

CHAPTER IV

RESULTS and DISCUSSIONS

4.1 Taxonomic revision

4.1.1 Morphology of *Chiloschista*

All species of *Chiloschista* in Thailand is an epiphytic orchid. Few species have habit type both epiphyte and lithophyte such as *C. usneoides* (Pearce and Cribb, 2002). Their stem obscure or very short and produce many roots. Their roots are flattened, ribbon-like or subcylindrical, scabrid. It is usually grey-green when dry and can fast absorb water or vapor. Then the photosynthesis takes place at their root. They hardly produce leaf, but sometime with small leaves during rainy season. Their leaves are elliptic or lanceolate with subacute apex and slightly bilobed. During flowering, there is no leaf, showing only roots and inflorescence. The large and old individuals usually produce many inflorescences (Figure 4.1).

Inflorescences were lateral raceme in general. Healthy and old individuals seem to have few branches as being a panicle which were found in *C. lunifera* and *C. parishii*. The inflorescence is usually pendent or sometime erect with many-flowered in all Thai species. Sometime there are few flowers in a short inflorescence which may be related in its age. The rachis and peduncle are pilose in all Thai species. The floral bracts are small with ovate-lanceolate shape, subtended the pedicel.

The floral part morphology is shown in Figure 4.2. Flowers are resupinate, ephemeral and fragrant. The pedicel including ovary is terete, terete and pilose in all species found in Thailand. Their color of sepals and petals are varied from white in *C. usneoides* to yellow in *C. rodriguezii*. In some species exhibits both white to pale yellow such as *C. rodriguezii*. In *C. lunifera*, there is a large reddish-brown patch on sepals and petals. While, *C. parishii*, *C. extincitoriformis* have reddish or purple spots. In contrast, *C. rodriguezii*, *C. usneoides*, *C. exuperei* have no any marking in the sepals and petals. The sepals and petals of *Chiloschista* vary from surrounded, ovate, elliptic

oblong to oblong. Some species such as *C. lunifera* has petals varied from oblong to rounded. While, *C. rodriguezii* has oblong and slight falcate petals. The color pattern of sepals and petals is a taxonomic character showing without any marking, spots and a blotch state. Seidenfaden (1988) used the characteristic of petal margin with sparsely cilliate as a taxonomic character. In this study showed that in *C. viridiflava* has cilliate or without, while of *C. parishii* is always cilliate. The labellum of the *Chiloschista* is concave to saccate to conical shape.

The labellum is upright and articulate with column foot. Their shapes are usually saccate with round tip hypochile. Exceptionally, in *C. extincitoriformis* has a conical and narrow tip hypochile and *C. rodriguezii* has a short cylindrical and obtuse tip. The epichile is 3 lobes consisting of 2 side lobes and a mid-lobe. Their side lobes are usually oblong. The mid-lobes are usually very small, except *C. exuperei* with having elongate oblong mid-lobe with retuse apex.

The column or androgynostemium of *Chiloschista* is a typical type of Epidendroid orchid, consisting of one incumbent anther and a stigma cavity below the anther. The pollinarium compose of 2 globular pollinia, which one is divided into 2 halves, one a litter smaller than another one, transparency strip and visidium.

Fruit of *Chiloschista* is an elongate capsule and 6-ridged. Inside of its capsule contains several thousand dust like seeds. However, the fruit specimens are difficult to identify. Thus, it is hard to indicate the morphological detail of each species.

Chiloschista can be recognized by being a leafless epiphytic orchid and the labellum erect and saccate with distinctly side lobes. The vegetative morphology of *Chiloschista* like the genus *Taeniophyllum* Blume in form of leafless epiphytic orchid. However, its flower quite different from the later genus.



Figure 4.1 *Chiloschista* habit: *Chiloschista viridiflava* Seidenf., showing its habit.

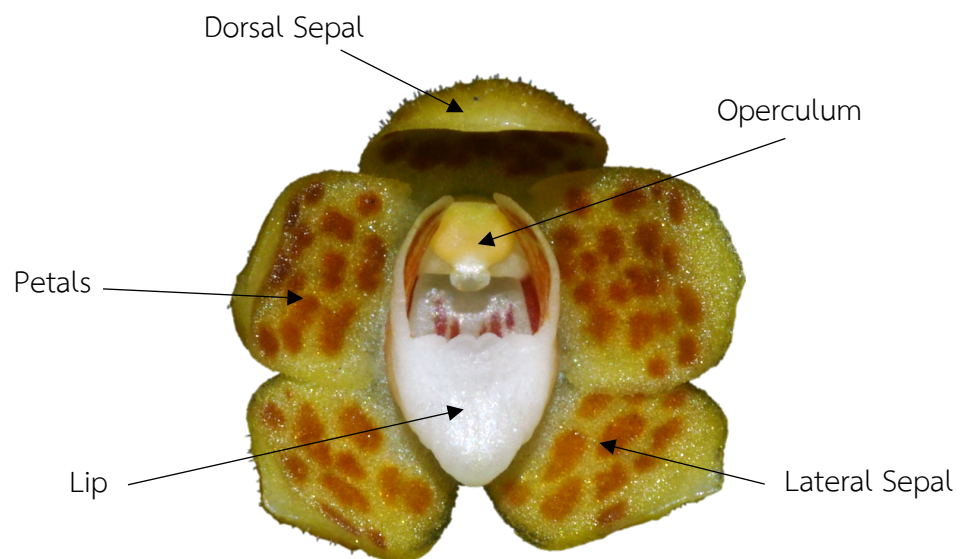


Figure 4.2 Morphology of *Chiloschista* flower.

4.1.2 Taxonomic treatment

Chiloschista Lindl. Edwardes' s Bot. Reg. 18, sub. T. 1522. 1832; M. D. Dassanayake., Fl. Ceylon.: 188. 1981; Seidenf., Opera Bot. 95: 168. 1988; J. B. Comber., Orchids Java: 301. 1990; Seidenf., Opera Bot. 114: 409. 1992; Seidenf. & J.J. Wood, Orchids Penins. Malaysia Singapore: 655. 1992; Pridgeon et al., Gen. Orchid. 6: 152. 2014; N. Pearce & P. J. Cribb., Fl. Bhutan 3(3): 503. 2002; S. C. Chen et al. In Z. Y. Wu et al. (eds), Fl. China 25: 470. 2009. Type specimens: *Chiloschista usneoides* (D. Don) Lindl.—basionym: *Epidendrum usneoides* D. Don.

Epiphytic or lithophytic herbs, stem very short or indistinct, erect with commonly leafless, rarely with small leaves during vegetation period; roots flattened, ribbon-like or subcylindrical, grey-green, photosynthetic. *Leaves* (when present) oblong-elliptic to ligulate, obliquely subacute or unequally bilobed, sometime slightly falcate, articulate. *Inflorescence* lateral, racemose, rarely paniculate, erect or pendent, (few-)many-flowered, usually tomentose or rarely glabrous; floral bracts triangular or ovate-lanceolate. *Flowers* resupinate, mild to rather strong fragrant, white, greenish yellow to yellow, with or without reddish or purple spots or a large patch. *Sepals* and *petals* free, subequal, oblong-ovate, obovate, oblanceolate or oblong-elliptic, lateral sepals and petals usually laterally adnate to column foot by a broad base. *Labellum* clawed, articulate to apex of column foot, motile trilobed, basal portion concave or saccate, with an erect or ascending, entire or weakly bilobed, pilose with short and thick hairs callus on inner surface of posterior wall; side lobe erect; mid-lobe usually common abbreviated, transverse, entire or rarely bilobed, disc often pilose. *Column* semi-terete, foot perpendicular to column, broad, at least twice as long as column; clinandrium shallowly excavate, with a membranous posterior margin. *Anther cap* provided on either side with a long-filiform, glandular-tipped appendage, or appendages reduced to a small tooth pollinia four, waxy, stipe sublinear, visidium small; stigma transverse, deeply set; rostellum deflexed, shortly bifid after removal of pollinarium. *Capsule* cylindrical with narrow at both ends, ridged; seeds dust-like.

Key to species

- 1 Labellum with a rounded pouch
 - 2 Labellum midlobe distinct, oblong with emarginate apex.....2. *C. exuperei*
 - 2 Labellum midlobe indistinct
 - 3 Sepals and petals without any marking or with only faint marking at base of sepals and petals
 - 4 Sepals and petal white or whitish yellow.....6. *C. usneoides*
 - 4 Sepals and petals greenish yellow.....7. *C. viridiflava*
 - 3 Sepals and petals with many reddish brown or purple spots or reddish a brown blotch
 - 5 Sepals and petals with reddish brown or purple spots.....4. *C. parishii*
 - 5 Sepals and petals with a reddish brown blotch.....3. *C. lunifera*
- 1 Labellum with a conical and short tubular pouch
 - 6 Labellum with a conical pouch. Petals rounded.....1. *C. extinctoriformis*
 - 6 Labellum with a short tubular-conical pouch. Petals oblong.....5. *C. rodriguezii*

1. *Chiloschista extinctoriformis* Seidenf., Opera Bot. 95: 178. 1988. Type specimen: Kerr 330 (holotype-K!) (Figure 4.3-4.4).

Epiphytic herb; stem very short, erect, simple. *Roots* silvery-green flattened, 1.5–2 mm wide, appressed to the host tree bark. *Inflorescence* axillary, pendulous raceme 10–12 cm long, arising near the stem apex; scape and rachis dull pale green, densely tomentose; scape 3.3–3.5 cm long, terete, with 3–4 distant triangular whitish scarious sterile bracts 2–3 mm long, 0.5–1 mm wide; rachis slightly zigzag, with 5–8 lax, spirally arranged flowers. *Flowers* widely opening, 1.1–1.2 cm across; sepals and petals whitish cream, with many brown spots; lip white to cream; base of side lobes with yellow base (inside); column whitish, column foot with dark purple variegated base; anther cap pale yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 2.5–3 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, 1.2–1.5 mm long, *ca.* 1.2 mm wide. *Dorsal sepal* broadly obovate to almost round, 5–6 mm long, 4.3–4.5 mm,

recurved, rounded apex; entire not ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Lateral sepals* broad elliptic, elliptic oblong, slightly oblique, 5–5.5 mm long, 3.5–4 mm wide, spreading, rounded at apex, entire not ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Petals* broadly ovate or ovate-oblong, 4.8–5 mm long, 3.5–4 mm wide, rounded at apex, entire with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Labellum* erect, 2.2–2 mm long, 1.8–2 mm wide, 3.8–4 mm high, movably attached to the column foot apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave to conical with narrow tip, 1.7–1.8 mm long, 1.8–2 mm wide, with a longitudinal median keel covered by thick and short hairs and dense longer thin hairs at apex of the keel; side lobes oblong, 3–3.2 mm long, 1.2–1.5 mm, erect, obtuse with entire margin; mid-lobe very small, *ca.* 0.5 mm long, *ca.* 1.5 mm wide. *Column* *ca.* 5 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, *ca.* 1 mm long and wide, at front with broadly triangular, obtuse, 0.2–0.3 mm long, with thread like appendages *ca.* 1.3 mm long on each side; pollinia 2, globular, *ca.* 0.5 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, *ca.* 1 mm long; viscidium attached distally, simple thin plate, wide oblong, 0.3 mm long, 0.2 mm wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai Singkhon (เอื้องพญาไร่ใบสิงขร)

Ecology: On tree trunk or branch in limestone forest, alt. 600–800 m. Flowering: April to May.

Distribution: Endemic to Thailand.

Specimens examined: SOUTH-WESERN: Prachuap Khiri Khan, Khao Luang, Kerr 330 (K!); Sinkhorn border market, 7.04.2017, *T. Pingyot*, *W. La-Ongsri*, *P. Tatiya* & *S. Satatha* 95 (QBG!); PENINSULAR: Phangnga, Sra Nang Mano Rah, *S. Watthana* and *S. Pumicong* 2031 (QBG!).

Conservation status in Thailand: Vulnerable (D2) In Thailand, it was found only two population in Prachuap Khiri Khan and Phang Nga Province. The local people who live near the population in Phang Nga inform that there are less than 500 mature individuals. While there is not any information about the population in Prachuap Khiri

Khan. So far, this species is an endemic species to Thailand. This species has been collected to sell in a wild plant market (Figure 4.5).

Notes: This species can be distinguished by having a narrow conical spur.

2. *Chiloschista exuperei* (Guillaumin) Garey, Bot. Mus. Leafl. 23,2: 166. 1972; Seidenf., Contr. Rev. Orchid Fl. Cambodia Laos Vietnam 25: 215. 1975; Opera Bot. 95: 171. 1988; Opera Bot. 114: 410. 1992.—*Taeniophyllum exuperei* Guillaumin, Bull. Mus. Natl. Hist. Nat. sér. 2, 29: 346. 1957. Type specimen: *Exupere* 70 (holotype-P! picture www.plant.jstore.org) (Figures 4.6-4.7).

