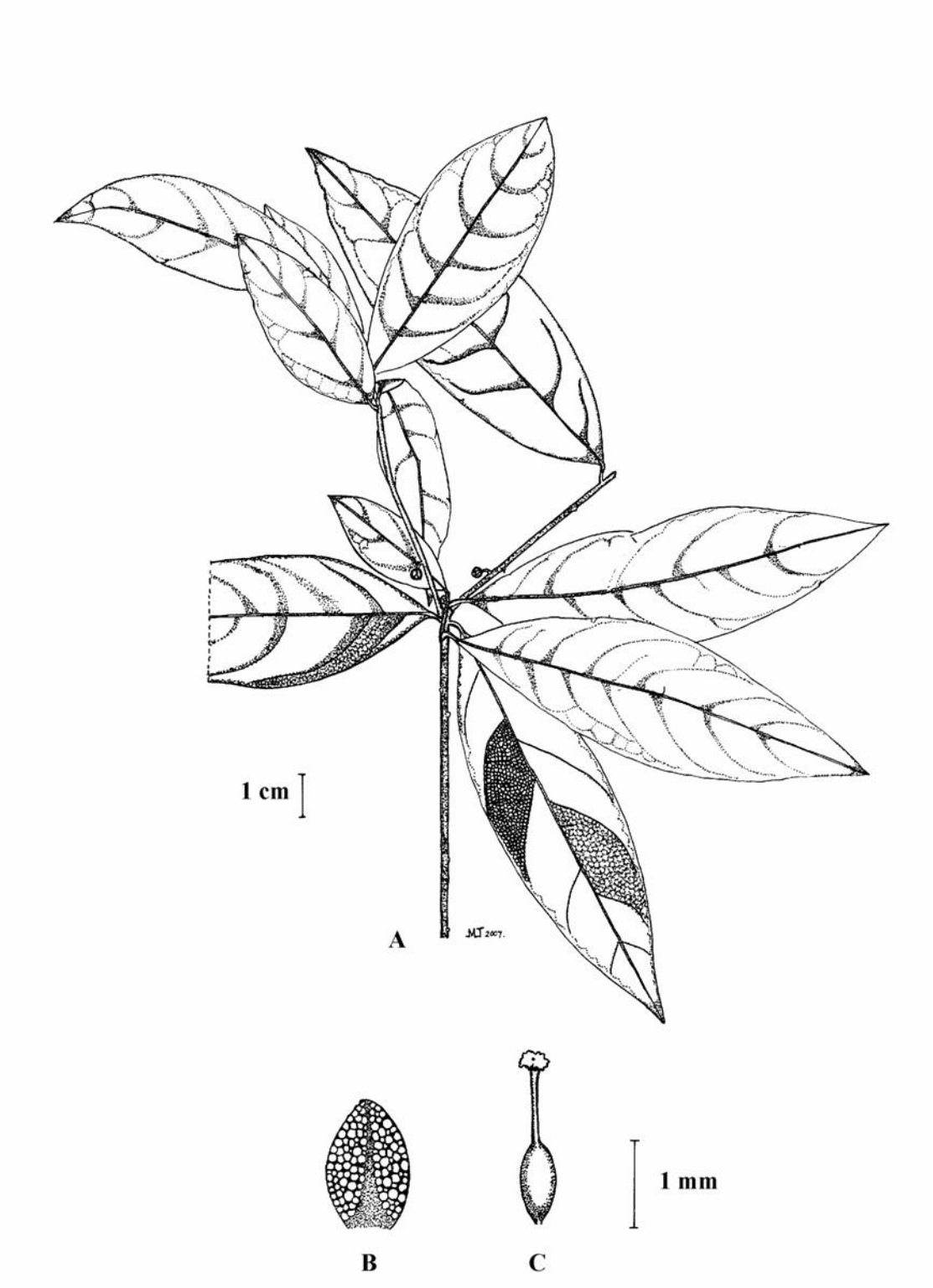


Figure 22 *Actinodaphne perglabra* Kosterm.: A. flowering twig; B. perianth lobes; C. pistil.

Figure 23 Photographs of *Actinodaphne perglabra* Kosterm.: A. flowering twig; B. branchlets below (leaves arranged alternate); C. pistillate flower; D. perianth lobes; E. pistil.

9. Actinodaphne sesquipedalis (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. in DC., Prodr. 15(1): 216. 1864; Hook. f., Fl. Brit. India 5: 151. 1885; Brandis, Ind. Trees 535. 1906; Ridl., Fl. Mal. Pen. 3: 107. 1967; Kochummen, Tree Fl. Malaya 4: 107. 1989; Sambus, E.N. and M.S.N. sosef, Plant. Resources of South-East Asia 5(3). Timber Trees: Lesser-known timber: 47. 1998; Beaman *et al*., Pl. Mt. Kinabalu (2001) 395.— *Luarus sesquipedalis* Wall. ex Kuntze, Revis. Gen. pl. 2: 570. 1891.

Small to medium-sized tree, c. 10-20 m high. dbh 8-15 cm. *Twigs* thick, glabrous or pubescent to puberulous. juvenile shoot pubescent or yellowish hairy. *Bark* smooth dark brown to black, inner bark orange-yellowish; buttress root about 1 m. *Terminal buds* covered with large green scale leaves like under-sized foliage leaves, narrowly elliptic-oblong or ovate-elliptic, 2-5 cm, glabrous or puberulous to pubescent. *Leaves* subverticillate of 5-10 leaves; blade narrowly elliptic-oblong to narrowly lanceolate or elliptic-oblanceolate, 22-45 (-60) by 5-9 (-18.5) cm; apex acute to acuminate or cuspidate; base cuneate to oblique; margin entire; coriaceous, shining green above, glabrous or yellowish pubescent to velutinous when young, glabrous on both surfaces when old, glaucous beneath; midrib thick, raised on both surfaces, glabrous to puberulous on both surfaces, lateral veins 9-16 pairs, at an angle of 30º-60º from the midrib, raised on both surfaces, arching and looping near margin, tertiary vein scalariform, slightly distinct above, prominent beneath. *Petiole* stout, 2-4 (-5.5) cm, glabrous to yellowish hairy. *Inflorescences* umbellate on short peduncles or fasicualte, 0.8-2.5 cm in diam., 5-flowers per umbel, peduncle 0.7-0.8 cm, tomentose. *Staminate flower*: pedicel 0.5-3 mm long, tomentose, perianth 6, ovate-elliptic, 2.6-6 by 2-3.5 mm, tomentose outside, 3-5 nerve, glabrous inside, 3-5 nerve inside; stamen 9, anther oblong, 2-2.5 mm long, filament 7-7.2 mm, villous along to middle filament; *Staminate flower*: pedicel 0.5-3 mm long; perianth 6, ovate-elliptic, 2.6-6 by 2-3.5 mm, tomentose outside, 3-5 nerve, glabrous inside; ovary ovoid, c. 0.6-1 by 0.6-1 mm, glabrous to densely hairy, style stout, 0.2-0.5 mm, glabrous to densely hairy, stigma peltate; staminode 9, elliptic to spathulate, 0.5-1.5 mm long, pilose or hairy yellowish at the base. *Infructescences* each bearing 1-4 fruits. *Fruit* globose, 1-2 cm in diam.; apex apiculate; young fruit green with white dot, mature dark purple to black; seated on enlarged perianth tube, perianth tube shallowly cup-shaped, 0.7-1 cm in

diam., glabrous to velutinous within, glabrous without; pedicels thicken, 0.3-0.5 cm long, glabrous to tomentose.

Thailand.— SOUTHEASTERN: Chanthaburi (Chang Sae Waterfall Ranger Station), Trat (Mu Ko Chang National Park), PENINSULAR: Trang (Khao Chong), Narathiwat (Hala-Bala Wildlife Santuary), Ranong (Khao Phota Luang Kaeo), Pattani (Banang Sta).

Distribution.— Cambodiana, Malay peninsula.

Ecology.— Tropical rain forest to Dry evergreen forest; altitude: 100-400 m. flowering: June-July; fruiting: July-August.

Key to the varieties

1. Terminal buds narrowly elliptic-oblong. Leaf blade narrowly elliptic-oblong or narrowly lanceolate. Petiole yellowish hairy, 2-4 cm long _____**var. cambodiana** H. Lec.

1. Terminal buds ovate-elliptic. Leaf blade elliptic-oblanceolate. Petiole glabrous, 3.5-5.5 cm long_____**var. glabra** Kochummen

9a. Actinodaphne sesquipedalis (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. var. **cambodiana** H. Lec. in Fl. gén. Indoch. 5: 130. 1914. Figure 24, 25.

Small to medium-sized tree, c. 10-20 m high. dbh 8-15 m. *Twigs* thick, glabrous to puberulous, juvenile shoot hairy yellowish. *Bark* smooth, dark brown to black, inner bark orange to yellowish, buttress root about 1 m. *Terminal buds* covered with large green scale leaves like under-sized foliage leaves, narrowly elliptic-oblong, 4-5 cm, glabrous to puberulous. *Leaves* subverticillate of 6-10 leaves; blade narrowly elliptic-oblong to narrowly lanceolate, 22-45 by 3-9 cm; apex acute; base cuneate; margin entire; coriaceous, shining green above, yellowish velutinous when young,

glabrous on both surfaces when old, glaucous beneath; midrib thick, raised on both surfaces, puberulous on both surfaces, lateral veins 9-12 pairs, at an angle of 35º-40º from the midrib, raised on both surfaces, arching and looping near margin, tertiary veins scalariform, slightly distinct above, prominent beneath. *Petiole* stout, 2-4 cm, yellowish hairy. *Inflorescences* umbellate on short peduncles, 2-2.5 cm in diam., borne along twigs between whorls of leaves, peduncle 0.7-0.8 cm, densely tomentose. *Staminate flower*: pedicel 3 mm long, tomentose; perianth lobes 6, elliptic to ovate, 5-6 by 3-3.5 mm, tomentose outside, glabrous inside; stamen 9, anther oblong, 2-2.5 mm long, filament 7-7.2 mm, villous along to middle filament. *Pistillate flower*: pedicel 3 mm long, tomentose; perianth lobes 6, elliptic to ovate, 5-6 by 3-3.5 mm, tomentose outside, glabrous inside; ovary ovoid, c. 1 by 1 mm, densely hairy, style stout, 0.2-0.3 mm, densely hairy, stigma peltate; staminode 9, elliptic to spathulate, 1-1.5 mm long, yellowish hairy at the base. *Infructescences* each bearing 2-4 fruits. *Fruit* globose, 1.5-2 cm in diam.; apex apiculate; young fruit green with white dot, mature fruit dark purple to black; seated on enlarge perianth tube, perianth tube shallowly cup-shaped, 1.0 cm in diam., velutinous within, glabrous without, pedicels thicken, 0.3-0.5 cm long, tomentose.

Thailand.— SOUTHEASTERN: Chanthaburi (Chang Sae Waterfall Ranger Station), Trat (Mu Ko Chang National Park).

Distribution.— Cambodia.

Ecology.— Tropical rain forest to dry evergreen forest; altitude: 100-400 m. flowering: June-July; fruiting: January-April.

Vernacular.— Tong Lat Bai Yao (ตองลาดใบยาว) (The name is given by the author).