Epiphytic herb; stem very short, erect, simple. *Roots* many, silvery-green flattened, 1.5–2 mm wide, addressed to the host tree bark. *Inflorescence* axillary, pendulous raceme 4.5–5 cm long, arising near the stem apex; scape and rachis dull pale green, densely tomentose; scape *ca.* 3 cm long, terete, with 3–4 distant triangular whitish scarious sterile bracts 2–3 mm long, 0.5–1 mm wide; rachis rather straight, with 7–8 lax, spirally arranged flowers. *Flowers* widely opening, *ca.* 1 cm across; sepals and petals whitish cream, without any marking; lip white to cream; side lobes cream, its base with yellow base (inside); column whitish, column foot with dark purple variegated base; anther cap pale yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 2.5–3 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, *ca.* 2.5 mm long, *ca.* 1 mm wide. *Dorsal sepal* broadly obovate to almost round, *ca.* 4.7 mm long, *ca.* 4.5 mm, recurved, rounded apex; entire not ciliate margin, abaxially densely hairy, adaxially sparsely hairy. *Lateral sepals* oblong, slightly oblique, 5–5.5 mm long, 3–3.5 mm wide, spreading, rounded at apex, entire not ciliate margin, abaxially and adaxially sparsely hairy. *Petals* oblong, 4.3–4.5 mm long, 2.3–2.5 mm wide, rounded at apex, entire with sparsely ciliate margin, abaxially and adaxially sparsely hairy. *Labellum* erect, 4–4.5 mm long, 3.3–3.5 mm wide, 3.8–4 mm high, movably attached to the column foot apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave to short saccate with rounded tip, *ca.* 3 mm long, *ca.* 2.3 mm wide, with a longitudinal median keel covered by thick and short hairs and dense longer thin

hairs at apex of the keel; side lobes oblong, 2.8-3 mm long, 1.8-2 mm, erect, obtuse with finely incised at margin; mid-lobe distinctly extended, oblong, 2.0-3.0 mm long, 1-1.5 mm wide, apex retuse. *Column* 3-4 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, ca. 0.7 mm long, ca. 1 mm wide, at front with broadly triangular, obtuse, ca. 0.2 mm long, without thread like appendage; pollinia 2, globular, ca. 0.5 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, ca. 1 mm long; viscidium attached distally, simple thin plate, quadrate, 0.2 mm long and wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai Pakpet (เอื้องพญาไร่ใบปากเปิด)

Ecology: In hill evergreen forest, alt. 750-900 m. Flowering: March-April.

Distribution: South China, Laos, Vietnam, Thailand, Cambodia and Malaysia.

Specimens examined: NORTHERN: Chiang Mai, Pa Pae, Mae Taeng District, elevation 829 m., 23.05.2015, S. Watthana & P. Momkaew 4301 (QBG!). *Ibid.*, 18.02.64, T.Chanokkhun 295 (QBG!); Doi Lang, Mae Aye, T.Chanokkhun 479 (QBG!); *Ibid.*, NC G. Seidenfaden & T. Smitinand 9610-14 (C); NORTH-EASTERN: Phetchabun, Nam Nao National Park, 750 m., G. Seidenfaden & T. Smitinand 8772 (C!); *Ibid.*, G. Seidenfaden & T. Smitinand 8779 (C).

Conservation status in Thailand: Vulnerable (D2). In Thailand, it was found in three localities in Chiang Mai and Petchabun. Available mapping showed Extent of occurrence (EOO) as 24,985 Km². From my field observation in 2022, in Doi Lang, Mae Aye, Chiang Mai Province, I visually estimated that there were less than 500 mature individuals. However, this orchid usually thrived on branch of Tea branches which may be cut in the future by farmer. Thus, there is a risk to reduce the population. Like the population in Pa Pae, they live on Tea's branches. I estimated that there are mature individuals less than 250 mature individuals (Figure 4.8).

Notes: This species can be distinguished by having oblong with bi-lobes apex of labellum.

3. *Chiloschista lunifera* (Rchb.f.) J.J.Sm., Orch. Java 553. 1905; A.D.Kerr, Nat. Hist. Bull. Siam Soc. 23, 1-2: 204. 1969; Seidenf., Bull. Mus. Hist. Nat. (Paris) 3. s. 71, Bot. 5: 113. 1973; Contr. Rev. Orchid Fl. Cambodia Laos Vietnam 1: 25. 1975; Opera Bot. 114: 411. 1992. — *Thrixspermum luniferum* Rchb.f., Gard. Chron. 1868: 786. 1868. — *Sarcochilus lunifer* (Rchb.f.) Benth. ex Hook.f., Bot. Mag. 115: t. 7044. 1889. Type specimen: *Reichenbach* 41550b (lectotype-WU, selected by Seidenfaden, 1988)

Chiloschista indica J.J.Sm., Bull. Jard. Bot. Buitenzorg, ser. 2, 10: 101. 1913, nom. superfl. Type specimen: not indicated.

Chiloschista ramifera Seidenf., 95: 179. 1988. Type specimen: Cumberlege s.n. (holotype-C!) (Figure 4.9-4.10).

Epiphytic herb; stem very short, erect, simple. *Roots* many, silvery-green flattened, 1.5–2 mm wide, addressed to the host tree bark. *Inflorescence* axillary, pendulous raceme 7-20 cm long, arising near the stem apex; scape and rachis dull pale green to dull greenish purple, densely tomentose; scape 2.3-8 cm long, terete, with 3–4 distant triangular whitish scarious sterile bracts 2–3 mm long, 0.5–1 mm wide; rachis rather straight to zigzag, with 7–8 lax, spirally arranged flowers. *Flowers* widely opening, 1-1.2 cm across; sepals and petals whitish cream, with a large dark reddish brown blotch; lip white to cream tinct with orange; side lobes white to cream with orange patch at base, its base with yellow base (inside); column whitish, column foot with dark purple variegated base; anther cap pale yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 4-4.5 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, *ca.* 1.5 mm long, *ca.* 1.2 mm wide. *Dorsal sepal* broadly obovate to almost round, 5-6 mm long, 3.5-4 mm, recurved, rounded apex; entire or sparsely ciliate margin, abaxially densely hairy, adaxially glabrous. *Lateral sepals* ovate, rounded or elliptic-oblong, slightly oblique, 5-5.2 mm long, 3.2–3.5 mm wide, spreading, rounded at apex, entire not ciliate margin, abaxially densely hairy, adaxially glabrous. *Petals* broad ovate to oblong, 5-5.5 mm long, 3.3-3.5 mm wide, rounded to truncate at apex, entire with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Labellum* erect, 2-2.2 mm long, 1.8-2.0 mm wide, 4-5 mm high, movably attached to the column foot

apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave to saccate with rounded tip, 1-1.2 mm long, 1.8-2 mm wide, with a longitudinal median keel covered by thick and short hairs thoroughly or upper half of the keel; side lobes oblong, 3.5-4 mm long, 2-2.5 mm, erect, obtuse with entire margin; mid-lobe very short, *ca.* 0.5 mm long, *ca.* 1 mm wide. *Column* 4.5-5 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, *ca.* 1 mm long and wide, at front with broadly triangular, obtuse, *ca.* 0.2 mm long, with thread like appendages 1.5-1.8 mm long on each side; pollinia 2, globular, *ca.* 0.5 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, *ca.* 0.7 mm long; viscidium attached distally, simple thin plate, quadrate, 0.3 mm long and wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai Dokdaeng (เอื้องพญาไร่ใบดอกแดง)

Ecology: On tree trunk or branches in dry dipterocarp forest or mixed deciduous forest, at alt. 600-1,000 m. Flowering: March-April.

Distribution: Assam, East Himalaya, Nepal, Laos, Myanmar, Thailand, Vietnam

Specimens examined: NORTHERN: Chiang Mai, Doi Chiang Dao Animal Sanctuary, 29.03.1995, *J. F. Maxwell* 95-272 (CMU!), Tak, Ban Tha Nuea, Tha Nuea Sub-district, Mae On District, *T.Chanokkhun* 476 (QBG!), Mae Hong Son, NW of Pang Mapha, elevation 600 m., *G. Seidenfaden & T. Smitinand* 7101 (C!); *Ibid.*, *G. Seidenfaden & T. Smitinand* 7171 (C), *G. Seidenfaden & T. Smitinand* 7194 (C), *G. Seidenfaden & T. Smitinand* 7195 (C); EASTERN: Nakhon Ratchasima, Pak Chong, elevation 350 m., 03.1964, *Cumberlege* 522 (K!), *Ibid.*, elevation 350 m., 13.05.1966, *G. Seidenfaden & T. Smitinand* 1362 (C!), Pak Chong, *Cumberlege s.n.* (C!); CENTRAL: Saraburi, Sahm Lahn, 125 m., 20.03.1974, *Maxwell* 74-216 (BK!).

Conservation status in Thailand: Near Threatened. In Thailand, the EOO is 35,321 km² based on available information which is not matched with any criteria of threatened categories (CR, EN and VU) However, this species is popular for ornamental purpose, so it may risk of disappear from natural population (Figure 4.11).

Notes: When Reichenbach (1868) named this plant as *Thrixspermum luniferum* Rchb.f., he did not cite type specimen, just said that the specimen was in British Museum. Seidenfaden (1988) cited the specimen from Reichenbach herbarium 41550b and 41549 left hand sketches. Seidenfaden (1988) named *Chiloschista ramifera* Seidenf. and indicated that it closed to *C. lunifera* but having branching inflorescences. I found that the branching inflorescence is a variable character depended on their age. Thus, in this treatment I lumped *C. ramifera* Seidenf. as a new synonym of *C. lunifera*.

4. *Chiloschista parishii* Seidenf., Opera Bot. 95: 176. 1988; Opera Bot. 114: 411. 1992; Type specimen: *S.B.Parish* 55 (holotype-WU!).—*Thrixspermum luniferum* auct. non Rchb. f.: 1868; Rchb. f., Tr. Linn. Soc. 30: 136, 1874; Parish., Mason, f. (ed.), Burma, its people and production. 2: 199. 1883.—*Sarcochilus luniferus* auct. non (Rchb. f.) Benth. ex Hook.f., Bot. Mag. 115: t 7044. 1889 (quoad descr. and plant); King & Pantling., Ann. Roy. Bot. Gard. 8: 207, P1, 276, 1898; Biswas., Ind. Forest. Rec. Bot. 3, 1: 52, 1941; Banerji., Candollea. 19: 218, 1964; Mehra & Vij., Taxon. 19: 110, 1970.—*Chiloschista lunifera* auct. non (Rchb. f.) J.J.Sm., Die Orchideen von Ambon.: 1905; Diels & Mansfeld., Dahl. no. 106. 11: 497. 1932; Holttum., Kew. Bull. 14: 273. 1960; Senghas., Die Orchidee. 13, 3: 99. 1962, Figure 1-2; Seidenf. & Smitinand., Orchids Thailand: 539. 1963, Figure 401; 821. 1965; Tuyama., Univ. Mus. Univ. 2: 181, 1971; Banerji & Thapa., J. Bomb. Nat. Hist. Soc. 70, 1: 28. 1973; Pradhan., Guide to identification and culture 2: 505, 1979; Rao & Deori., J. Ind. For. 3, 3-4: 258, 1980; Barthlott & Ziegler., Ber. Deutsch. Bot. Ges. 93: 391. 1980; Bechtel et al., The manual of cultivated orchid species.: 87. 1981; Banerji & Pradhan., The orchids of Nepal Himalaya.: 484. 1984; Misra., Biology, Conservation, and Culture of Orchids.: 315. 1986 (Figure 4.12-4.13).

Epiphytic herb; stem very short, erect, simple. *Roots* many, silvery-green flattened, 1.5–2 mm wide, addressed to the host tree bark. *Inflorescence* axillary, pendulous raceme 7-15 cm long, arising near the stem apex; scape and rachis dull pale green, densely tomentose; scape 1-2 cm long, terete, with 3–4 distant triangular whitish scarious sterile bracts 1.5–2.5 mm long, 1-2.5 mm wide; rachis rather straight, with 7–8 lax, spirally arranged flowers. *Flowers* widely opening, 1-1.3 cm across; sepals

and petals greenish yellow or yellow, with many reddish brown spots; lip white to cream; side lobes yellowish white, its base with reddish brown base (inside); column whitish, column foot with dark purple variegated base; anther cap pale yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 4-4.5 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, 2-2.5 mm long and wide. *Dorsal sepal* obovate to oblanceolate, 5-6 mm long, 3-4 mm, recurved, rounded apex; entire not ciliate margin, abaxially densely hairy, adaxially glabrous. *Lateral sepals* lanceolate-oblong, (not)-slightly oblique, 5-5.5 mm long, 3-3.5 mm wide, spreading, rounded at apex, entire not ciliate margin, abaxially and adaxially glabrous. *Petals* oblong, 5-5.5 mm long, 3.5-4 mm wide, rounded at apex or subtruncate, entire with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Labellum* erect, 2.3-2.5 mm long, 1.8-2.0 mm wide, 5-5.5 mm high, movably attached to the column foot apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave to saccate with rounded tip, 1-1.2 mm long, 1.8-2 mm wide, apex slightly grooved and obtuse, with a longitudinal median keel covered by thick and short hairs through or half of the keel; side lobes oblong, 2.5-3 mm long, 1.8-2 mm, erect, obtuse with entire margin; mid-lobe very short, *ca.* 0.5 mm long, *ca.* 1.5 mm wide. *Column* 4.5-5 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, *ca.* 1.5 mm long, *ca.* 2 mm wide, at front with broadly triangular, obtuse, *ca.* 0.2 mm long, with thread like appendages 1.5-2 mm long on each side; pollinia 2, globular, *ca.* 0.5 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, 1-1.3 mm long; viscidium attached distally, simple thin plate, wide quadrate, 0.5 mm long and wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai Judpra (เอื้องพญาไร่ใบจุดประ)

Ecology: On tree or branches in mixed deciduous forest or dry evergreen forest, alt. 500-1,500 m. Flowering: March-April.

Distribution: Andaman Is. , Assam, Bangladesh, East Himalaya, India, Laos, Myanmar, Nepal, Thailand, Vietnam.

Specimens examined: NORTHERN: Chiang Mai, Fang District, *G. Seidenfaden* & *T. Smitinand* 2096 (QBG!), Chiang Dao District, 24.04.2022, *T.Chanokkhun* 480 (QBG!), Tha Ton Sub-district, Mae Ai District, 24.04.2022, *T.Chanokkhun* 489 (QBG!), Mae Chaem, 600 m., *Kerr s.n.* (K), Doi Suthep, 1,100 ft., *Kerr* 130 (K), Doi Saket, *G. Seidenfaden* & *T. Smitinand* 7403 (C), Chiang Rai province, Chiang Saen District, *T.Chanokkhun* 461 (QBG!), Mae Sai District, 29.04.2022, *T.Chanokkhun* 513 (QBG!), Pa Teung Sub-district, Mae Chan District, 24.04.2022, *T.Chanokkhun* 488 (QBG!), Lampang, Huai Mae Tam, 1,400 ft., *Kerr* 130b (K), Tak, Ban Tham Suea, Phra That Pha Daeng Subdistrict, Mae Sot, elevation 500 m., 10.03.2011, *S. Watthana* 3708 (QBG!), Mae Ramat, *G. Seidenfaden* & *T. Smitinand* 7885 (K), Phitsanulok, trail to Nam Dam, Ban Rom Klao, Chattrakaan, elevation 100 m., 05. 30. 2006, *P. Suksathan* 3854 (QBG!); NORTH- EASTERN: Loie, Wang Saphung, *T. Smitinand* 441 (BKF), Phethabun, Heaw Sai waterfall, Nam Nao, 12.05.2012, *S. Watthana* 3426 (QBG!); EASTERN: Chayaphum, Nong Bua Daeng, 300 m., *Kerr* 0931 (K); *Ibid.*, *Kerr s.n.* (K), Nakhon Ratchasima, Khao Yai, *Cumberlege s.n.* (BKF); Pak Chong, *Cumberlege*. 1362 (C); WESTERN: Kanchanaburi, Sri Sawat, 01.04.1975, *Sornsuaay, Sakarin & Aditep* 153 (BKF); SOUTHERN: Satun, Thung Nui, elevation 50 m., 29.01.1961, *T. Smitinand* 7096 (BKF!).

Conservation status in Thailand: Least Concern. This species is so common in Thailand. They have been found more than 20 localities. Each population were usually many individuals (Figure 4.14).

Notes: Dalström & Kolan (2020) named a specimen collected from Kanchanaburi Province as *C. lindstroemii* Dalström & Kolan indicated that its feature closed to *C. parishii* but having large size of the flower. From my field observation, I found that it is a variable. However, I have not seen type specimens, *A.Lindstrom* 90-1571 (holotype-BK not seen). It needs further study.

5. *Chiloschista rodriguezii* Casvestro & Ormerod, *Orchidophile* (Asnieres) 166: 180, Figure 179-183, 2005. Type specimen: Thailand, Northern, Mae Hong Son, 500 m alt. September 2003. *W. Cavestro* s.n. (holotype-LY) (Figure 4.15-4.16).

Epiphytic herb; stem very short, erect, simple. *Roots* many, silvery-green flattened, 1.5–2 mm wide, addressed to the host tree bark. *Inflorescence* axillary,

pendulous raceme 8.5-10 cm long, arising near the stem apex; scape and rachis dull pale green, densely tomentose; scape 2.5-3 cm long, terete, with 3-4 distant triangular whitish scarious sterile bracts 2-2.2 mm long, 1-1.5 mm wide; rachis rather straight, with 7-8 lax, spirally arranged flowers. *Flowers* widely opening, 0.8-1 cm across; sepals and petals white to cream, without any marking; lip cream to yellow; side lobes yellow, its base with reddish brown tinct at base (inside); column whitish yellow, column foot with dark purple variegated base; anther cap (pale)-yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 2.8-3 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, *ca.* 1.5 mm long, *ca.* 1.2 mm. *Dorsal sepal* oblanceolate, 3.5-4 mm long, 2-2.5 mm, recurved, rounded apex; entire with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Lateral sepals* oblanceolate or obovate, slightly oblique, 3.5-4 mm long, 3.2-3.5 mm wide, spreading, rounded at apex, entire with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Petals* oblong slightly falcate, 3.5-4.0 mm long, 2.0-3.5 mm wide, subtruncate at apex, entire with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Labellum* erect, *ca.* 2 mm long, *ca.* 2.5 mm wide, 3 mm high, movably attached to the column foot apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave, cylindrical conical with obtuse and tip, *ca.* 2 mm long, *ca.* 1.5 mm wide, with a longitudinal median keel covered by thick and short hairs through the keel; side lobes oblique triangular-oblong, 1-1.5 mm long, 1 mm, erect, subacute; mid-lobe very small, *ca.* 0.5 mm long, *ca.* 1 mm wide. *Column* 3-3.5 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, *ca.* 1 mm long, *ca.* 1.3 mm wide, at front with broadly triangular, obtuse, *ca.* 0.1 mm long, with thread like appendages *ca.* 0.5 mm long on each side; pollinia 2, globular, *ca.* 0.3 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, *ca.* 0.4 mm long; viscidium attached distally, simple thin plate, oblong, 0.4 mm long and 0.2 mm wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai Khangyound (เอื้องพญาไร่ใบคางยาว)

Ecology: On tree or branches in hill evergreen forest, alt. 800- 1,000 m.
Flowering: April-May.

Distribution: Endemic to Thailand.

Specimens examined: NORTHERN: Mae Hong Son, Ban Den, Wat Chan, elevation 1,298 m., 29.04.2014, *M. Norseangsri* 10950 (QBG!), Ban Huai Phu Loei, elevation 1,063 m., 29.04.2014, *M. Norseangsri* 10989 (QBG!), Doi Pui, Huai Hi, elevation 1,544 m., 16.12.2016, *S. Watthana* 2605 (QBG!), Pang Uung, 19.02.2021, *T.Chanokkhun* 326 (QBG!), Pang Tong, 19.02.2021, *T. Chanokkhun* 313 (QBG!), Pang Mapha, *T.Chanokkhun* 477 (QBG!), Chiang Mai, Doi Maonlan, Phrao District, *T.Chanokkhun* 496 (QBG!).

Conservation status in Thailand: Vulnerable B1ac(iii,iv). This species has a narrow distribution, found only Northern Thailand with 8,698 Km² and found only 7 populations. Each population usually has a low number of mature plants (Figure 4.17).

Notes: This species is easily recognized by having tubular- conical pouch labellum.

6. *Chiloschista usenoides* (D.Don) Lindl., Edwards's Bot. Reg. 18: t. 1522. 1832; Wall. Cat. no. 7330. 1832, nom. nud.; Bot. Reg. 18: sub T.1522, 1832; 219. 1833; Sert. Orch. Frontesp.: 1840, Figure 4. – Gard. Chron.: 135. 1846; Lindley., J. Linn. Soc. 3: 43, 1859; Diels & Mansfeld., Dahl. no. 106. 11: 496. 1932; Holttum., Kew. Bull. 14: 273. 1960; Ghose., Orch. Rev. 78: 296. 1970; Hara et al., An enumeration of the flowering plants of Nepal.: 35. 1978; Banerji & Thapa., J. Bomb. Nat. Hist. Soc. 70, 1: 28. 1973; Pradhan., Guide to identification and culture 2: 505, 1979; Seidenf. & Arora., Nord. J. Bot. 2: 11, 1982; Banerji & Pradhan., The orchids of Nepal Himalaya.: 484. 1984; Deva & Naithani., The orchid flora of North West Himalaya.: 365. 1986, Figure 208. — *Epidendrum suneoides* D.Fon in Prodr. Fl. Nepal.: 37. 1825.—*Sarcochilus usneoides* (D.Don) Rchb.f. in W.G.Walpers, Ann. Bot. Syst. 6: 497. 1863.—*Thixspermum usneoides* (D.Don) Rchb.f. in Xenia Orchid. 2; 120. 1867. Type specimen: *Wallich* 7330 (neotype-K! selected by Seidenfaden 1988) (Figure 4.18-4.19).

Epiphytic herb; stem very short, erect, simple. *Roots* many, silvery-green flattened, 1.5–2 mm wide, addressed to the host tree bark. *Inflorescence* axillary, pendulous raceme 13–30 cm long, arising near the stem apex; scape and rachis dull pale green, densely tomentose; scape 2.3–8 cm long, terete, with 3–4 distant triangular whitish scarious sterile bracts 2–2.5 mm long, 1–1.5 mm wide; rachis rather straight, with 7–8 lax, spirally arranged flowers. *Flowers* widely opening, 1–1.2 cm across; sepals and petals whitish cream, without any marking or tinct with pale purple at base; lip yellowish white or white; side lobes cream, its base with yellow base (inside); column whitish, column foot with dark purple variegated base; anther cap pale yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 4–4.5 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, 1.8–3 mm long, 1–2 mm. *Dorsal sepal* oblanceolate, 5–7 mm long, 3.5–4 mm, recurved, rounded apex; entire not ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Lateral sepals* oblanceolate or obovate, slightly oblique, 5–7 mm long, 3.5–4 mm wide, spreading, rounded at apex, entire not ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Petals* ovate almost rounded or lanceolate oblong, 6–6.2 mm long, 3.7–4.2 mm wide, rounded at apex, entire without ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Labellum* erect, 2.2–2.6 mm long, 2.3–2.5 mm wide, 4.5 mm high, movably attached to the column foot apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave to saccate with rounded and grooved tip, 2–3 mm long, 2.3–2.5 mm wide, with a longitudinal median keel covered by thick and short hairs about half of the keel; side lobes oblong, *ca.* 2 mm long, 2–3 mm, slightly recurved; mid-lobe very small, *ca.* 0.5 mm long, *ca.* 1 mm wide. *Column* 4.5–5 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, 1–1.7 mm long, 1–2 mm wide, at front with broadly triangular, obtuse, *ca.* 0.2 mm long, with thread like appendages 0.6–1.2 mm long on each side; pollinia 2, globular, *ca.* 0.5 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, *ca.* 1 mm long; viscidium attached distally, simple thin plate, quadrate, 0.5 mm long and wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai (เอื้องพญาไร่ใบ)

Ecology: On tree trunk or branches in hill evergreen forest, alt. 800-1,200 m.
Flowering: February-March.

Distribution: East Himalaya, Myanmar, Nepal, West Himalaya and Thailand.

Specimens examined: NORTHERN: Chiang Mai, Mae Taman, Chiang Dao, 21.25.2004, *Th. Wongprasert et al.* 045-15 (BKF), Sa Loung, Mae Rim, 01.04.2008, *A. Keratikorkol* 362 (QBG!), Mae Hong Son Province, Pang Oung, 19.04.2021, *T.Chanokkhun* 325 (QBG!); SOUTH-WESTERN: Phetchaburi, Kaeng Krachan National Park, Phanoen Thung, elevation 1,000 m., 29.03.2008, *S. Suddee et al.* 3727 (BKF!), Uthai Thani, Huay Kha Khaeng Wildlife Sanctuary, 09.04.2013, *P. Srisom* 21 (BKF!).

Conservation status in Thailand: Near Threatened. There are 6 populations from herbarium information, including the population from Doi Inthanon National Park (W. Phumsaringkharm facebook accessed on 13 March 2023). The EOO of this species in Thailand is 20,561 km², which does not match with threatened status but it has rather few populations (Figure 4.20).

Notes: Seidenfaden (1988) indicated that type specimen of *Epidendrum useneoides* G. Don may be disappeared, then he selected specimen of Wallich (Wall. 7330) as a neotype.

7. *Chiloschista viridiflava* Seidenf. , Opera Bot. 95: 175. Type specimen: *G. Seidenfaden* & *T. Smitinand* 9616 (holotype-C!) (Figure 4.21-4.22).