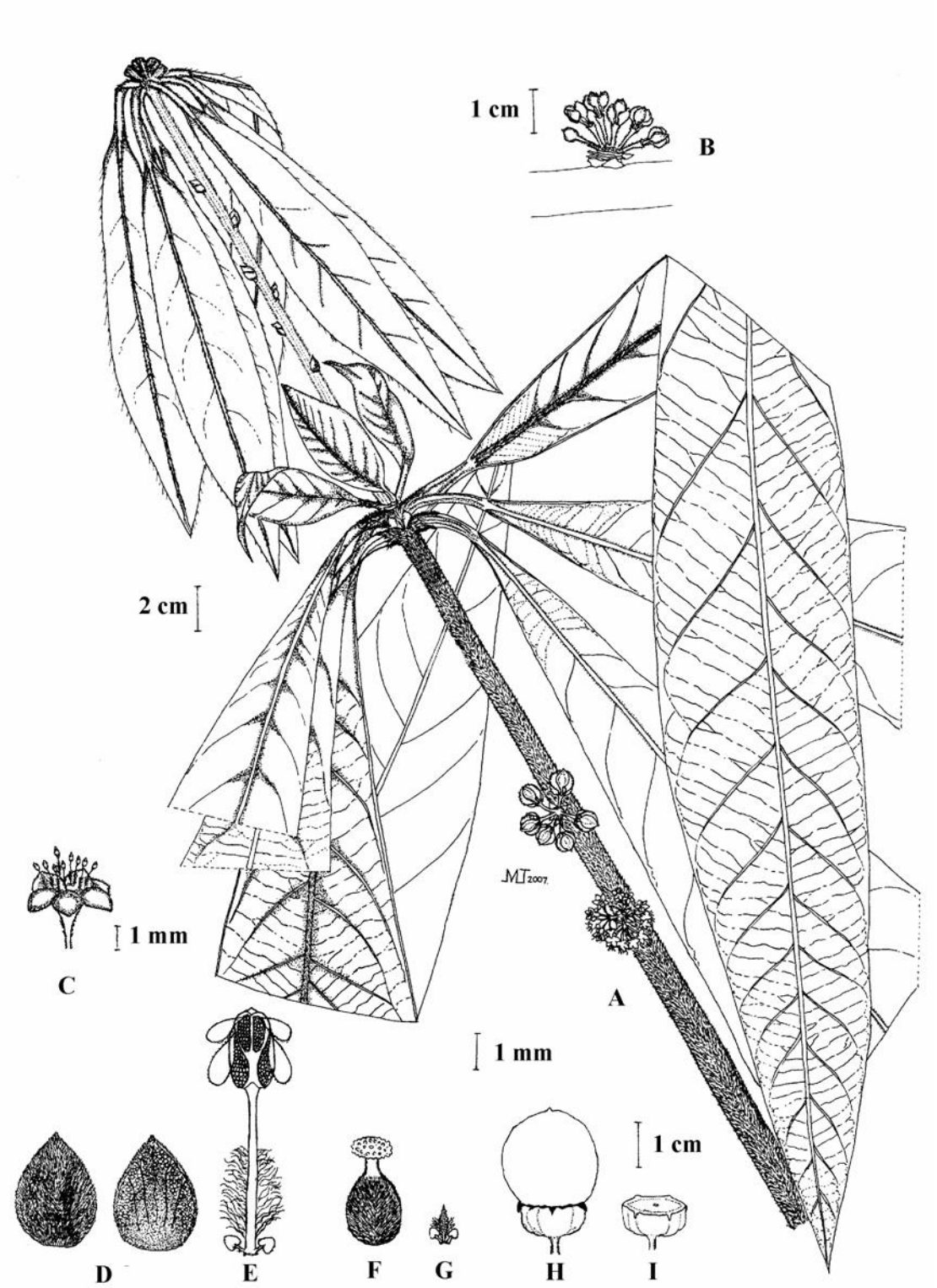


Figure 24 *Actinodaphne sesquipedalis* (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.: A. flowering twig; B. inflorescences; C. staminate flower; D. perianth lobes; E. stamen; F. pistil; G. staminode; H. fruit; I. perianth tube enlarged shallowly cup-shaped.

Figure 25 Photographs of *Actinodaphne sesquipedalis* (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.: A. habit; B. outer bark; C. terminal bud; D. staminate flowers; E. pistillate flowers; F. fruits; G. stamen; H. staminode; I. pistil.

9b. Actinodaphne sesquipedalis (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. var. **glabra** Kochummen, Tree Fl. Malaya 4: 108. 1989; Kochummen in Gard. Bull. Singapore, 43: 23. (1991 publ. 1992). Figure 26, 27.

Small to medium-sized tree, c. 10-12 m high. dbh 10-15 cm. *Twigs* thick, glabrous to pubescent, juvenile shoot yellowish pubescent. *Bark* smooth, dark brown - black, inner bark yellowish. *Terminal buds* covered with large green scale leaves like under-sized foliage leaves, ovate to elliptic, 2-4 cm, glabrous to pubescent. *Leaves* subverticillate of 5-8 leaves; blade elliptic-oblanceolate, 30-60 by 9-18.5 cm; apex cuspidate; base cuneate to oblique; margin entire; coraiceous, shining green above, glabrous to yellowish pubescent when young, glabrous on both surfaces when old, glaucous beneath; midrib thick, raised on both surfaces, glabrous on both surfaces, lateral veins 12-16 pairs, at an angle of 40º-60º from the midrib, raised on both surfaces, arching and looping near margin, tertiary veins scalariform, slightly distinct above, prominent beneath. *Petiole* stout, 3.5-5.5 cm, glabrous. *Inflorescences* fasiculate, 0.8-1 cm in diam., borne along twigs between whorls of leaves. *Staminate flower*: not seen. *Pistillate flower*: pedicel 0.5-1 mm long, tomentose; perianth lobes 6, ovate, 2.6-2.8 by 2-2.5 mm, tomentose outside, glabrous inside; ovary ovoid, c. 0.6 by 0.6 mm, glabrous, style stout, 0.5 mm, glabrous, stigma peltate, 4-lobes; staminode 9, elliptic to spathulate, 0.5-0.7 mm long, pilose at the base. *Infructescences* each bearing 1-3 fruits. *Fruit* globose, 1-1.2 cm in diam.; apex apiculate; young fruit green with white dot, mature fruit dark purple to black; seated on enlarge perianth tube, perianth tube shallowly cup-shaped, 0.7-0.8 cm in diam., glabrous inside, glabrous without; pedicels thicken 0.4-0.5 cm long, glabrous.

Thailand.— PENINSULAR: Narathiwat (Hala-Bala Wildlife Santuary), Trang (Khao Chong), Ranong (Khao Phota Luang Kaeo), Pattani (Banang Sta).

Distribution.— Malay Peninsula.

Ecology.— Tropical rain forest to dry evergreen forest; altitude 100-400 m. flowering: June-July; fruiting: July-August.

Vernacular.— Kan Rom (ก้านร่ม)(Narathiwat).

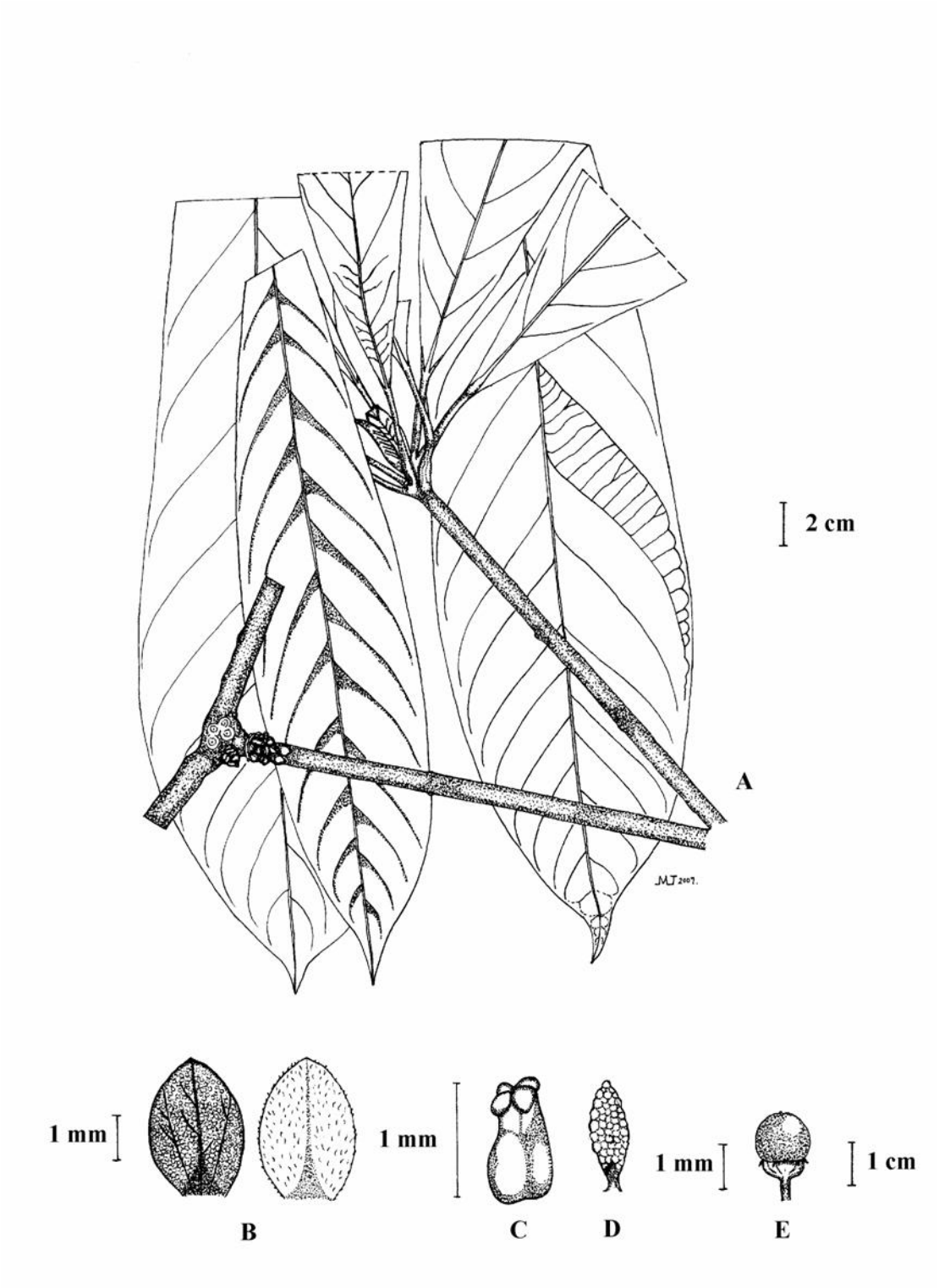


Figure 26 *Actinodaphne sesquipedalis* (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. var. *glabra* Kochummen: A. habit; B. perianth lobes; C. pistil; D. staminode; E. fruit.

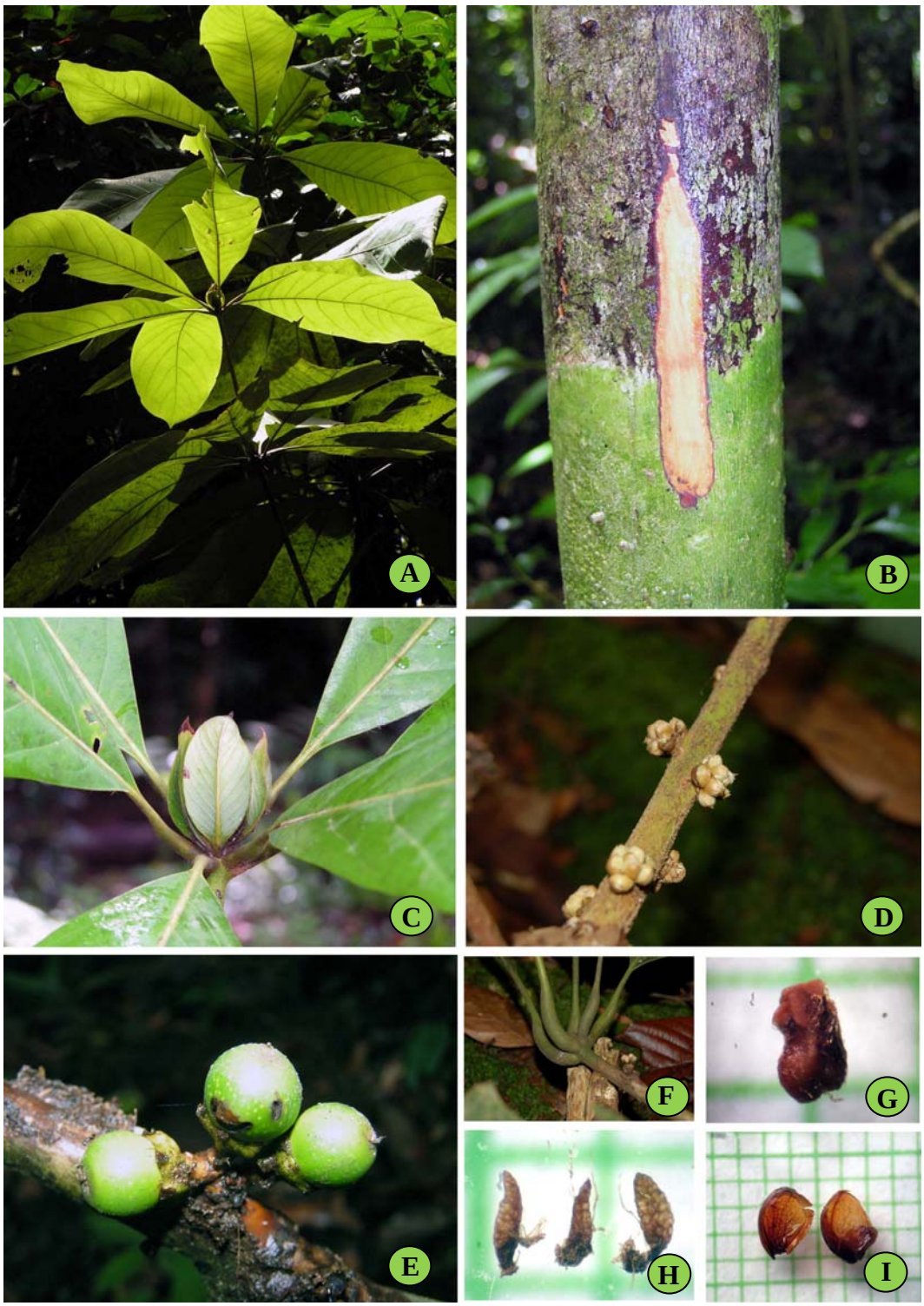


Figure 27 Photographs of *Actinodaphne sesquipedalis* (Wall. ex Kuntze) Hook.f. & Thoms. ex Meisn. var. *glabra* Kochummen: A. habit; B. outer bark; C. terminal buds; D. young pistillate flower; E. fruits; F. petiole stout and glabrous; G. pistil; H. staminode; I. perianth lobes.

10. Actinodaphne sikkimensis Meisn. in DC., Prodr. 15(1): 213. 1864; Hooker f., Fl. Brit. India 5: 147. 1886; Brandis, Ind. Trees 535 et 716. 1906; Kanjilal, De & Das, Fl. Assam 4: 77. 1940. Figure 28, 29.

Small to medium-sized tree, c. 6-20 m high. dbh 20-30 cm. *Twigs* slender, juvenile shoot pubescent. *Bark* grey to brown, cracking, inner bark yellowish-brown. *Terminal buds* perulate with imbricate scale, elliptic-oblanceolate, 0.8-1 cm, velutinous. *Leaves* subverticillate of 4-6 leaves; blade lanceolate-elliptic, 10-14 by 2-4 cm; apex acuminate to caudate; base cuneate; margin entire; chartaceous, greenish and almost shining above, velutinous when young, glabrous on both surfaces sometime puberulous beneath when old, glaucous beneath; midrib sunken above, raised beneath, lateral veins 8-12 pairs, at an angel of 30º-50º from the midrib, raised on both surfaces, arching and looping near margin, tertiary veins reticulate-scalariform, slightly distinct, prominent beneath. *Petiole* slender, 0.5-1 cm long, puberulous. *Inflorescences* fasiculate, 0.6-1.2 cm in diam., axillary or borne along twigs between whorls of leaves. *Staminate flower*: pedicel 3 mm long, velutinous; perianth lobes 6, elliptic-oblong, 3-3.2 by 1-1.2 mm, velutinous outside, glabrous inside, stamen 9(-10), anther oblong, 2 mm long, filament 4 mm long, villous along filament. *Pistillate flower*: pedicel 3 mm long, velutinous; perianth lobes 6, elliptic-oblong, 3-3.2 by 1-1.2 mm, velutinous outside, glabrous inside; ovary ovoid, c. 1 by 1 mm, glabrous, style slender, 0.5-1 mm long, glabrous, stigma peltate; staminode 9(-10), 3-lobe, 2 mm long, glabrous. *Infructescences* each bearing 1-5 fruits. *Fruit* ellipsoid, 0.7-0.8 cm in diam.; apex apiculate; young fruits green, mature fruits red, drying black; seated on enlarge perianth tube, perianth tube shallowly cup-shaped, 0.7-0.8 cm in diam., glabrous within, glabrous without; pedicels thicken, 0.7-1.5 cm long, puberulous.

Thailand.— NORTHERN: Phitsanulok (Phu Hin Rong Khlao National Park); NORTHEASTERN: Loie (Phu Luang Wildlife Santuary and Phu Kra dueng National Park).

Distribution.— India (Sikkim).

Ecology.— Lower montane forest, near streamside; altitude: 1,000-1,400 m. flowering: November-January; fruiting: March-July.

Vernacular.— Tong Lat Sikkim (ตองลาดสิกขิม) (The name is given by the author).

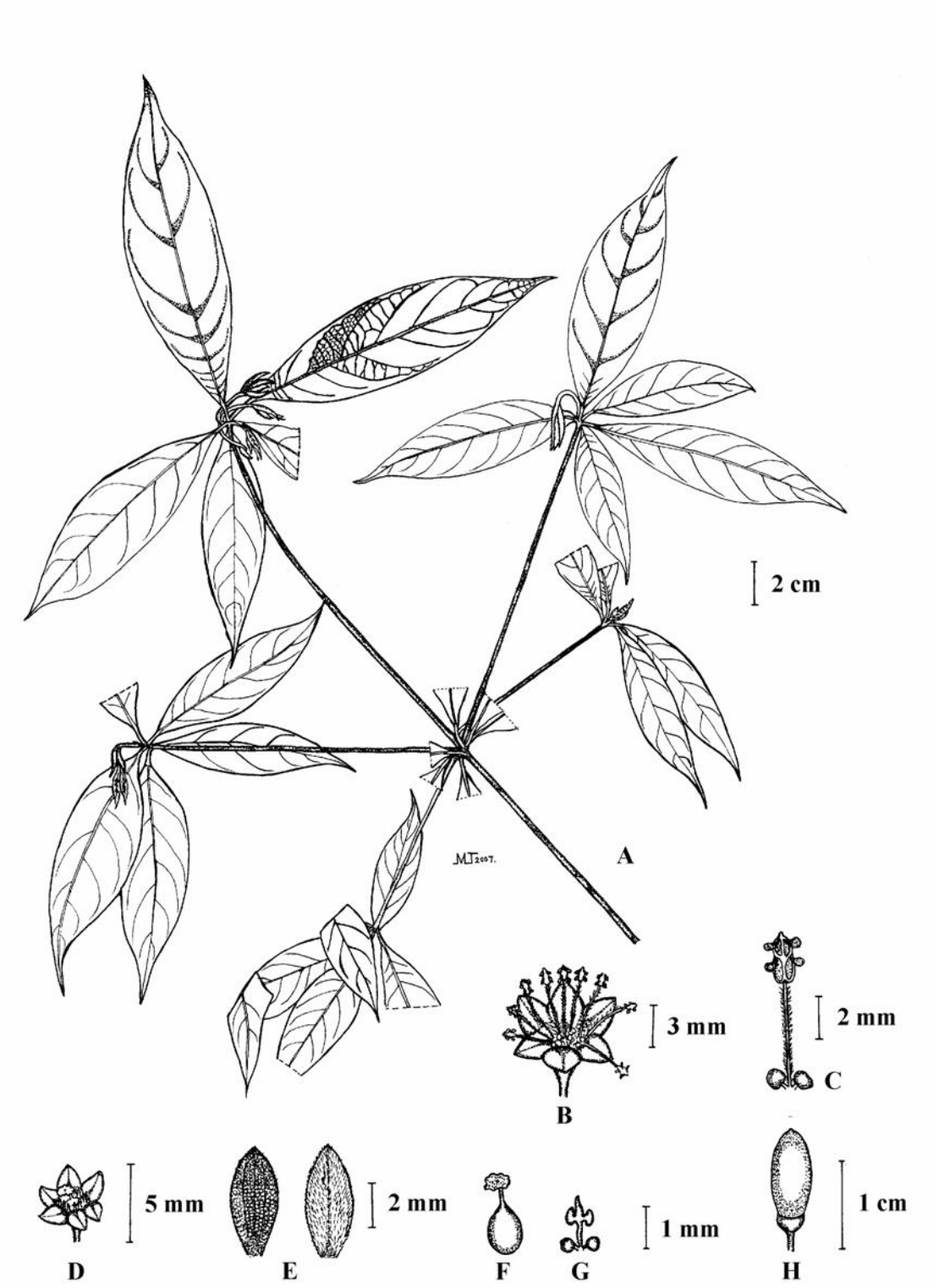


Figure 28 *Actinodaphne sikkimensis* Meisn.: A. habit; B. staminate flower; C. stamen; D. pistillate flower; E. perianth lobes; F. pistil; G. staminode; H. fruit.

Figure 29 Photographs of *Actinodaphne sikkimensis* Meisn.: A. habit; B. outter bark; C. staminate flower; D. pistillate flower; E. fruits; F. pistil; G. stamen; H. staminode; I, glands.

11. Actinodaphne sp.1. Figure 30, 31.

Medium-sized tree, c. 18 m high. dbh 30 cm. *Twigs* slender, juvenile shoots densely pale brown tomentose. *Terminal buds* covered with large green scale leaves like under-sized foliage leaves, narrowly lanceolate-narrowly elliptic, 0.7-1.3 cm, tomentose. *Leaves* subverticillate of 5-7 leaves, blade lanceolate-elliptic to oblanceolate, 10-16.5 by 3.5-5 cm; apex acute; base cuneate-oblique; margin entire; thinly coriaceous, shining green above, glabrous on both surfaces when old, glaucous beneath, midrib raised above, sunken beneath, puberulous beneath when young, glabrous on both surfaces when old, lateral veins 6-10 pairs, at an angle of 50º-60º from the midrib, sunken above, arching and looping near margin, tertiary veins reticulate-scalariform, obscure or slightly distinct on both surfaces. *Petiole* slender, 1-2 cm long, glabrous. *Inflorescences* umbellate on short peduncles, borne along twigs between whorls of leaves, peduncle 0.5-0.7 cm, velutinous. *Staminate flower*: not seen. *Pistillate flower*: pedicel 3-4 mm long, velutinous, perianth lobes 6, elliptic, 2.5-3 by 1.5-2 cm, velutinous outside, glabrous inside, ovary ovoid, c. 1 by 1 mm, villous, style thick, 0.5-1 mm long, villous, stigma peltate, 4-lobes; staminode 9, spathulate, 1-1.3 mm long, glabrous to pilose at the base. *Infructescences* each bearing 1-3 fruits. *Fruit* globose, 0.2 cm in diam., young fruit green, mature fruit red; seated on enlarge perianth tube, perianth tube deeply cup-shaped, 0.3 cm in diam., glabrous within, pubescent without; pedicels slender, 0.5-0.7 cm long, velutinous.

Thailand.— PENINSULAR: Krabi (Khao Phanom Benja National Park).

Distribution.— Thailand.

Ecology.— Lower montane rain forest; altitude: 500-900 m. flowering: April; fruiting: June.

Vernancular.— Tong Lat Phanom Benja (ตองลาดพนมเบญจา)(The name is given by the author).

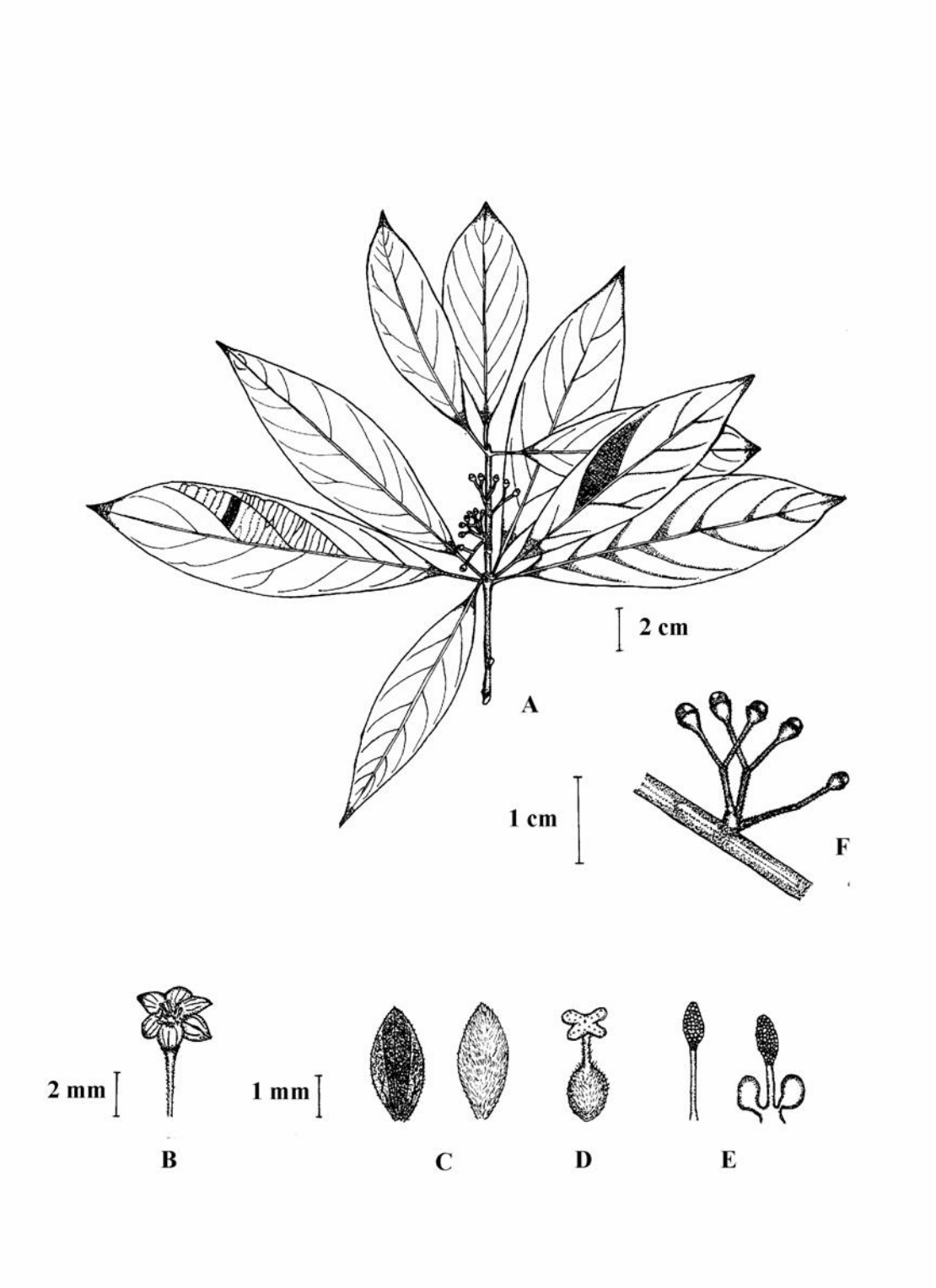


Figure 30 *Actinodaphne* sp.1.: A. fruiting twig; B. pistillate flower; C. perianth lobes; D. pistil; E. staminode; F. infructescences.