Epiphytic herb; stem very short, erect, simple. *Roots* many, silvery-green flattened, 1–2 mm wide, addressed to the host tree bark. *Inflorescence* axillary, pendulous raceme 5-11 cm long, arising near the stem apex; scape and rachis dull pale green or dull purple, densely tomentose; scape 0.5-5 cm long, terete, with 3–4 distant triangular whitish scarious sterile bracts 2-2.5 mm long, 1-1.5 mm wide; rachis rather straight, with 7–8 lax to dense, spirally arranged flowers. *Flowers* widely opening, 1-1.4 cm across; sepals and petals greenish white or yellowish green, without any marking sometime faint with brown tinct; lip white to cream; side lobes cream, its base

with pale yellow base (inside); column whitish, column foot with dark purple variegated base; anther cap pale yellow; pollinia dull yellowish; pedicel and ovary terete, dull olive-green, straight or slightly curved, 2.5-5 mm long, densely tomentose with short hairs; floral bracts whitish, scarious, triangular, acute, 1.5-3 mm long, 1.5-2 mm. *Dorsal sepal* broadly obovate to almost round, 5-7 mm long, 3.5-5 mm, recurved, rounded apex or subobtusate; entire without or ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Lateral sepals* obovate, 5.5-7 mm long, 4-4.5 mm wide, spreading, rounded to obtuse at apex, entire not ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Petals* obovate or ovate oblong, 5-6 mm long, 3-5 mm wide, rounded at apex, entire (without-)with sparsely ciliate margin, abaxially sparsely hairy, adaxially glabrous. *Labellum* erect, 1.5-2.5 mm long, 1.5-3 mm wide, 5-6.5 mm high, movably attached to the column foot apex, obscurely divided into a saccate hypochile and 3-lobbed epichile; hypochile concave to saccate with rounded tip, 2-3 mm long, 1.5-3 mm wide, with a longitudinal median keel covered by thick and short hairs along or almost of the keel; side lobes oblong, 3-3.5 mm long, 1.5-2 mm, erect or recurve, obtuse; mid-lobe very small, oblong, ca. 0.5 mm long, ca. 1 mm wide. *Column* 4-5 mm long including column foot; stigma concave, transversely lunate. *Anther cap* simple, helmet-shaped, 1.3-1.5 mm long, 1.4-1.5 mm wide, at front with broadly triangular, with thread like appendages 1.6-2.3 mm long on each side, obtuse, ca. 0.2 mm long; pollinia 2, globular, 0.4-0.5 mm in diameter, each almost completely split into 2 unequal hemispheric halves; stipe (tegula) in the form of simple, oblong-lanceolate, 1-1.5 mm long; viscidium attached distally, simple thin plate, quadrate, 0.5 mm long and wide. *Capsule* unknown.

Vernacular name: Ueang Phaya Raibai Dok Khiew (เอื้องพญาไร่ใบดอกเขี้ยว)

Ecology: On tree or branches in mixed deciduous forest and dry dipterocarp forest, alt. 250-800 m. Flowering: March-May.

Distribution: Nepal and Thailand.

Specimens examined: NORTHERN: Chiang Mai, Doi Saked, 10.04.1987, G. Seidenfaden & T. Smitinand 9616 (C!), *Ibid.*, G. Seidenfaden & T. Smitinand 9617-23 (C), Huai Bong, Tambon Ta Nuea, Mae on District, elevation 480 m., 30.05.2016,

W. La-onsri, P. Panyachan, T. Pingyat & S. Satata 4869 (QBG!), Mae Sa elephant camp, Mae Rim, elevation 580 m., 01.06.2016, *W. La-onsri, P. Panyachan, T. Pingyat & S. Satata* 4875 (QBG!), Suan Pha Luang Sankham Pang, Tambon Ta Nuea, Mae on District, elevation 480 m., 30.05.2016, *W. La-onsri, P. Panyachan, T. Pingyat & S. Satata* 4868 (QBG!), *Ibid.*, *T. Chanokkhun* 469 (QBG!), Mae Rim, Doi Sutep-Pui National Park, 03.05.1989, *J. F. Maxwell* 89-550 (BKF!), Phitsanulok, Plant brought from Khwae Noi, Flower at Rom Klao Garden, 31.03.2005, *S. Watthana* 1833 (BKF!); NORTH-EASTERN: Loei, Phu Kradueng National Park, elevation 316 m., *K. Duangdee s.n.* (BKF!), *Ibid.*, *K. Duangdee* 82 (BKF!); *Ibid.*, elevation 300 m., 14.06.1992, *C. Niyomdham* 2954 (BKF!); SOUTH-WESTERN: Phetchaburi, Kaeng Krachan National Park, Ban Krang Camp, elevation 403 m., 22.01.2011, *N. Toolmal, Ch. Chunmngoen & W. Somprasong* 73 (BKF!); Pong Phrom, 16.04.2008, *S. Ruksue* 81 (BKF!).

Conservation status in Thailand: Least Concern. This species is found many populations, more than 20. (Each population usually found many individuals (Figure 4.23).

Notes: This species can be recognized by having pure green sepals and petals but sometime with weak brown tinct at base of sepals and petals.

4.1.3 Discussion on taxonomic revision and conservation status

Based on morphological characteristic of the genus *Chiloschista* in Thailand, *Chiloschista exuperei*, *C. extincitoriformis* and *C. rodiguezii* have their unique characteristics and well separate from other species (see notes of each species). The group which has short saccate and round tip labellum is so difficult to separate into distinct species i.e., *C. lunifera*, *C. parishii*, *C. usneoides* and *C. viridiflava*. Only the color pattern can be used for taxonomic character. The shape and hairiness on margin of sepals and petals, presenting thread appendage of operculum, callus shape and hairiness on callus and mid-lobe shape which were proposed from previous authors are variable characters. Thus, the identification key to species which I provided forced

me to use the color pattern only in some group. It should be noted that with little taxonomic characters may led to classify Thai *Chiloschista* into varieties level. However, the phylogenetic analysis result (see below) based on ITS showed that each species proposed by Seidenfaden (1988) is well separated. I do strongly recommend that it needs more genes and samples which related the floral morphology for phylogenetic analysis.

For the conservation status of Thai *Chiloschista*, I followed the IUCN Standards and Petitions Committee's 2019 version of the Guidelines for Applying the IUCN Red List Categories and Criteria, Version 14, to evaluate the national level of each species. Previous reports by Chamchumroon, V., Suphuntee, N., Tetsana, N., Poopath, M. and Tanikkool, S. (2017) indicated that *C. extinctoriformis*, *C. ramifera* and *C. viridiflava* were endangered species (EN) but not indicated the criteria reason (Table 2.1). The authors seem to use the number of the occurrent population to evaluate the conservation status. From my evaluation based on the area of their distribution and population qualities, I found that *C. extinctoriformis*, *C. exuperei* and *C. rodriguezii* are vulnerable (VU) and indicated the criteria reason.

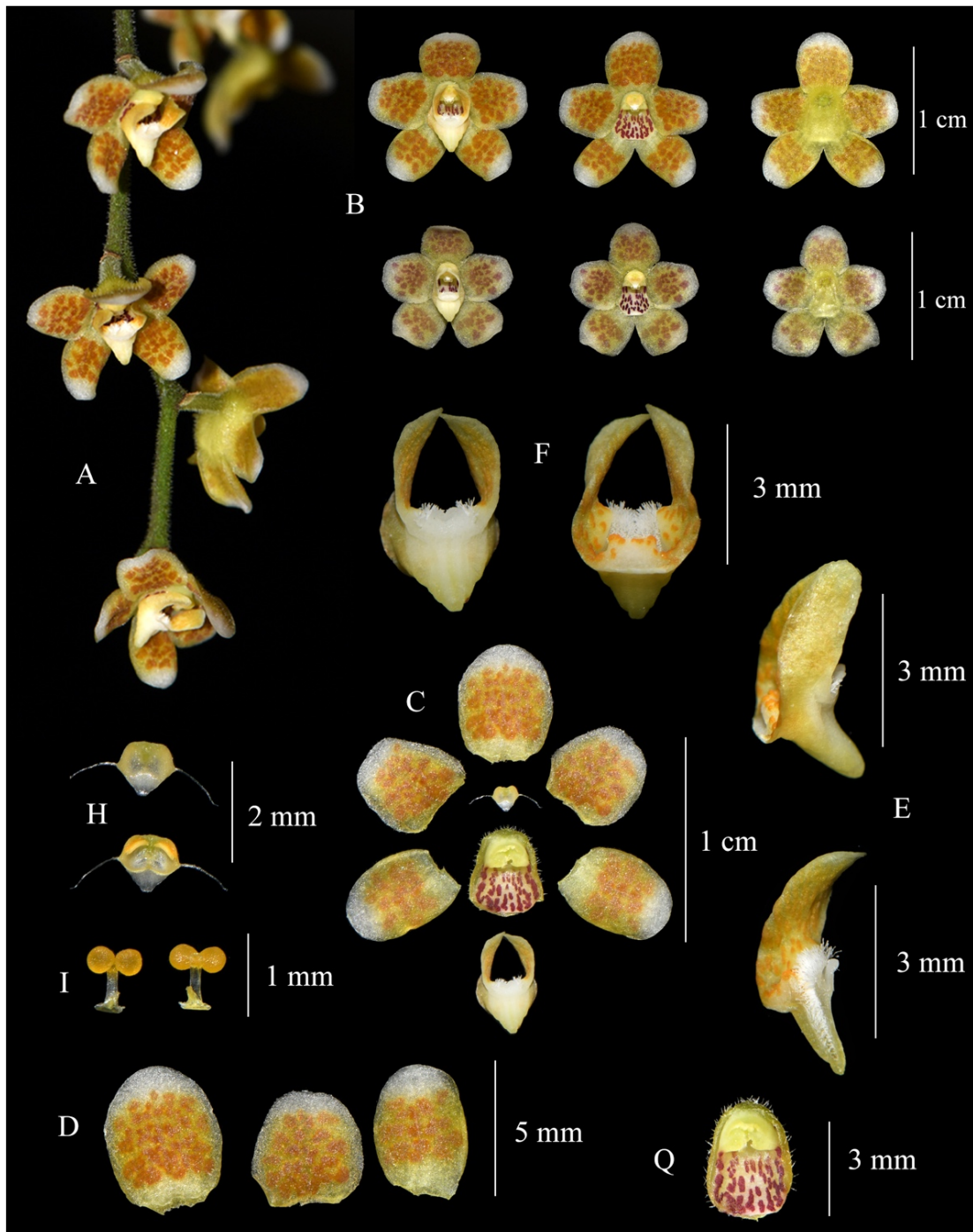


Figure 4.3 *Chiloschista extinctoriformis* Seidenf.: A. inflorescence, B. flowers showing with and without the labellum and front and back sides, C. dissected part of a flower, D. dorsal sepal, petal and lateral sepal from left to right, E. labellum side view and longitudinal half cut showing inside, F. column (Pictured by T.Chanokkhun).

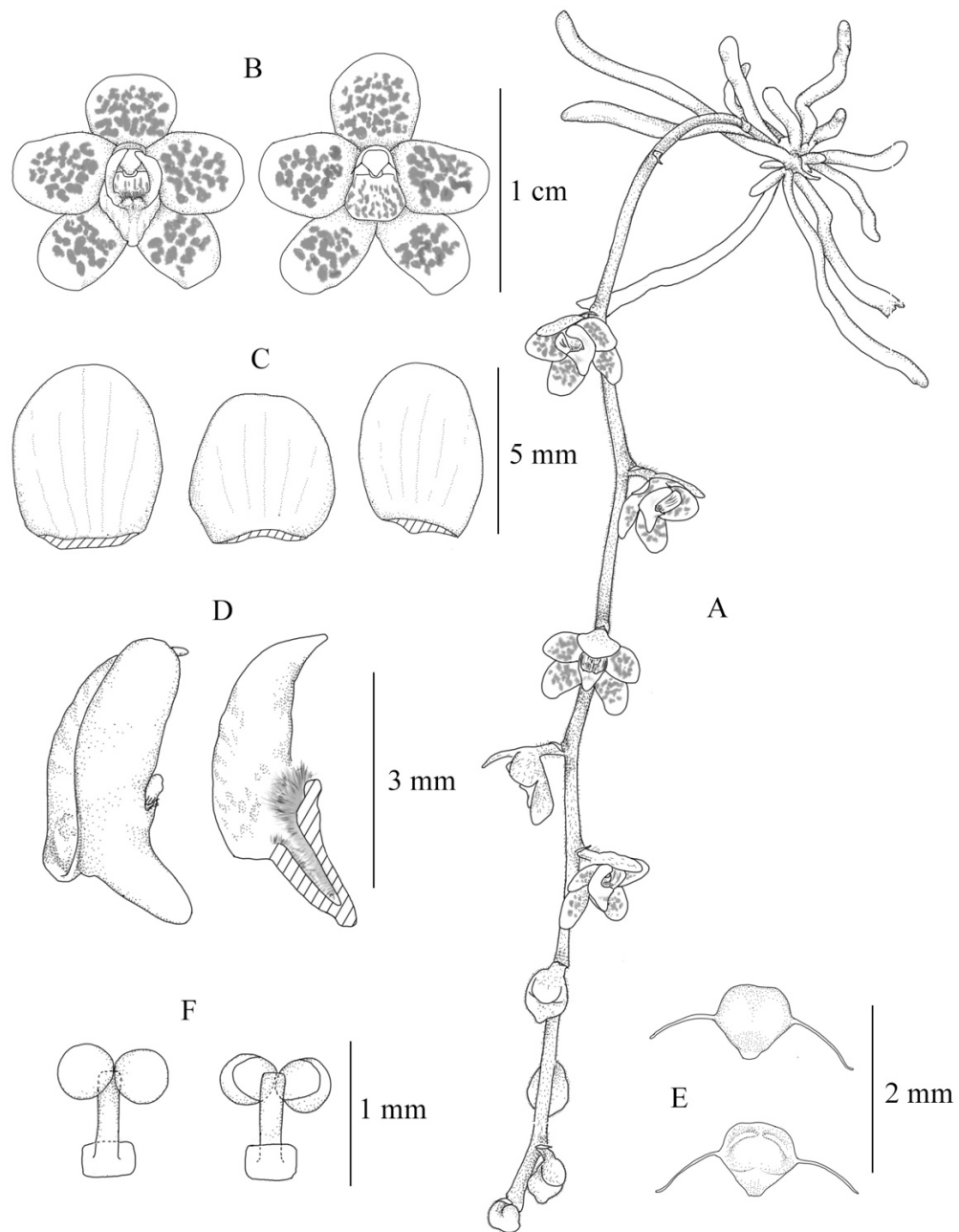


Figure 4.4 *Chiloschista extincitoriformis* Seidenf.: A. habit, B. flowers, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum side view, E. operculum, F. pollinaria (Drawn by T.Chanokkhun).



Figure 4.5 Distribution map of *Chiloschista extincitoriformis* Seidenf. with available location (The map was received from google map).

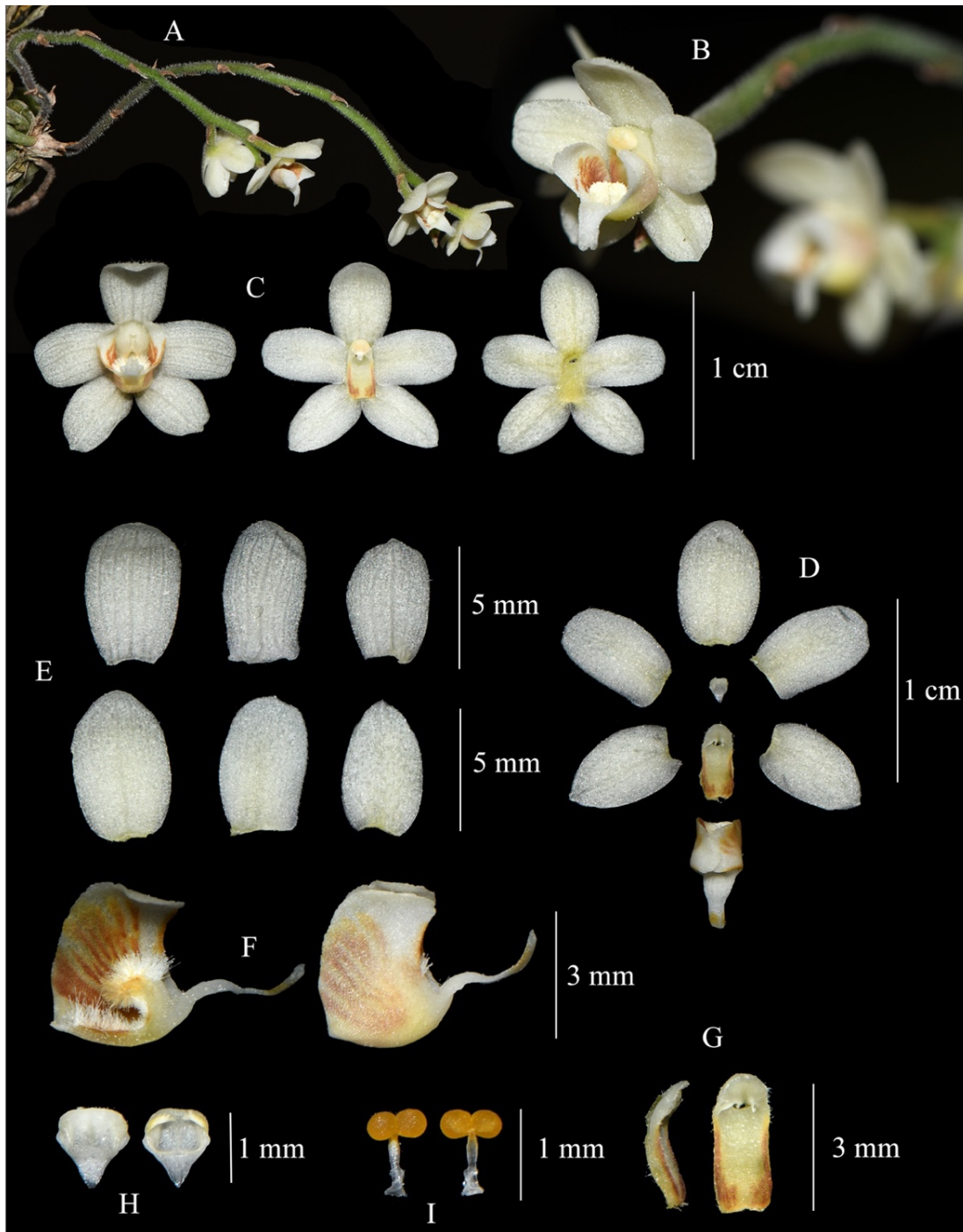


Figure 4.6 *Chiloschista exuperei* (Guillaumin) Garey: A. habit, B. closed up inflorescence, C. flowers, with and without labellum and front and back views, D. dissected flower parts, E. dorsal sepal, petal and lateral sepal, from 2 flower, F. labellum side view, with longitudinal half cut showing inside, G. column, H. operculum, I. pollinaria (Pictured by T.Chanokkhun).

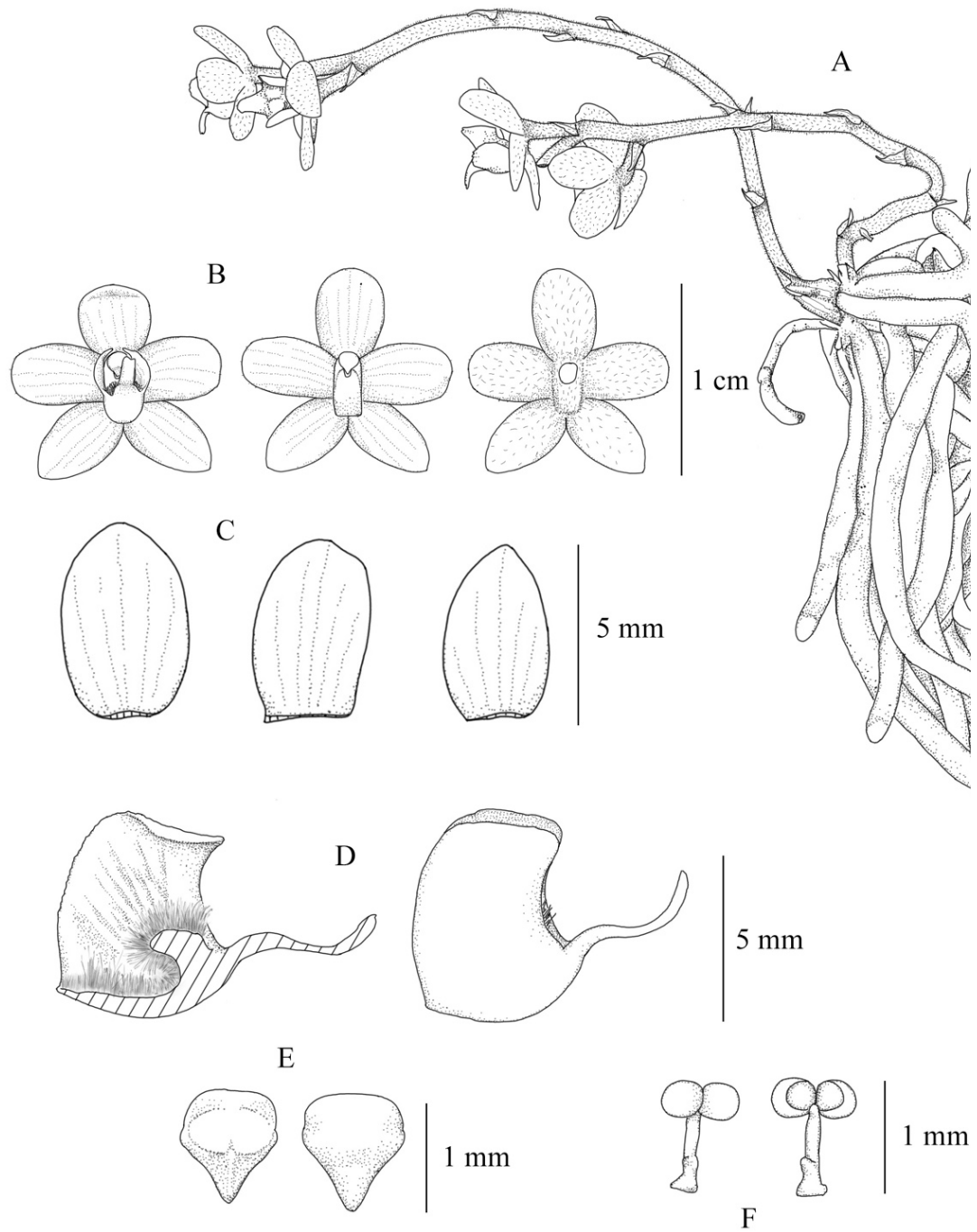


Figure 4.7 *Chiloschista exuperei* (Guillaumin) Garey: A. habit, B. flowers, with and without labellum and front and back views, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum side view, E. operculum, F. pollinaria (Drawn by T.Chanokkhun).



Figure 4.8 Distribution map of *Chiloschista exuperei* (Guillaumin) Garey with available location (The map was received from google map).

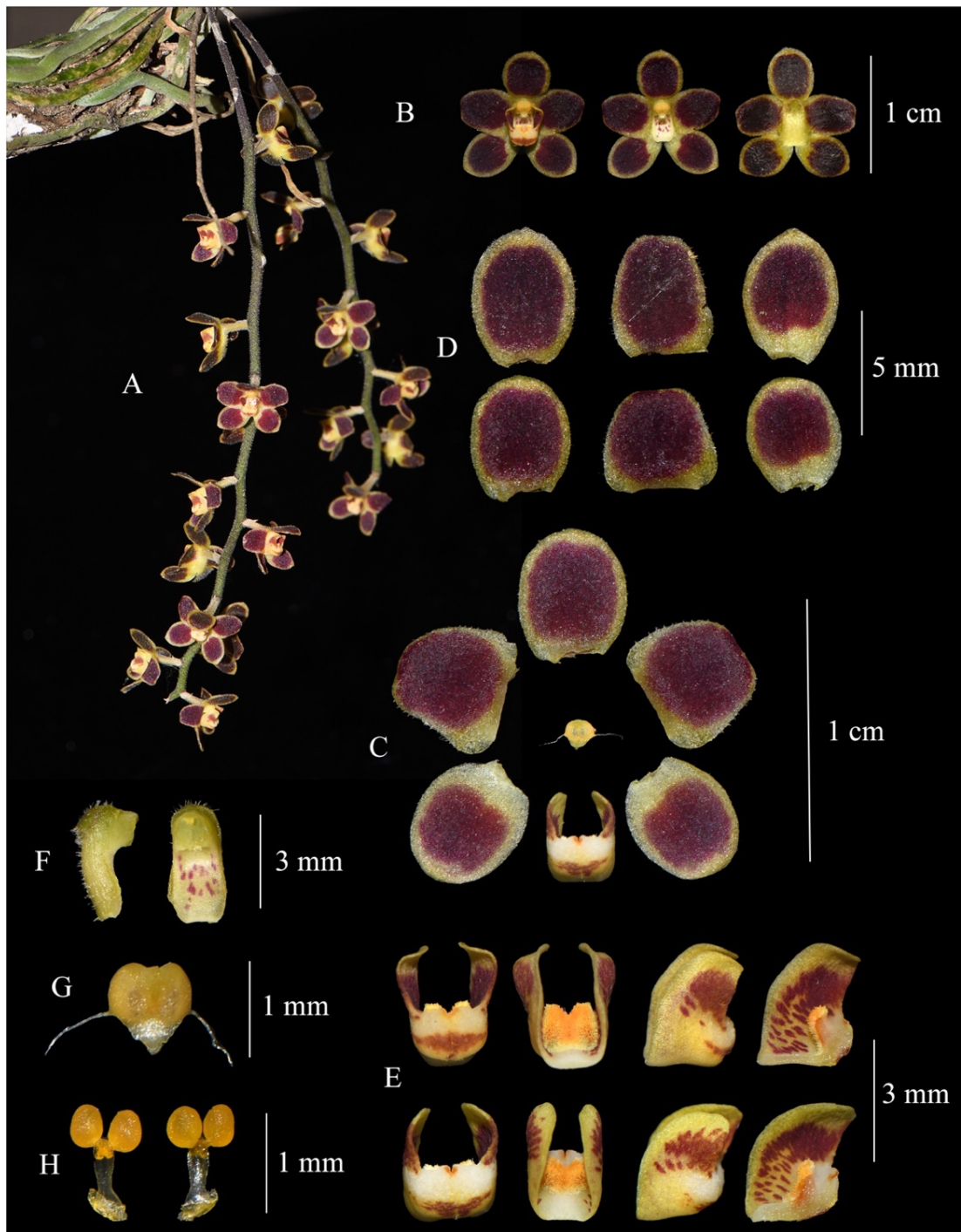


Figure 4.9 *Chiloschista lunifera* (Rchb.f.) J.J.Sm.: A. habit, B. flowers, with and without labellum and front and back views, C. dissected flower parts, D. dorsal sepal, petal and lateral sepal (from left to right), from 2 flower, E. labellum from two flowers, showing front and back view and side view, with longitudinal half cut showing inside, F. column, G. operculum, H. pollinaria (Pictured by T.Chanokkhun).