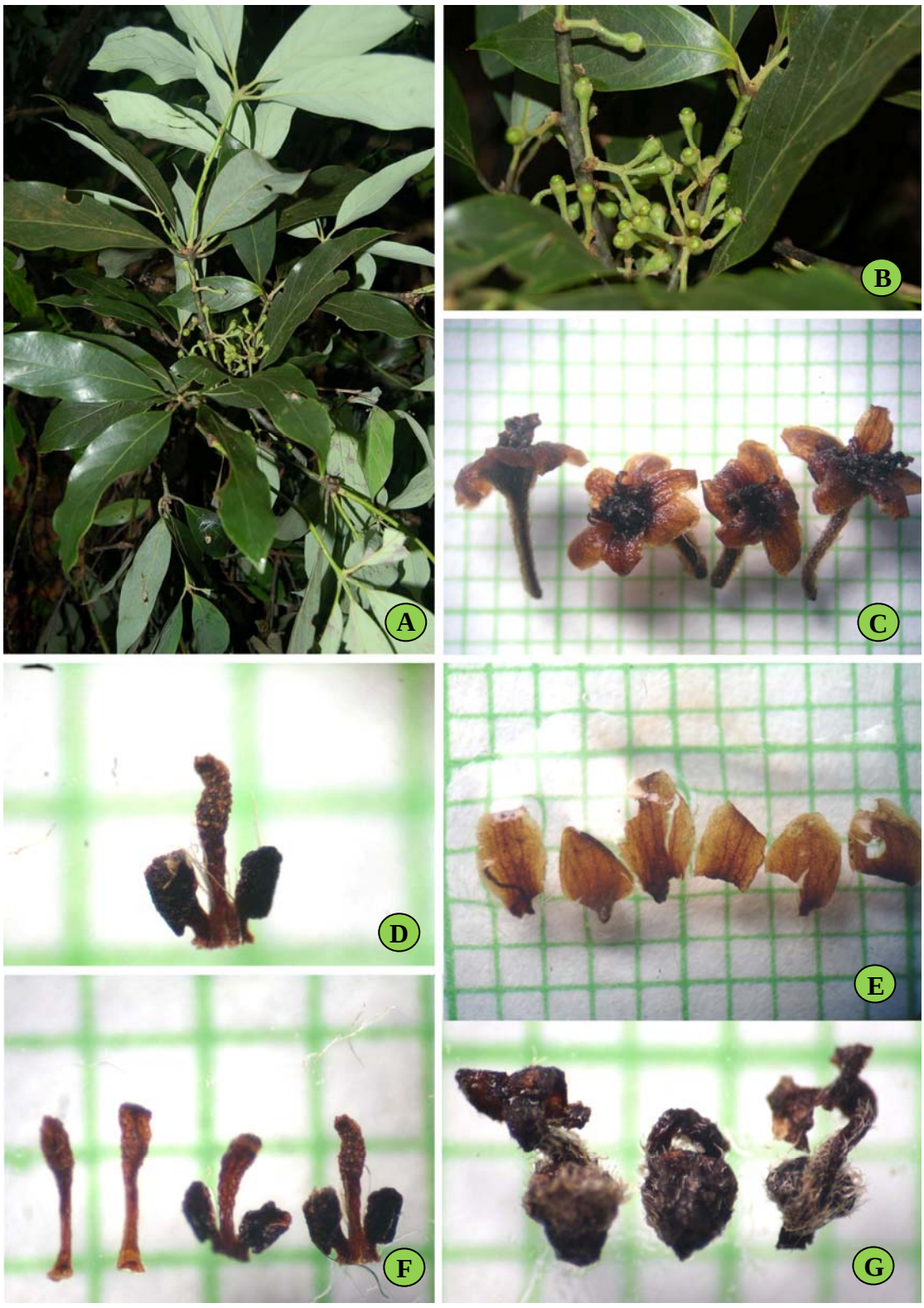


Figure 31 Photographs of *Actinodaphne* sp.1.: A. habit; B. infructescences; C. pistillate flowers; D. staminode; E. perianth lobes; F. staminode; G. pistil.

Geographical and ecological distributions of *Actinodaphne* spp. in each floristic region and different forest types in Thailand (Santisuk, 2006) are presented in Table 2 and Table 3, respectively.

Table 2 Distribution of *Actinodaphne* in each Floristic region of Thailand.

Species	N	NE	E	SW	C	SE	PEN
Actinodaphne amabilis		/					/
A. angustifolia			/			/	/
A. cupularis	/	/	/				
A. glomerata							/
A. henryi	/		/	/		/	
A. montana							/
A. omeiensis				/			
A. perglabra			/				
A. sesquipedalis var. *cambodiana*						/	
A. sesquipedalis var. *glabra*							/
A.sikkimensis	/	/					
Actinodaphne sp.1							/

Note: Northern (N), Northeastern (NE), Eastern (E), Southwestern (SW), Central (C), Southeastern (SE), Peninsular (PEN).

Table 3 Ecological distribution of *Actinodaphne* spp. in Thailand.

Species	LMRF	TRF	DEF	MDF
Actinodaphne amabilis	/			
A. angustifolia			/	/
A. cupularis	/			
A. glomerata	/	/		
A. henryi	/			
A. montana	/			
A. omeiensis	/			
A. perglabra			/	
A. sesquipedalis var. *cambodiana*		/	/	
A. sesquipedalis var. *glabra*		/	/	
A.sikkimensis	/			
Actinodaphne sp.1	/			

Note: Lower Montane Rian Forest (LMRF), Tropical Rain Forest (TRF), Dry Evergreen Forest (DEF), Mixed Deciduous Forest (MDF).

Discussion

The circumscriptions of the genus *Actinodaphne* were considered on the basis of morphological characters, and other data supported from the literatures. Eleven species, two varieties of the genus *Actinodaphne* in Thailand were recognized as follows:

Eleven species of *Actinodaphne* i.e. *A. angustifolia* (Blume) Nees, *A. henryi* Gamble, *A. montana* Gamble, *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec., *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen, *A. sikkimensis* Meisn. and *Actinodaphne* sp. 1, were described by the author's investigation, the comparison with the herbarium sheets found in the Forest Herbarium, National Park Wildlife and Plant Conservation Department, and the consideration from the description in the original literatures.

The following 5 species of *A. amabilis* Kosterm., *A. cupularis* (Hemsl.) Gamble, *A. glomerata* (Blume) Nees, *A. omeiensis* (H. Liu) C.K. Allen and *A. perglabra* Kosterm. were described by comparing with the historical herbarium sheets borrowed from Kew Herbarium and the herbarium sheets in BK and BKF herbarium. Those collections were *A.F.G. Kerr* 16931 collected from Phangnga, Khao Phota Luang Kaeo in 17 Febuary 1929 (K), *A.F.G. Kerr* 5366 collected from Chiang Mai, Doi Chiang Dao Wildlife Santuary in 4 June 1921 (K), *N. Fukuoka*, *T. Santisuk* & *W. Na Nakorn* T-35912 collected from Ranong in 6 September 1984 (BKF), *A.F.G. Ker*r 11011 collected from Prachuap Kiri Khan, Khao Luang in 4 July 1924 (BK) and *Put* 4308, 4324, collected from Nakhon Ratchasima in 7 November 1931 (BK, K). The information from first and other relevant publications were also consulted because these species were not found during the surveys although the author had followed the notes on geographical distribution from the specimens.

The differences between 2 varieties of *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. i.e. var. *cambodiana* and var. *glabra* are the terminal buds, leaf shape and indumentums on petiole, including the distribution of these 2

varieties i.e. *A. sesquipedalis* var. *cambodiana* occured in Chanthaburi and Trat Province (Southeastern) while *A. sesquipedalis* var. *glabra* occured in Ranong to Narathiwat Province (Peninsular). The differences are adequate to separate the species into varieties.

A. sesquipedalis (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen is similar to *A. glomerata* (Blume) Nees by leaf shape and leaf apex, but the difference is the inflorescences of *A. sesquipedalis* var. *glabra* which is umbellate on short peduncles while cymose in *A. glomerata*.

The two species *A. montana* Gamble and *A. henryi* Gamble are similar by sharing the characters of the umble arranged in raceme inflorescences, leaf shape and scalariform tertiary veins which slightly distinct above and finely prominent beneath. However, they are easily separated because of the slender petiole and smooth bark in *A. montana* while stout petiole and furrowed bark in *A. henryi*.

Kostermans (1974) described *A. perglabra* as a new species in the Natural History Bulletin of the Siam Society volume 25, which I included here although I was rather doubtful with it. Because when I considered the leaf arrangement and tertiary veins, they are both totally different from the genus *Actinodaphne* (seen tertiary veins in Appendix Figure 14). Normally the leaf arrangement of the genus is verticillate or subverticillate but in *A. perglabra* is subverticillate above and alternate below. Meanwhile the tertiary veins are scalariform or reticulate-scalariform but in *A. perglabra* is finely reticulate. These characters of *A. perglabra* Kosterm. may be the characteristics of other genera in Lauraceae which I have not studied. When the treatment of the whole family has been finished, this species might belong to other genera.

*Actinodaphn*e sp. 1 cannot be indentified to species because of the imcomplete specimens.

Among plants in the same species, sometime the inflorescences, leaf arrangement and leaf shape are variable, which is difficult to indentify the species. Therefore, additional characters such as; terminal buds, bark, indumentums, stamen, staminode and fruit characters are the additional tools for the identification which should be taken into consideration.

The difficulties in surveying and collecting plants in the fields are the genus *Actinodaphne* is commonly big tree, seldom flowers and fruits. Mostly the materials collected are sterile. Photographs, morphological and ecological data from fresh material are then scant. The remarkable observation of *Actinodaphne* in the field are:

Actinodaphne has terminal buds which are perulate with imbricate scales, with the shape ellipsoid to ovoid, oblong or lanceolate and with acute apex. The buds are glabrous to tomentose or covered with large green leaf-like scales. The leaf-like scales are narrow of more or less elliptic-oblong to lanceolate, the texture is glabrous to tomentose. When the leaves fall, they leave the distinct scars just above the whorls of leaves. The large leaf-like scales which cover the buds which make them look like double green flowers, are usually inhabited by ants which find them convenient places to build theirs nests. The large, whorled, papery leaves with glaucous underneath and the big scale buds can distinguish this plant from other plants in the field.

Leaves characters is sometimes easily to distinguished, e.g. the leaf arrangement which are verticillate or subverticillate, very rarely alternate, leaf texture as chartaceous or thinly coriaceous to coriaceous, shinning green or dull dark green above and glaucous beneath.

The flowering twigs seem to be as common character as Lauraceous plants. It is hardly to distinguished as *Actinodaphne* only precisely notice of the small flowers in cymose, panicle or umbellate on short peduncles, sometime umbel arranged in raceme and fasiculate.

A distribution map for *Actinodaphne*, based on the data extracted from the specimens and additional survey which is provided in Table 2 shows that the genus *Actinodaphne* is found mostly in the Peninsular of Thailand. *A. henryi* is the most widely distributed in Thailand reaching from the north to southeast. All of the species are absent from the Central because of the lowland because there habitats were destroyed and changed to the agriculture areas. Moreover although *Actinodaphne* prefers the moist area which often found along streams and waterfalls where these habitats are abundant in the Central, but the genus itself can grow in high altitude from 500-1,700 m. The natural distribution can be found in not many variety of habitats i.e. tropical rain forest and lower montane rain forest. One species is found in mixed decidous forest i.e. *A. angustifolia* in Southeast of Thailand.

CONCLUSION AND RECOMMENDATION

Conclusion

A taxonomy of the genus *Actinodaphne* Nees in Thailand was conducted from March 2005 to March 2008. The literatures and herbarium specimens (BK, BKF and K) of the genus were studied. Field surveys and additional specimens collections of the genus were made throughout the country.