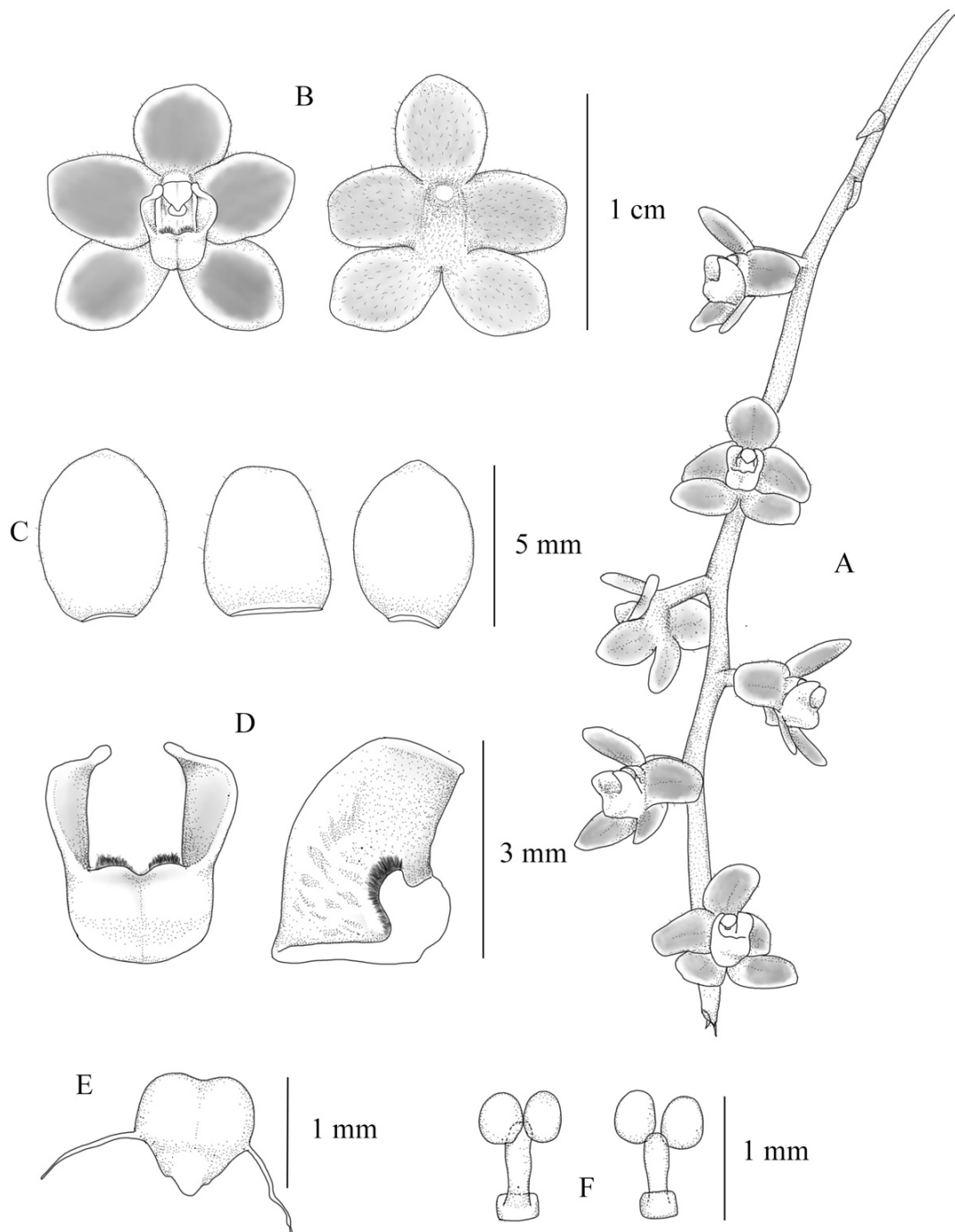


Figure 4.10 *Chiloschista lunifera* (Rchb.f.) J.J.Sm.: A. habit, B. flowers, front and back view, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum, front and side view, with longitudinal half cut showing inside, E. operculum, F. pollinaria (Drawn by T.Chanokkhun).



Figure 4.11 Distribution map of *Chiloschista lunifera* (Rchb.f.) J.J.Sm. with available location (The map was received from google map).

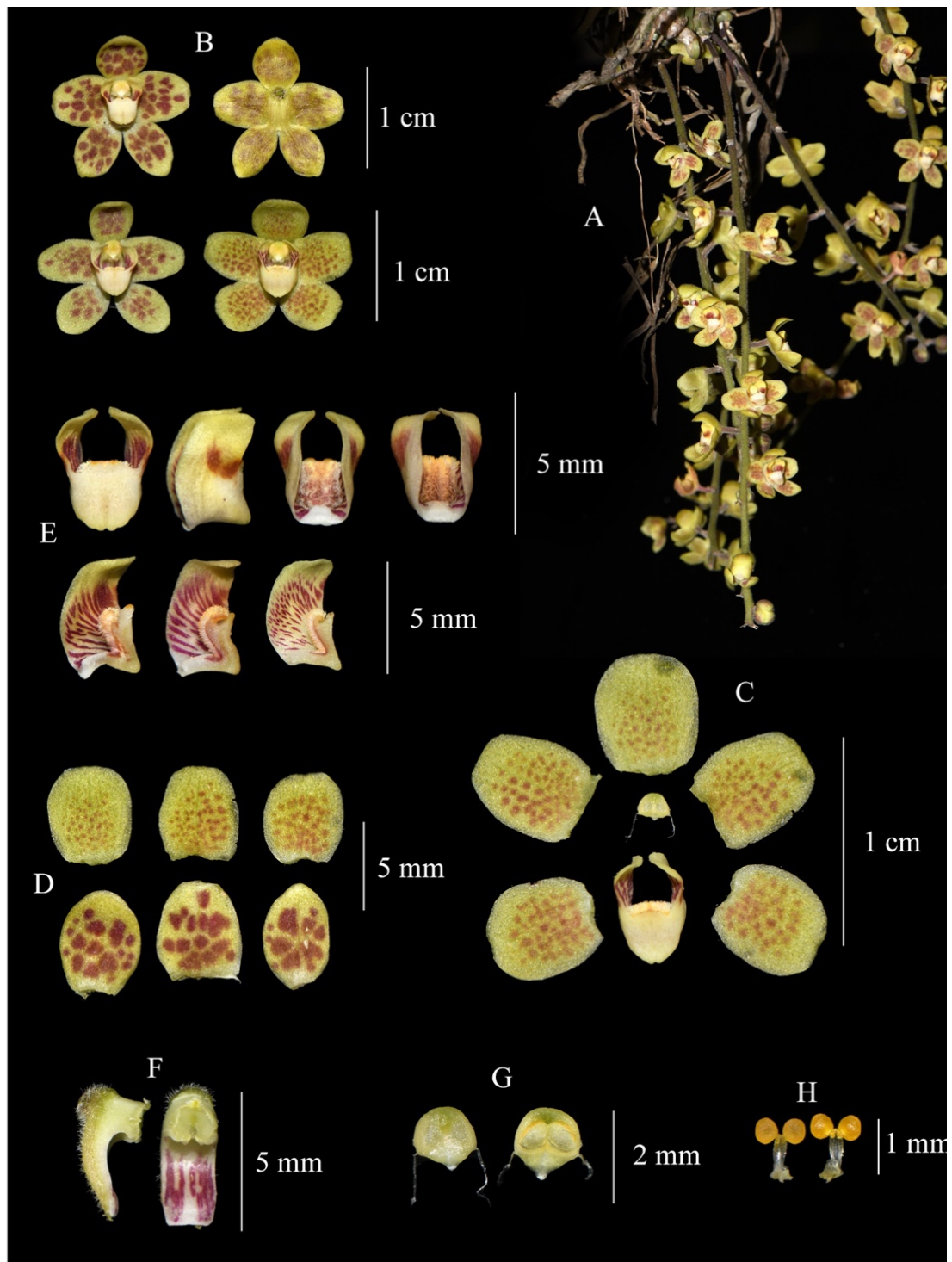


Figure 4.12 *Chiloschista parishii* Seidenf.: A. habit, B. flowers, front and back view, C. dissected flower parts, D. dorsal sepal, petal and lateral sepal, from 2 flower, E. labellum from two flowers, showing front and back view and side view, with longitudinal half cut showing inside, F. column, G. operculum, H. pollinaria (Pictured by T.Chanokkhun).

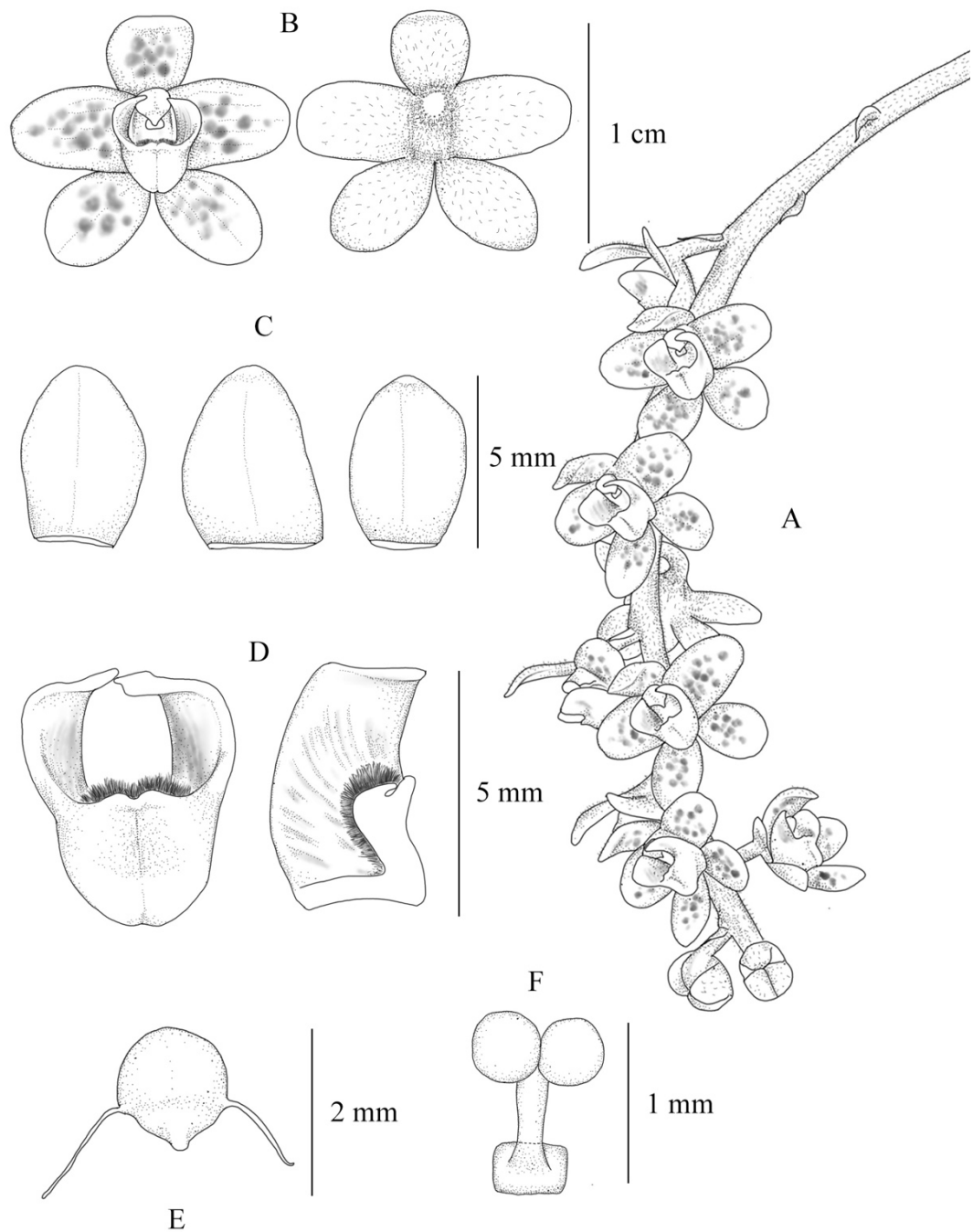


Figure 4.13 *Chiloschista parishii* Seidenf.: A. habit, B. flowers, front and back view, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum, front and side view, with longitudinal half cut showing inside, E. operculum, F. pollinaria (Drawn by T.Chanokkhun).

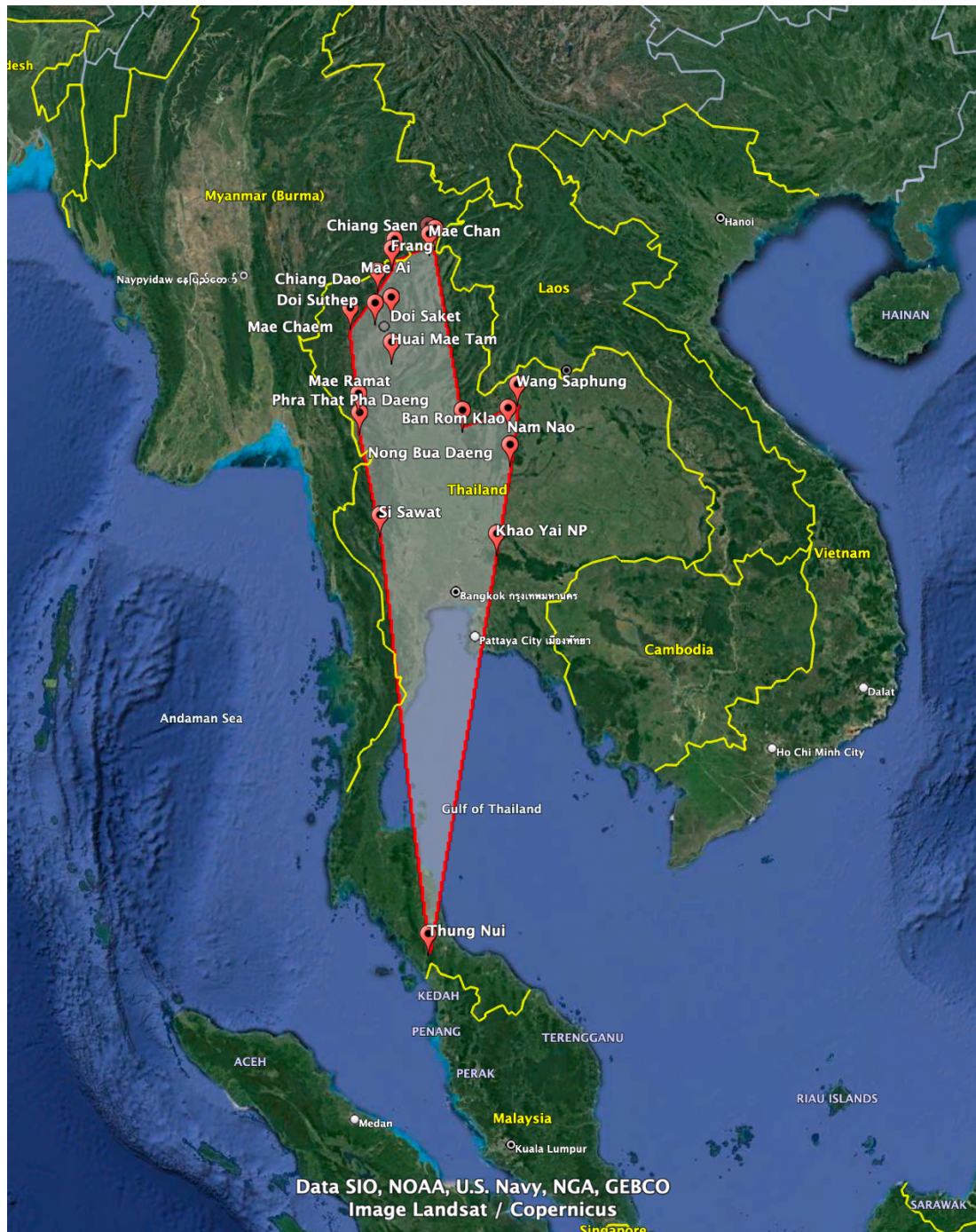


Figure 4.14 Distribution map of *Chiloschista parishii* Seidenf. with available location (The map was received from google map).

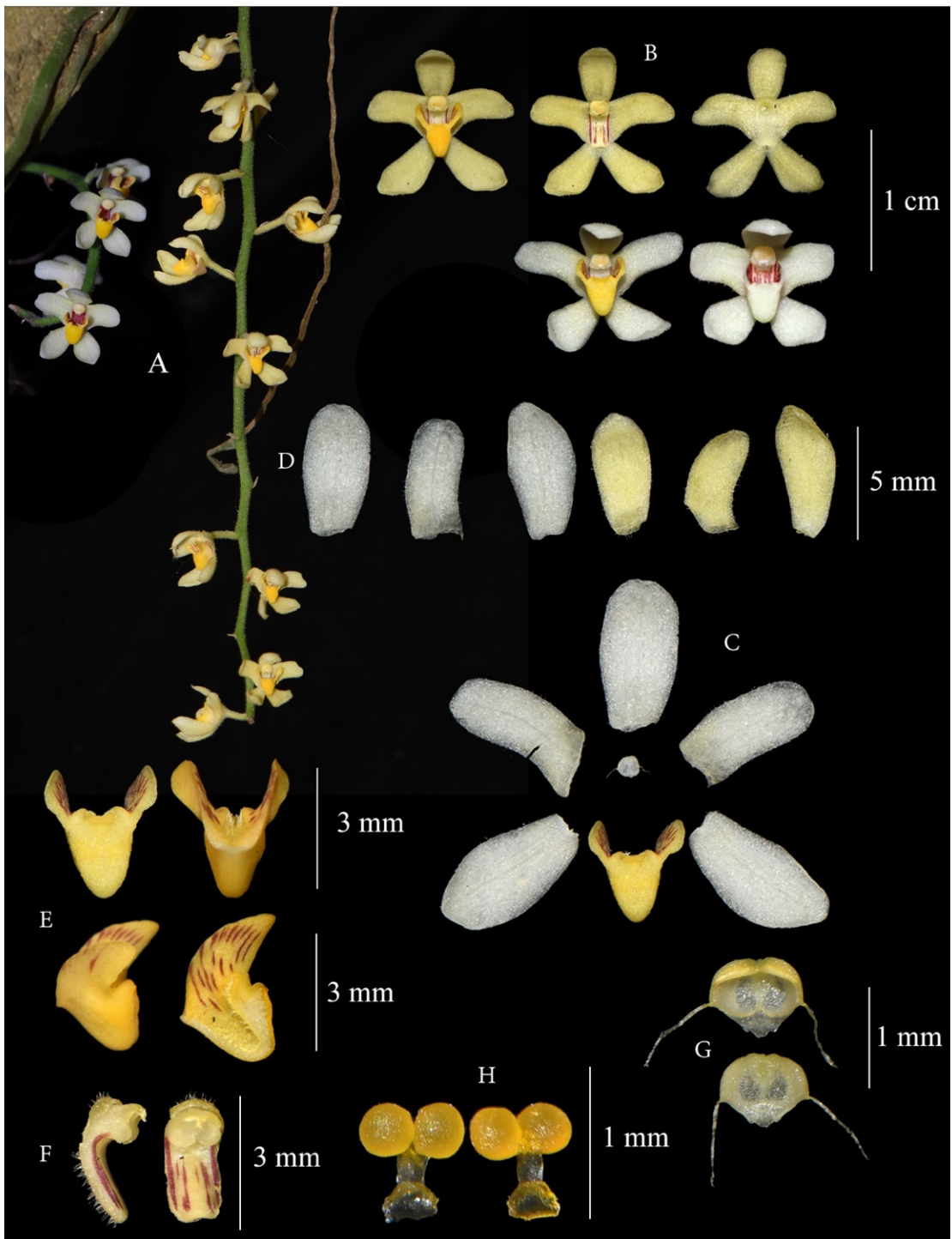


Figure 4.15 *Chiloschista rodriguezii* Casvestro & Ormerod: A. habit, B. flowers, with and without labellum and front and back views, C. dissected flower parts, D. dorsal sepal, petal and lateral sepal, from 2 flower, E. labellum, showing front and back view and side view, with longitudinal half cut showing inside, F. column, G. operculum, H. pollinaria (Pictured by T.Chanokkhun).

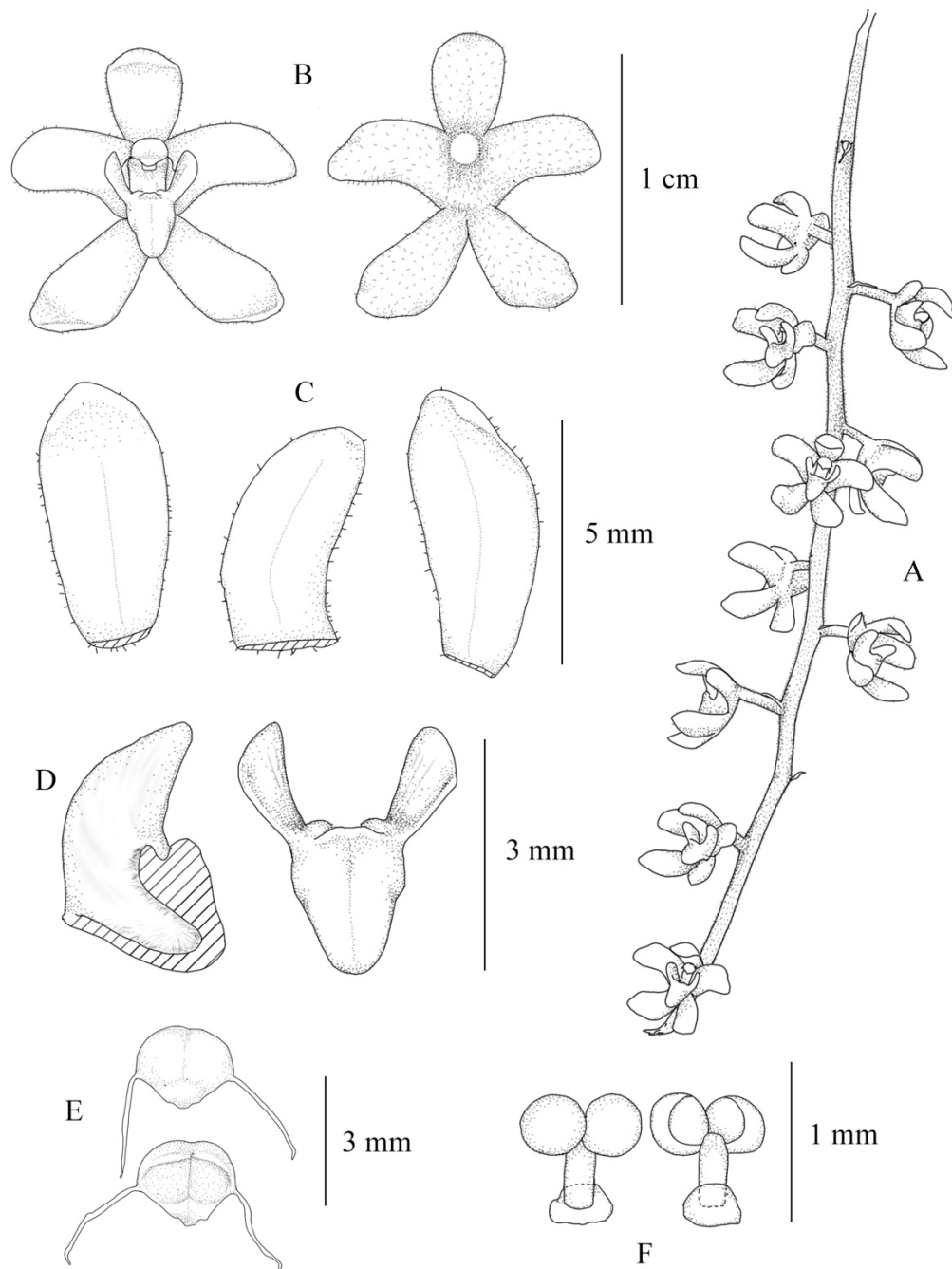


Figure 4.16 *Chiloschista rodriguezii* Casvestro & Ormerod: A. habit, B. flowers, front and back view, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum, front and side view, with longitudinal half cut showing inside, E. operculum, F. pollinaria (Drawn by T.Chanokkhun).



Figure 4.17 Distribution map of *Chiloschista rodiguezii* Casvestro & Ormerod with available location (The map was received from google map).

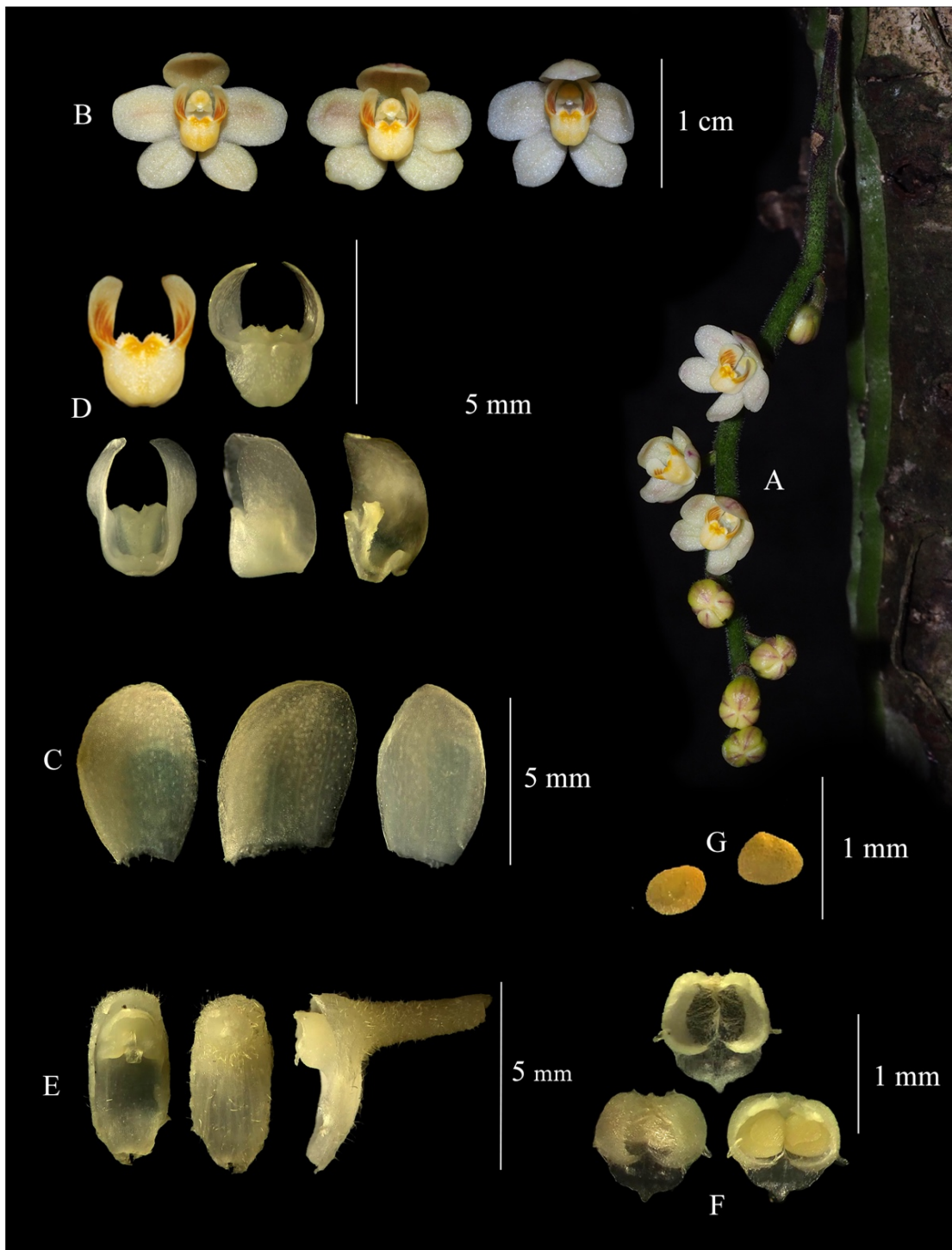


Figure 4.18 *Chiloschista usenoides* (D. Don) Lindl.: A. habit, B. flowers, from three flower, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum, showing front and back view and side view, with longitudinal half cut showing inside, E. column, F. operculum, G. pollen (Pictured by T.Chanokkhun).