The present study is the first taxonomic revision of genus *Actinodaphne* in Thailand. As a result, eleven species, two varieties have been described and recorded, namely: *A. amabilis*, *A. angustifolia*, *A. cupularis*, *A. glomerata*, *A. henryi*, *A. montana*, *A. omeiensis*, *A. perglabra*, *A. sesquipedalis* var. *cambodiana*, *A. sesquipedalis* var. *glabra*, *A. sikkimensis* and *Actinodaphne* sp.1.

The *Actinodaphne* sp. 1 can not be identified due the lack of data and incompleted specimens. This species is found at Khao Phanom Bencha National Park, Krabi Province. It has a unique characterisitic, which never matched with any species. More advanced research should be continued in the future. This species may be new to science.

Actinodaphne sesquipedalis var. *cambodiana* and *A. sesquipedalis* var. *glabra* are newly recorded for Thailand.

The study provides indentification key to species based on flowering, fruiting materials and morphological characteristics of plants. Full description of species, including the distribution range, ecology, vernacular names and uses are given, supported by line drawings and photographs of individual species.

Recommendation

Considering the distribution of the species *Actinodaphne sesquipedalis* var. *cambodiana* and *A. sesquipedalis* var. *glabra* which is not continuously distributed, these 2 varieties of this species are suggested by the author to raise them into 2 species. The work on new status of the plants should be considered before the completion treatment of the genus for the Flora of Thailand.

Further study for *Actinodaphne* sp.1 is needed in order to name this plant or establish new species. Moreover, intensive survey of *Actinodaphne* should be continued, which may result in finding more species than this study. The data gained from this study can be used to support the diversity of the family Lauraceae under the Flora of Thailand project.

LITERATURE CITED

Backer, C.A. and R.C. Bakhuizen Van Den Brink. 1963. **Flora of Java** (Spermatophytes Only) Vol. I. N.P.V. Noordhoff-Groningen, Netherlands.

Beaman, J. H., C. Anderson and R. S. Beaman. 2001. **Lauraceae**, pp. 393-395. *In* O.M. Hilliard ed. The Plants of Mount Kinabalu Dicotyledon Families: Acanthaceae to Lythraceae 4. Natural History Publications (Borneo) Sdn. Bhd. Sabah, Malaysia.

Brandis, D. 1978. **Indian Tree**. Bishen Singh Mahendra Pal Singh, India.

Corner, E.J.H. 1988. **Wayside Trees of Malaya** Vol. 1 3rd eds. United Selangor press, Kuala Lampur, Malaysia.

Dassanayake, M.D., F. R. Fosberg and W. D. Clayton. 1995. **A Revised Handbook to the Flora of Ceylon** Volume 9. Amerind Publishing Co. Pvt. Ltd., New Delhi.

Gandhi, K.N. 1976. **Lauraceae**, pp. 43-50. *In* C.J. Saldanha and D.H. Nicolson, eds. Flora of Hassan District, Kernataka, India. Amerind Publishing Co. Pvt. Ltd., New Delhi.

Hô, P.H. 1991. **Câyco Viêtnam** Quyen 1 Tap 1 (An Illustrated Flora of Vietnam). Mekong Printing, Vietnam.

Hooker, J.D. 1885. **Flora of British India** Vol. V (Chenopodiaceae to Orchidaceae). L. Reeve & Co., Ltd., London.

Julia, S. 2005. A Synopsis of the genus *Actinodaphne* Nees (Lauraceae) in Sabah and Sarawak, Malaysia. **Gardens' Bulletin Singapore.** 57(1): 69-100.

Kanjilal, U.N., P.C. Kanjilal, R.N. De and A. Das. 1940. **Flora of Assam** Vol. IV (Nyctaginaceae to Cycadaceae). Prabasi Press, Calcutta.

Keng, H. 1990. **The Concise Flora of Singapore: Gymnosperm and Dicotyledons.** Jin Jin Printing Industry Pte. Ltd., Singapore.

Kochummen, K.M. 1989. Lauraceae, pp. 98-109. *In* F.P.S.Ng, ed. **Tree Flora of Malaya, A Manual For Foresters** 4. Longman, Kuala Lumpur.

Kostermans, A.J.G.H. 1957. **Communication (Pengumuman) of the Forest Research Institute, Indonesia** Nr 57: 1-64.

_____. 1974. New species and combination of Lauraceae from Thailand. **Nat. Hist. Bull. Siam. Soc.** 25: 29-44.

Li, H.L. 1963. **Woody Flora of Taiwan.** Livingston Publishing Company, Pensylvania.

Long, D.G. 1984. Lauraceae, pp.280-281. *In* A.J.C. Grierson & D.G. Long, eds. **Flora of Bhutan** 1(2). Royal botanic garden, Edinburg.

Malla, S.B. , S.B. Rajbhandari , T.B. Shrestha , P.M. Adhikari , S.R. Adhikari and P.R. Shakya 1986. **Flora of Kathmandu Valley**. H.M.G. Press, Singh Durbar , Kathmandu.

Perry, L.M. 1980. **Medicinal Plant of East and Southeast Asia (**Altributed Properties and use**).** The MIT Press,Cambridge, Massachusettes,London.

Ridley, H.N. 1967. **The Flora of the Malay Penisula Vol.III (Apetalae)**. A. Asher & Co., Amsterdam.

Rohwer, J.G. 1993. Lauraceae, pp. 366-391. *In* K. Kubitzki, J.G. Rohwer and V. Bittrich, eds. **The Families and Genera of Vascular Plants volume 2**. Springer-Verlay Berlin Heidelberg, Germany.

Sambus, E.N. and M.S.M. Sosef. 1998. ***Actinodaphne* Nees**, pp. 45-47. *In* Sosef, M.S.M., Hong, L.T. & S, Prawirohatmodjo, eds. Plamnt Resources of South-East Asia No 5(3). Timber trees: Lesser-known timbers. Backhuys Publishers, Leiden.

Santisuk, T. 2006. **Forest of Thailand.** Forest Herbarium, National Park Wildlife and Plants Conservation Department. Prachachon Co., Ltd., Bangkok.

Takhtajan, A. 1997. **Diversity and Classification of Flowering Plants**. Columbia University Press, New York.

The Forest Herbarium. 2001. **Thai Plant Names Tem Smitinand** (Revised Edition). Prachachon co. Ltd., Bangkok.

Van der Werff, H. 2001. An Annotated Key to The Genera of Lauraceae in The Flora Malesiana Region. **Blumea** 46(1): 152-140**.**

APPENDIX

N (Northern)
1 Mae Hong Son
2 Chiang Mai
3 Chiang Rai
4 Phayao
5 Nan
6 Lamphun
7 Lampang
8 Phrae
9 Uttaradit
10 Tak
11 Sukhothai
12 Phitsanulok
13 Kamphaeng Phet
14 Phichit
15 Nakhon Sawan

NE (Northeastern)
16 Phetchabun
17 Loei
18 Nong Bua Lum Phu
19 Udon Thani
20 Nong Khai
21 Sakon Nakhon
22 Nakhon Phanom
23 Mukdahan
24 Kalasin
25 Maha Sarakham
26 Khon Kaen

E (Eastern)
27 Chaiyaphum
28 Nakhon Ratchasima
29 Buri Ram
30 Surin
31 Roi Et
32 Yasothon
33 Amnat Charoen
34 Si Sa Ket
35 Ubon Ratchathani

SW (Southwestern)
36 Uthai Thani
37 Kanchanaburi
38 Ratchaburi
39 Phetchaburi
40 Prachuap Khiri Khan

C (Central)
41 Chai Nat
42 Sing Buri
43 Lop Buri
44 Suphan Buri
45 Ang Thong
46 Phra Nakhon Si Ayutthaya
47 Saraburi
48 Nakhon Pathom
49 Pathum Thani
50 Nakhon Nayok
51 Nonthaburi
52 Bangkok
53 Samut Prakan
54 Samut Songkhram
55 Samut Sakhon

SE (Southeastern)
56 Sa Kaeo
57 Prachin Buri
58 Chachoengsao
59 Chon Buri
60 Rayong
61 Chathaburi
62 Trat

PEN (Peninsular)
63 Chumphon
64 Ranong
65 Surat Thani
66 Phangnga
67 Phuket
68 Krabi
69 Nakhon Si Thammarat
70 Phatthalung
71 Trang
72 Satun
73 Songkhla
74 Pattani
75 Yala
76 Narathiwat

Appendix 1 Floristic regions and Provinces of Thailand (from The Forest Herbarium, 2001).

Appendix 2 Index to specimens examined

1. *Actinodaphne amabilis* Kosterm.

   A.F.G. Kerr 16931, 17 Febuary 1929, Phangnga, Khao Phota Luang Kaeo (K)

   R. Geesink, P. Hiepko, C. Phengklai 7697, 28 November 1974, Phangnga, Khao Phota Luang Kaeo (BKF)

2. *Actinodaphne angustifolia* (Blume) Nees

   A.F.G. Kerr 16372, 26 December 1928, Ranong, Kraburi (BK)

   A.F.G. Kerr 17676, 22 December 1929, Krabi, Dan Chumpon (BK)

   A.F.G. Kerr 18334, 3 January 1925, Krabi (BK)

   P S. 2207, 7 November 1964, Trat, Chang Kluea (BKF)

   Put 2747, 2 Febuary 1930, Rayong, Ban Phe (BK, K)

   M. Tanaros 5, 16 April 2005, Chanthaburi, Klung (BKF)

   M. Tanaros 8, 9 Febuary 2006, Nakhon Ratchasima, Khao Yai National Park (BKF)

   M. Tanaros 9, 7 May 2005, Chanthaburi, Trok Nong Waterfall Substation (BKF)

3. *Actinodaphne cupularis* Gamble

   A.F.G. Kerr 5566, 4 June 1921, Chiang Mai, Doi Chiang Dao Wildlife Santuary (K)

   A.F.G. Kerr 9947, 12 Jan 1925, Nakhon Ratchasima, Khao Laem (K)

   C. F. Beusekom et al. 9621, 27 December 1971, Loei, Phu Kradueng National Park (BKF)

   J. E. Vidal 5202, 26 September 1970, Chiang Mai, Doi Chiang Dao Wildlife Santuary (BKF)

   T. Smitinand & C. Phengklai 11567, 22 January 1972, Nakhon Ratchasima, Khao Laem (BKF)

4. *Actinodaphne glomerata* (Blume) Nees

   A. Cuadra A1309, 7 March 1948, Lamut, Beaufort, Brunei (BKF)

   N. Fukuoka, T. Santisuk & W. Na Nakorn T-35912, 6 September 1984, Ranong (BKF)

5. *Actinodaphne henryi* Gamble

   A.F.G. Kerr 1643, 8 Jan 1911, Chiang Mai, Doi Suthep-Pui National Park (K)

   A.F.G. Kerr 5374, 7 May 1921, Chiang Mai, Doi Ang Khang (BK)

   A.F.G. Kerr 5931, 3 May 1922, Sukhothai, Khao Luang (BK, BKF)

   Put 3517, 26 December 1930, Nakhon Ratchasima, Khao Laem (BK, BKF)

   T. Smitinand 2128, 15 December 1954, Loei, Phu Kradueng National Park (BKF)

   Th. Sorensen, Kai Larsen, Bertel Hansen 3066, 27 April 1958, Chiang Mai, Doi Suthep-Pui National Park (BKF)

   Th. Sorensen, Kai Larsen, Bertel Hansen 3531, 18 May 1958, Chiang Mai, Doi Suthep-Pui National Park (BKF)

   Th. Sorensen, Kai Larsen, Bertel Hansen 6619, 14 January 1959, Chiang Mai, Doi Suthep-Pui National Park (BKF)

   K. Iwatsuki & N. Fukuoksa T-3967, 31 December 1965, Chiang Mai, Doi Suthep-Pui National Park (BKF)

   Sakol Sutisorn 1529, 27 June 1970, Chiang Rai, Kua Ku Tan Mountain (BK)

   J.F. Maxwell 75-1117, 7 December 1975, Chonburi, Khao Khiao (BK)

   J.F. Maxwell 88-112, 30 January 1988, Chiang Mai, Doi Suthep-Pui National Park (BKF)

   J.F. Maxwell 93-1557, 27 December 1993, Lampoon, Doi Khun Tan National Park (BKF)

   J.F. Maxwell 96-657, 8 May 1996, Chiang Mai, Doi Lohn (BKF)

   T. Smitinand 90-49, 15 March 1990, Chiang Mai, Mae Tang (BKF)

T. Smitinand 90-94, 19 March 1990, Chiang Mai, Doi Inthanon National Park (BKF)

Th. S. et al. 299, 6 May 1992, Kanchanaburi, Tinuang Forest Protection Units (BKF)

T. Santisuk sn 030609, 16 May 1992, Nan, Doi Phukha National Park (BKF)

T. Smitinand & T. Santisuk et al. 549, 1 March 1993, Kanchanaburi, Thung Yai Naresuan Wildlife Santuary (BKF)

Th. Wongprasert sn 112160, 25 November 1997, Nan, Doi Phukha National Park (BKF)

M. Tanaros 3, 7 Febuary 2006, Lampoon, Doi Khun Tan National Park (BKF)

M. Tanaros 26, 18 June 2006, Nakhon Ratchasima, Khao Yai National Park (BKF)

M. Tanaros 27, 13 November 2006, Uthai Thani, Haui Kha Kaeng Wildlife Santuary (BKF)

6. *Actinodaphne montana* Gamble

A.F.G. Kerr 7206, 15 July 1923, Pattani, Bachaow (BK, K)

M. Tanaros 10, 3 September 2005, Yala, Betong (BKF)

M. Tanaros 29, 15 March 2007, Phattalung (BKF)

M. Tanaros 32, 18 April 2007, Nakhon Si Thammarat, Khao Nan (BKF)

7. *Actinodaphne omeiensis* (H. Liu) C.K. Allen

A.F.G. Kerr 10994, 4 July 1924, Prachuap Kiri Khan, Khao Luang (BK)

A.F.G. Kerr 11011, 5 July 1924, Prachuap Kiri Khan, Khao Luang (BK)

8. *Actinodaphne perglabra* Kosterm.

   Put 4323, 7 November 1931, Nakhon Ratchasima, Lat Bua Kao (BK, K)

9. *Actinodaphne sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.

   A.F.G. Kerr 17766, 25 December 1929, Trat, Mu Ko Chang National Park (BKF)

   M. Tanaros 1, 14 July 2006, Chanthaburi, Chang Sae Waterfall Ranger (BKF)

   M. Tanaros 2, 21 July 2006, Chanthaburi, Chang Sae Waterfall Ranger (BKF)

   M. Tanaros 22, 30 June 2006, Trat, Tan Ma Yom Waterfall, Mu Ko Chang National Park (BKF)

10. *Actinodaphne sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen

    A.F.G. Kerr 7327, 25 July 1923, Pattani, Banang Sta (BKF)

    B. Nimanong & S.P. 1625, 10 June 1973, Trang, Khao Chong (BKF)

    Kai Larsen & Supee S. Larsen 33591. 2 May 1974, Ranong (BKF)

    M. Tanaros 16, 25 June 2007, Narathiawat, Hala-Bala Wildlife Santuary (BKF)

    T. santisuk 1185, 1 April 1977, Ranong , Khao Phota Laung Kaeo (BKF)

    S. Phusomsaeng et al. 1528, 10 June 1973, Trang, Khao Chong (BKF)

11. *Acinodaphne sikkimensis* Meisn.

    L.B. & E.C. Abbe, T. Smitinand 9428, 10 Jan 1960, Loei, Khao Kating Phu kradueng National Park (BKF, K)

    Pirun Promhitathorn -, - April 2000, Phitsanulok, Phu Hin Rong Kla National Park (BKF)

M. Tanaros 7, 20 June 2005, Loei, Phu Luang Wildlife Santuary (BKF)

M. Tanaros 18, 25 November 2006, Phitsanulok, Phu Hin Rong Kla National Park (BKF)

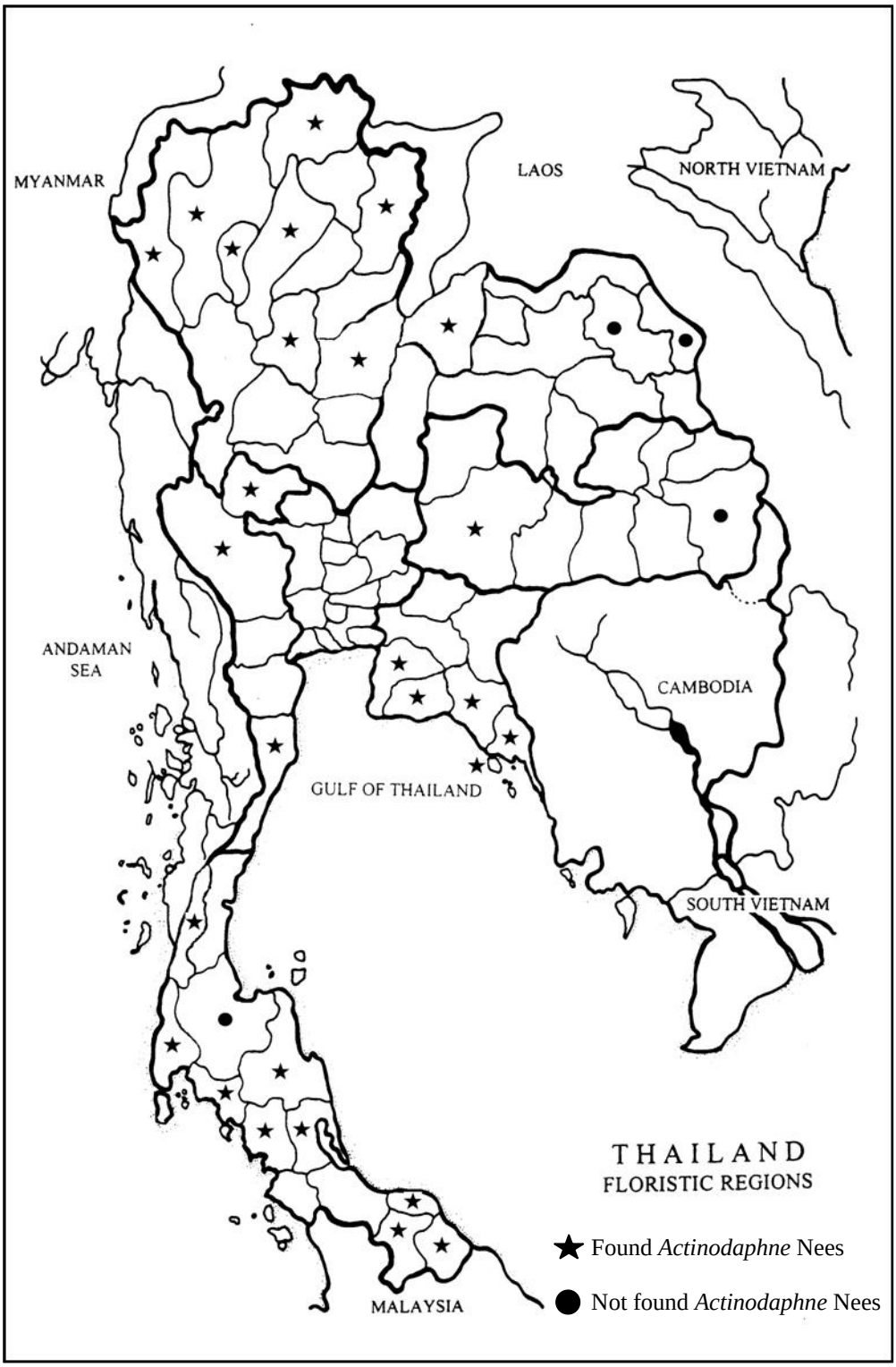
M. Tanaros 20, 23 December 2006, Loei, Phu Luang Wildlife Santuary (BKF)

M. Tanaros 31, 24 Febuary 2007, Loei, Phu Luang Wildlife Santuary (BKF)

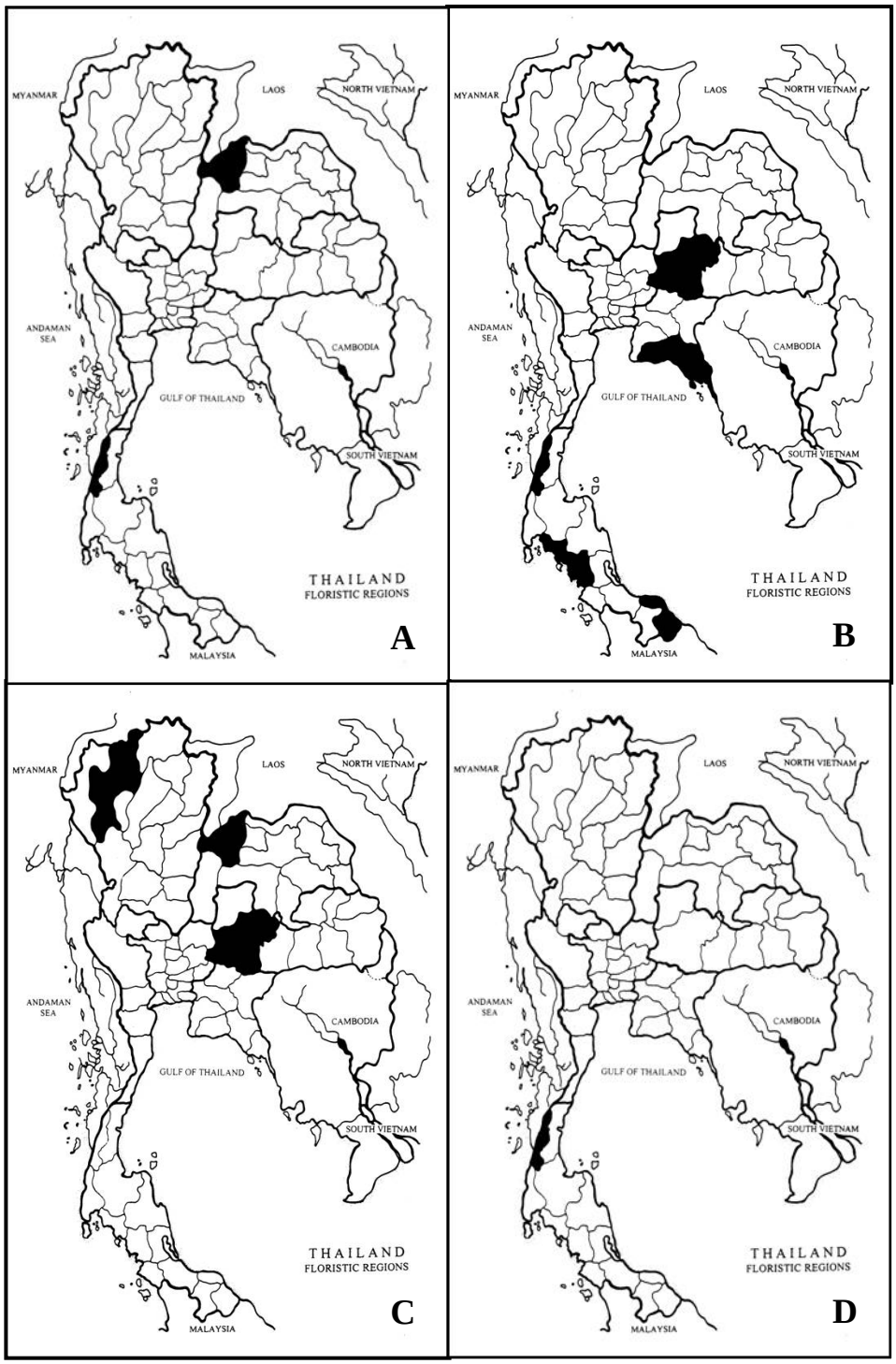
12. *Actinodaphne* sp.1

M. Tanaros 21, 18 June 2006, Krabi, Khao Phanom Bencha National Park (BKF)

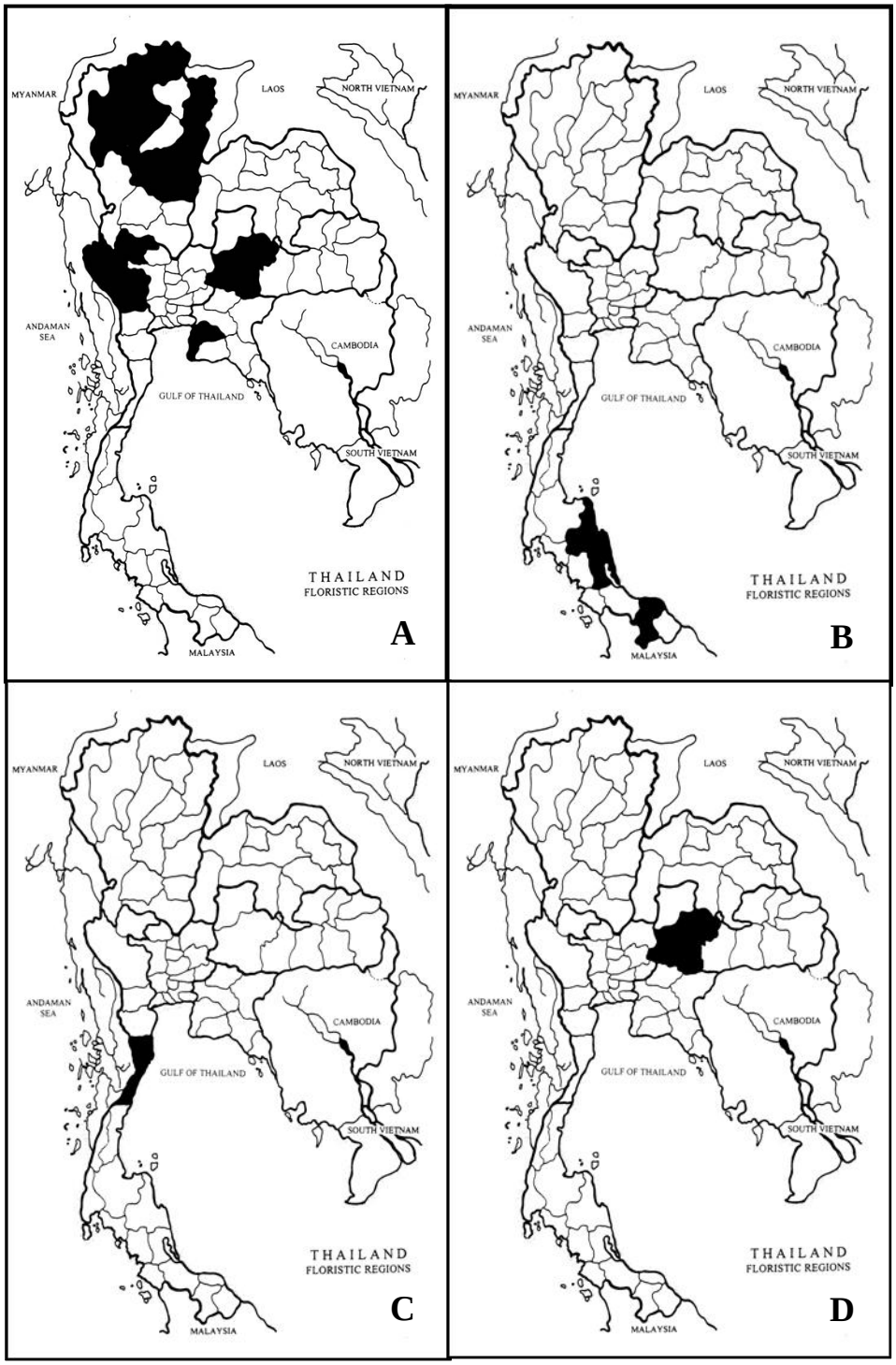
Appendix Figure 1 Floristic regions and Provinces of Thailand (From The Forest Herbarium, 2001).



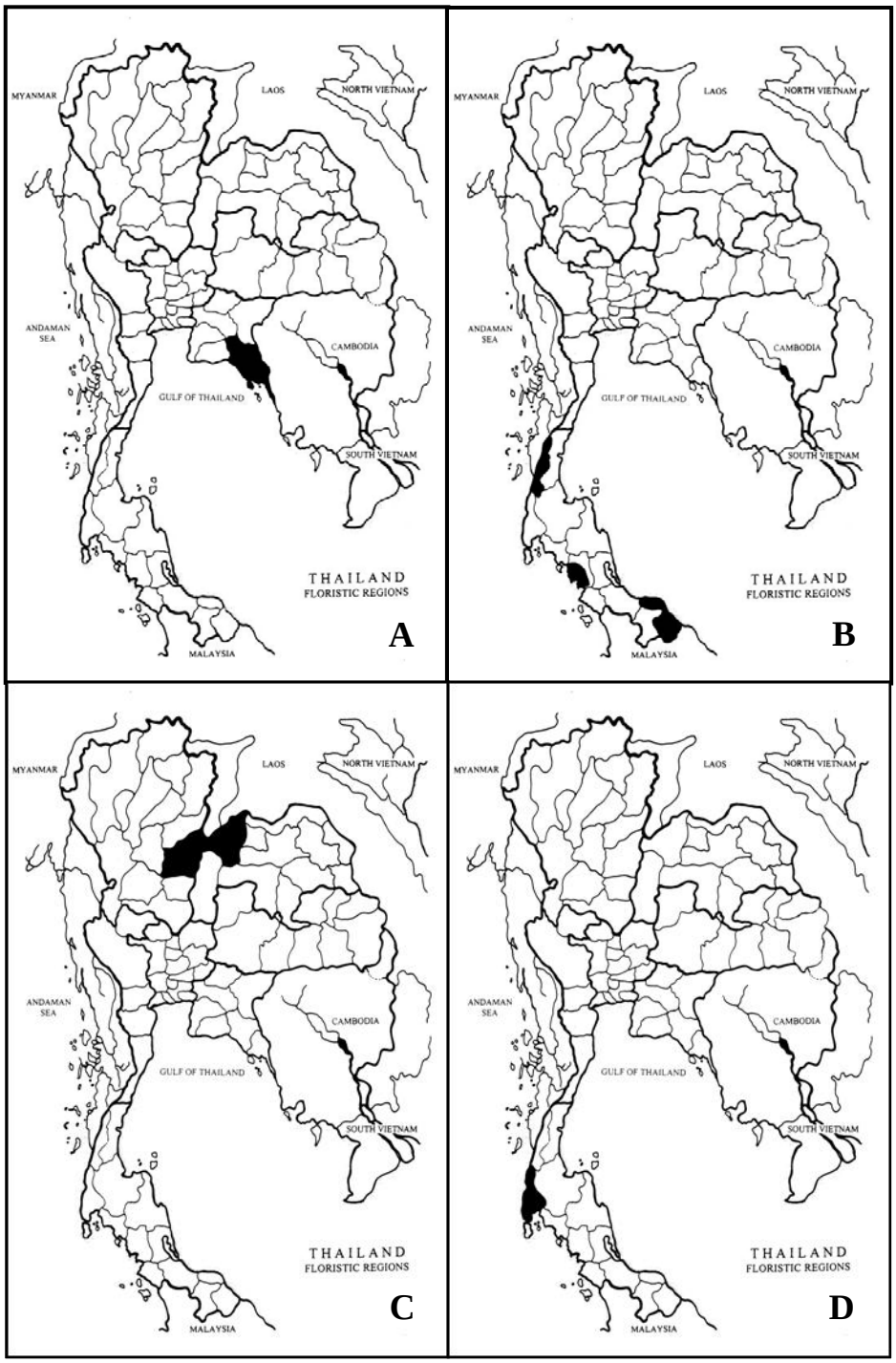
Appendix Figure 2 Plant surveys in Thailand.



Appendix Figure 3 Distribution of *Actinodaphne* Nees in each region of Thailand: A. *A. amabilis* Kosterm.; B. *A. angustifolia* (Blume) Nees; C. *A. cupularis* (Hemls.) Gamble; D. *A. glomerata* (Blume) Nees.



Appendix Figure 3 (Continued) Distribution of *Actinodaphne* Nees in each region of Thailand: A. *A. henryi* Gamble; B. *A. montana* Gamble; C. *A. omeiensis* (H. Liu) C.K. Allen; D. *A. perglabra* Kosterm.



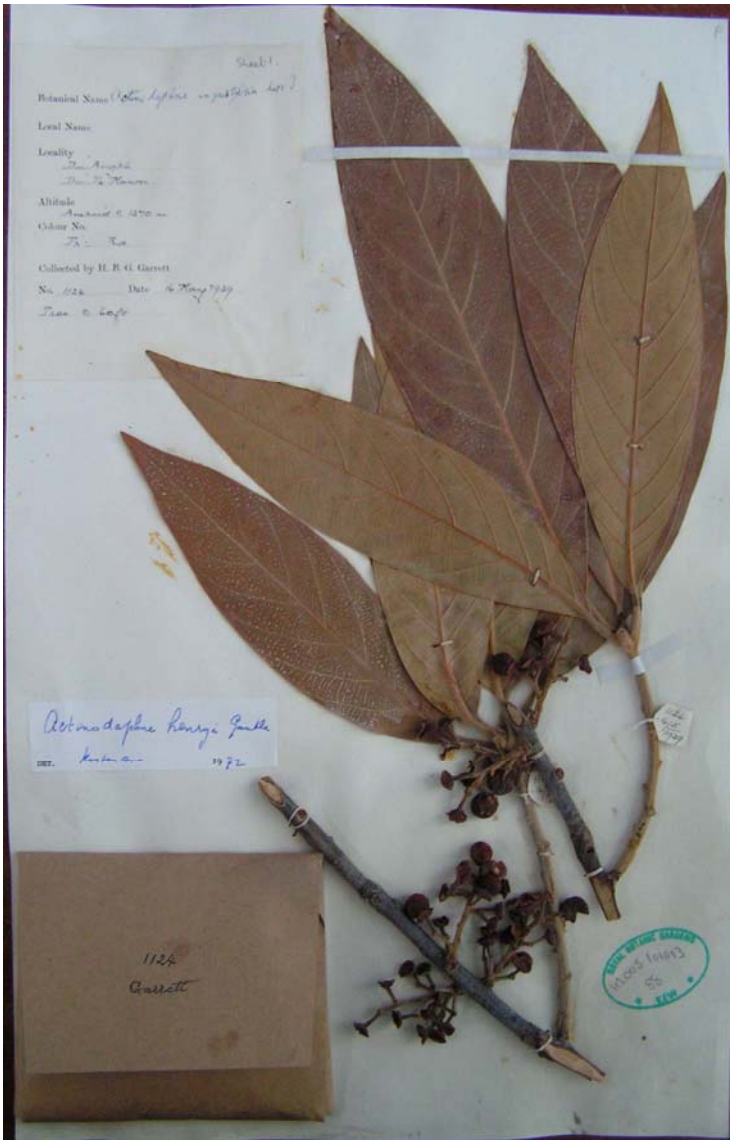
Appendix Figure 3 (Continued) Distribution of *Actinodaphne* Nees in each region of Thailand: A. *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.; B. *A. sequipedalis*(Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *glabra* Kochummen; C. *A. sikkimensis* Meisn.; D. *Actinodaphne* sp.1.

Appendix Figure 4 Type photograph of *A. amabilis* Kosterm.
(From Royal Botanic Gardens, Kew)

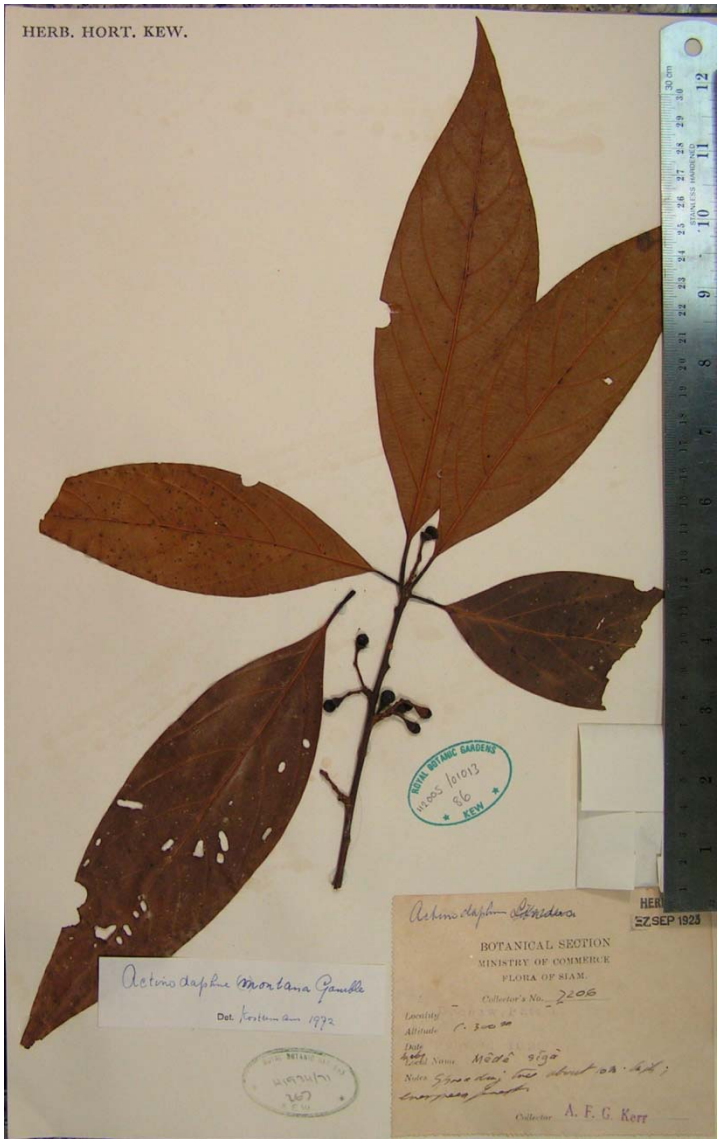
Appendix Figure 5 Type photograph of *A. angustifolia* (Blume) Nees (From Royal Botanic Gardens, Kew)

Appendix Figure 6 Type photograph of *A. cupularis* (Hemsl.) Gamble (From Royal Botanic Gardens, Kew)

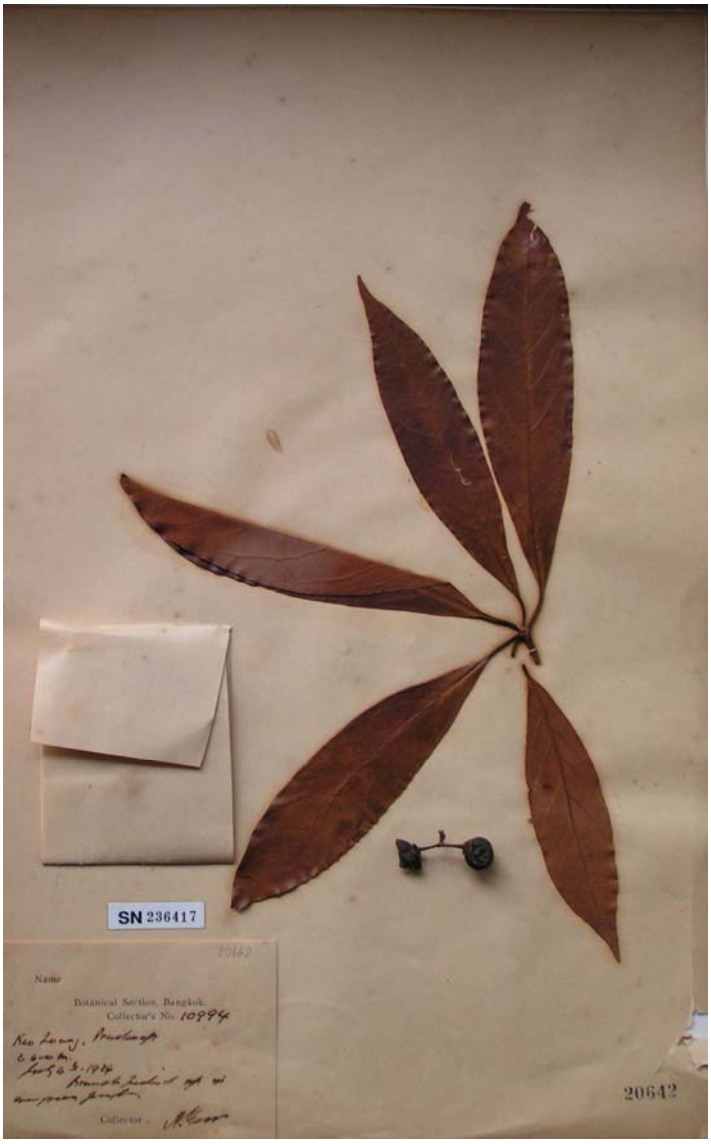
Appendix Figure 7 Type photograph of *A. glomerata* (Blume) Nees
(From Royal Botanic Gardens, Kew)



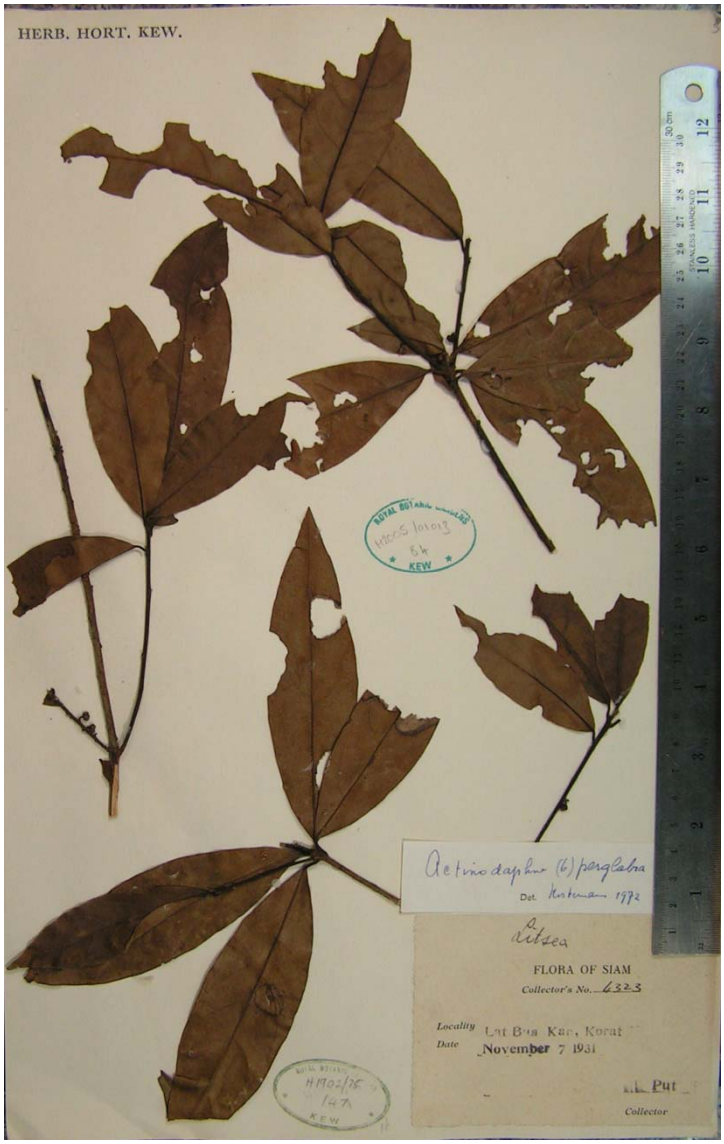
Appendix Figure 8 Type photograph of *A. henryi* Gamble
(From Royal Botanic Gardens, Kew)



Appendix Figure 9 Type photograph of *A. montana* Gamble
(From Royal Botanic Gardens, Kew)

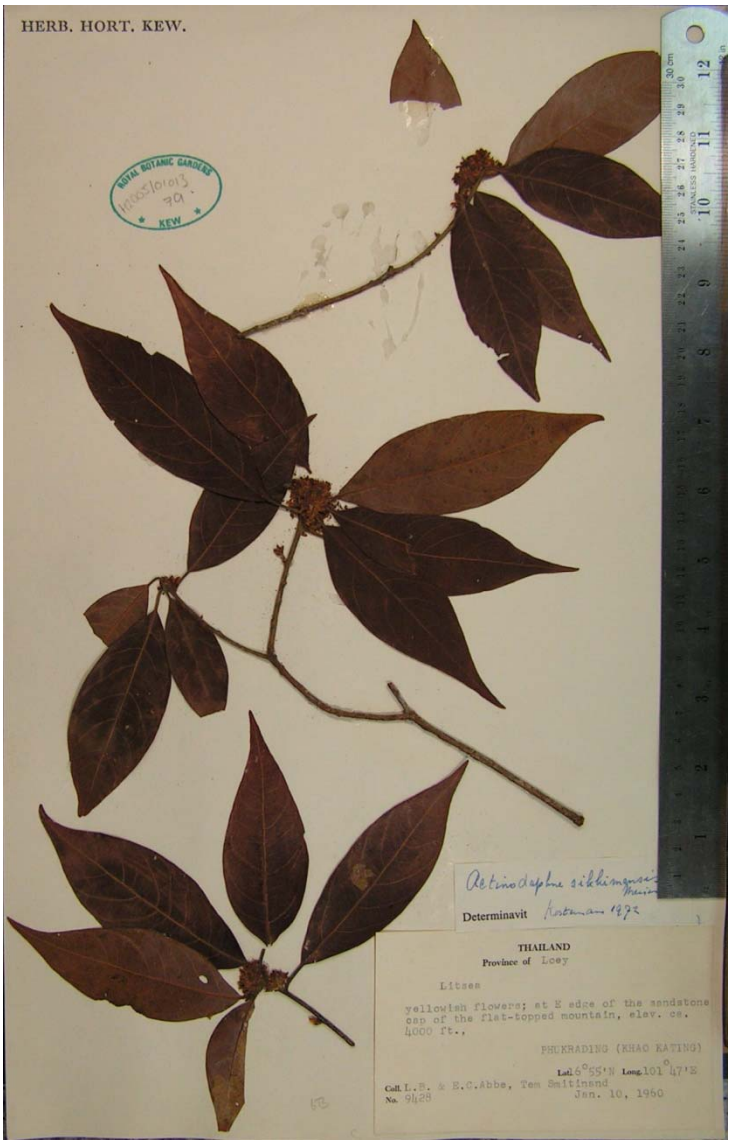


Appendix Figure 10 Type photograph of *A. omeiensis* (H. Liu) C. K. Allen (From Bangkok Herbariums, BK)

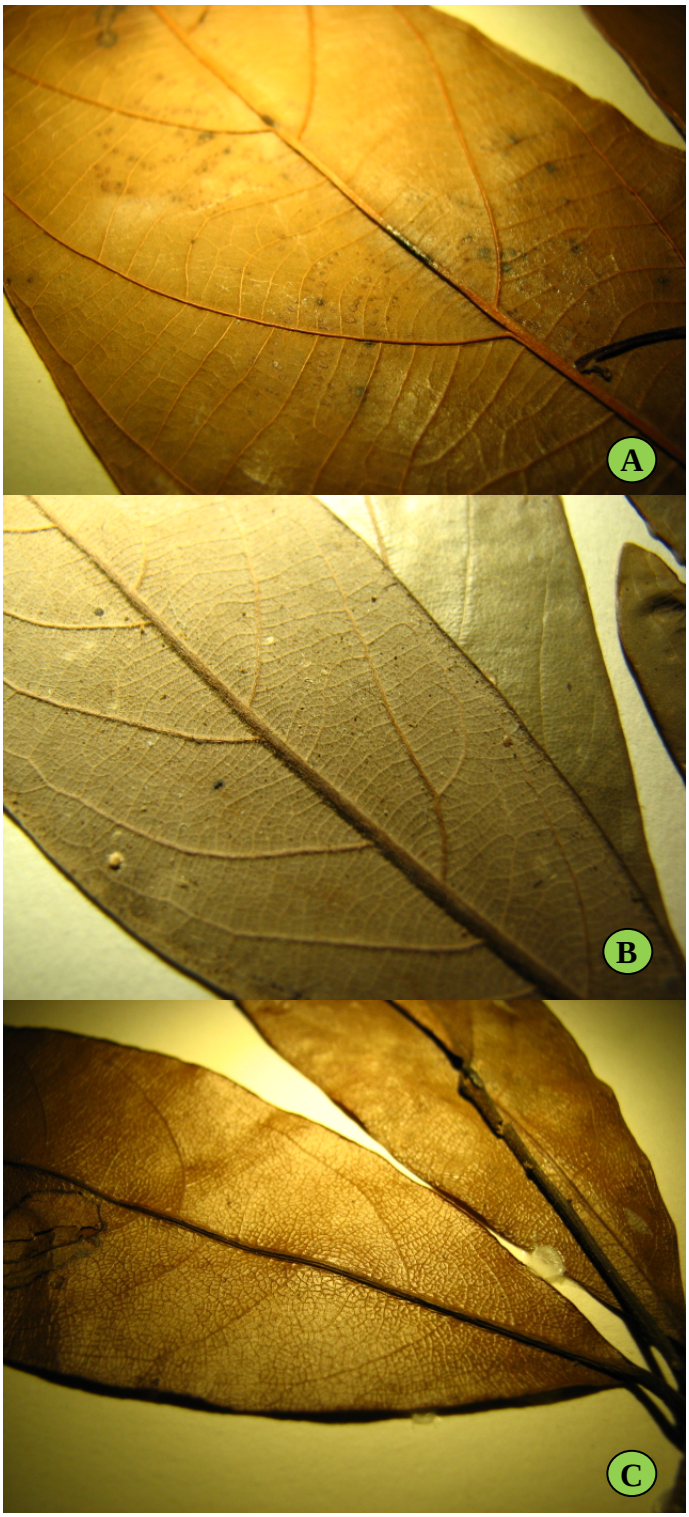


Appendix Figure 11 Type photograph of *A. perglabra* Kosterm.
(From Royal Botanic Garden, Kew)

Appendix Figure 12 Type photograph of *A. sesquipedalis* (Wall. ex Kuntze) Hook. f. & Thoms. ex Meisn. var. *cambodiana* H. Lec.
(From Royal Botanic Gardens, Kew)



Appendix Figure 13 Type photograph of *A. sikkimensis* Meisn.
(From Royal Botanic Gardens, Kew)



Appendix Figure 14 Tertiary veins in genus *Actinodaphne* Nees: A. scalariform (commonly found in many species); B. reticulate-scalariform (found in few species); C. finely reticulate (only found in *Actinodaphne perglabra*).

CURRICULUM VITAE

NAME : Mr. Montri Tanaros

BIRTH DATE : March 8, 1980

BIRTH PLACE : Chanthaburi, Thailand

EDUCATION :	**YEAR**	**INSTITUTION**	**DEGREE/DIPLOMA**
	2003	Kasetsart Univ.	B.S. Sci. (Biology)

POSITION/TITLE : Research Assistants

WORK PLACE : Forest Herbarium, National Park Wildlife and Plants Conservation Department, BKF

SCHOLARSHIP/AWARDS : TRF/BIOTEC Special Program for Biodiversity and Training grants BRT R_146008