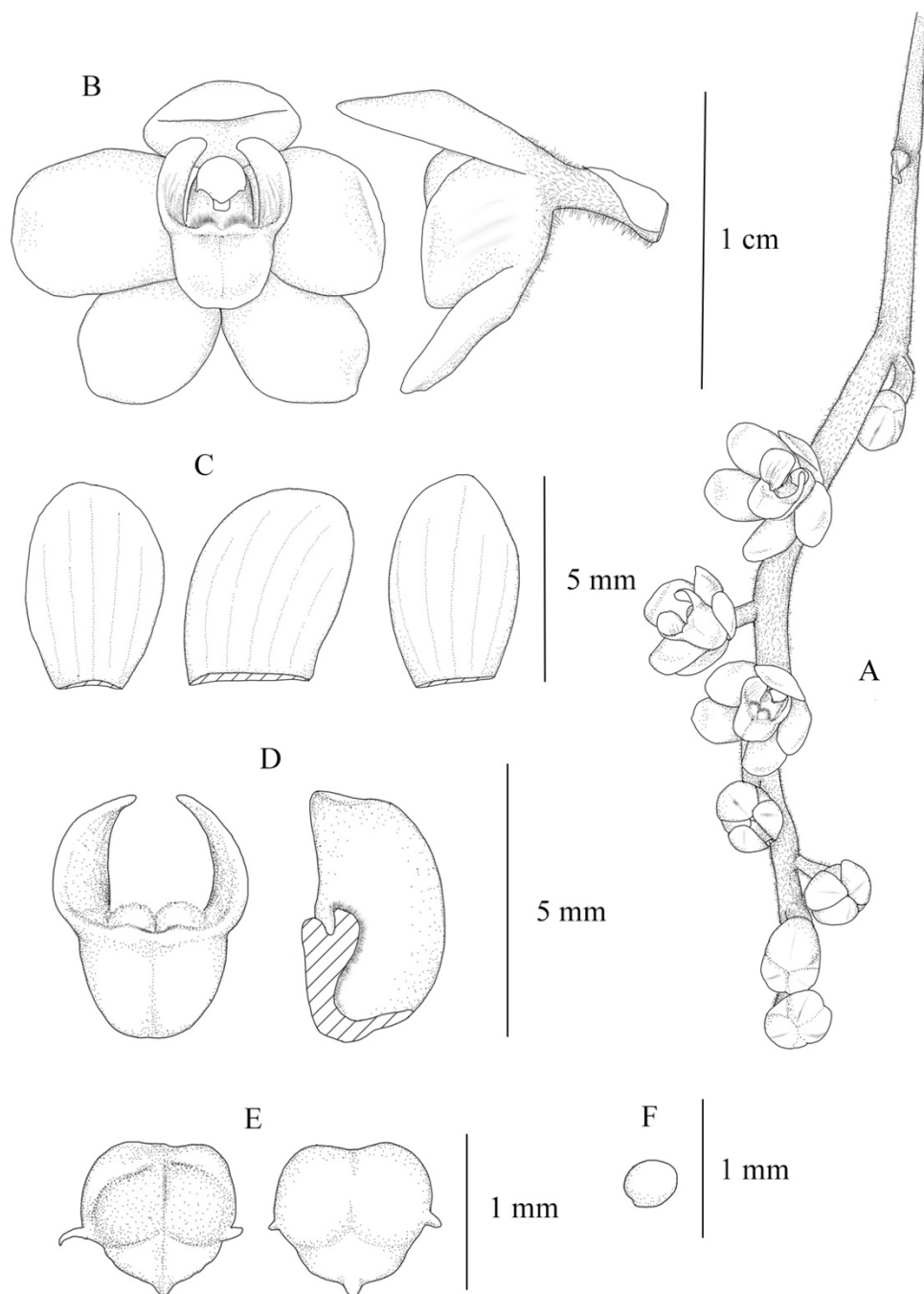


Figure 4.19 *Chiloschista usenoides* (D. Don) Lindl.: A. habit, B. flowers, front and side view, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum, front and side view, with longitudinal half cut showing inside, E. operculum, F. pollen (Drawn by T.Chanokkhun).

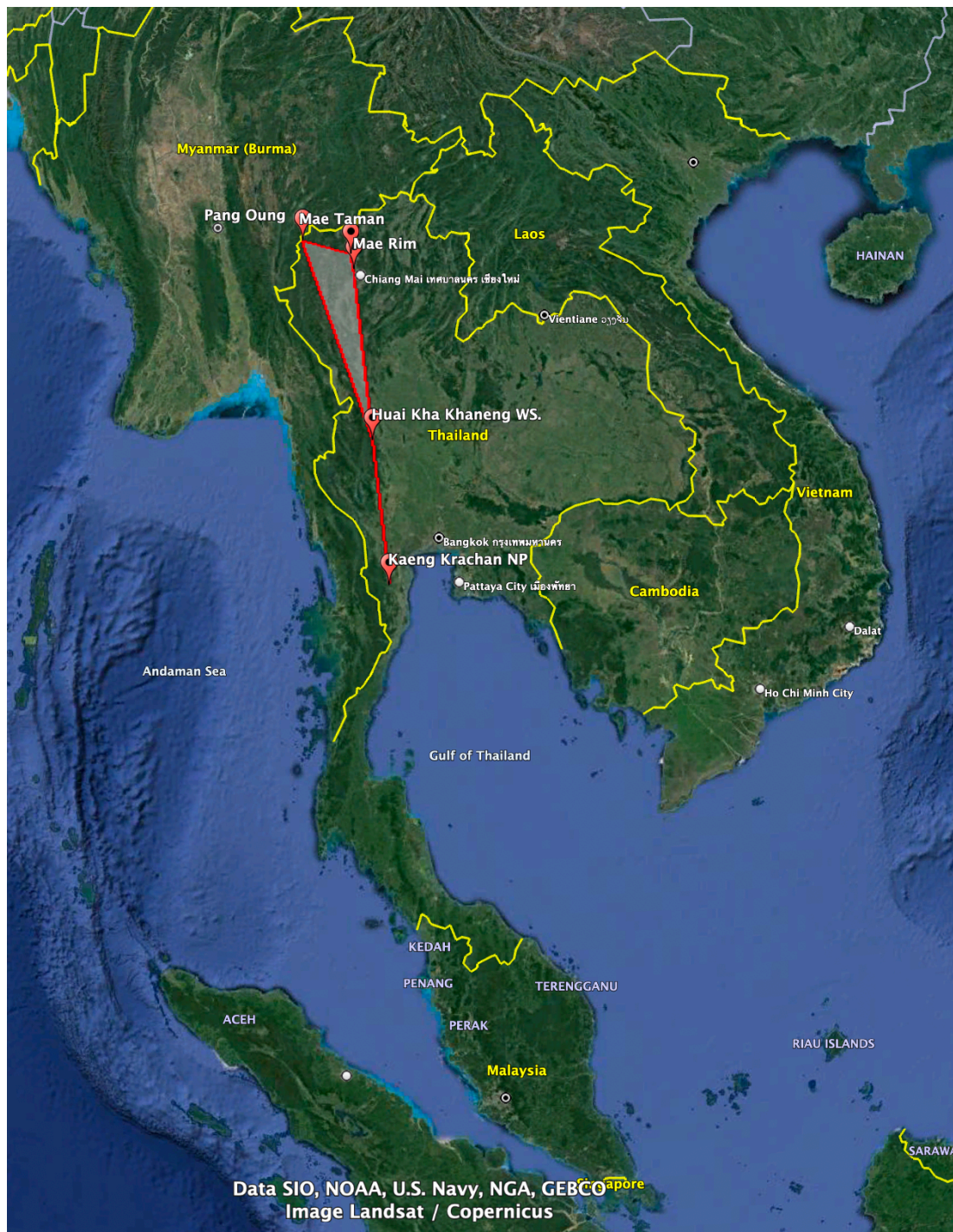


Figure 4.20 Distribution map of *Chiloschista usenoides* (D. Don) Lindl. with available location (The map was received from google map).

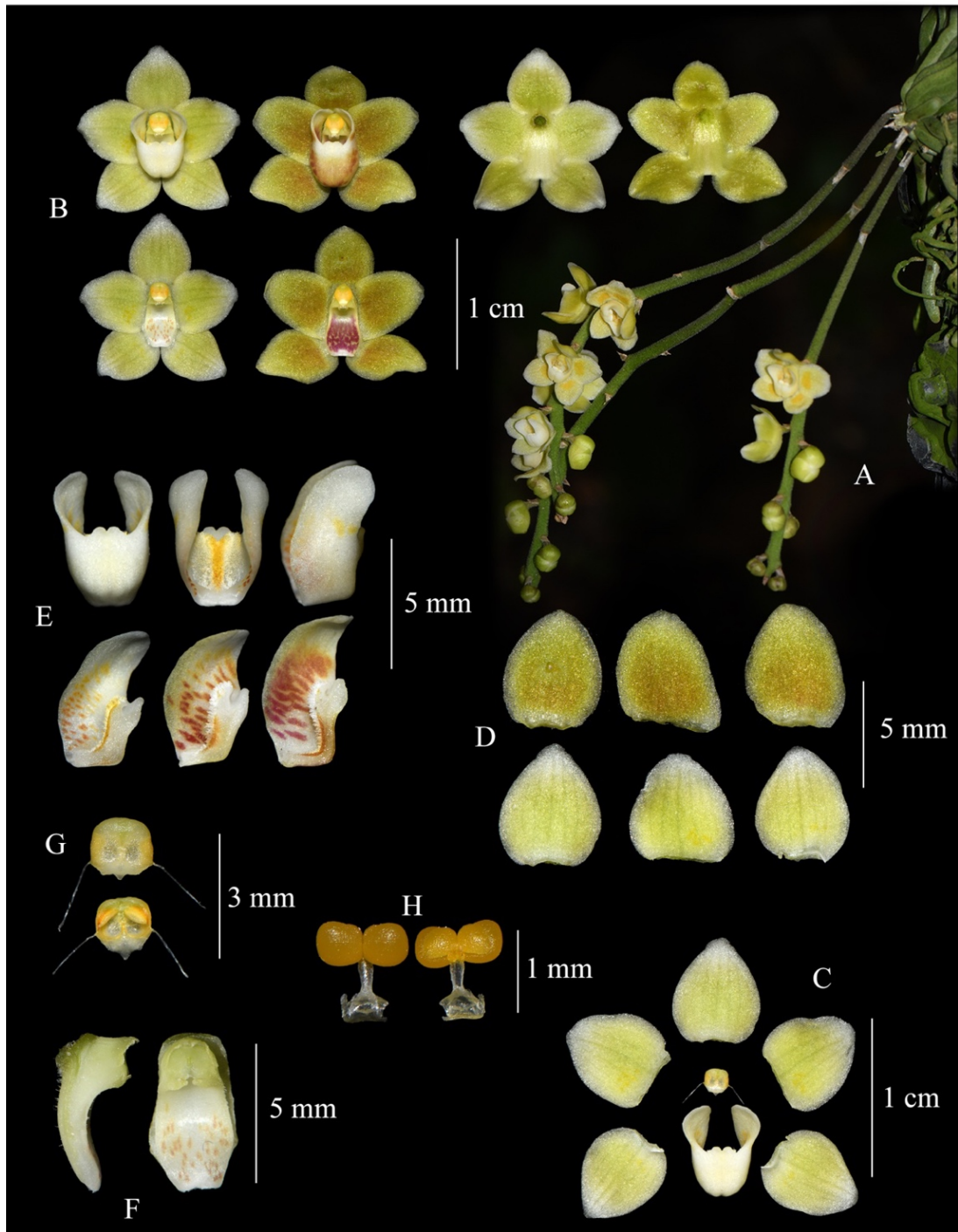


Figure 4.21 *Chiloschista viridiflava* Seidenf.: A. habit, B. flowers, with and without labellum and front and back views, C. dissected flower parts, D. dorsal sepal, petal and lateral sepal, from 2 flower, E. labellum from two flowers, showing front and back view and side view, with longitudinal half cut showing inside, F. column, G. operculum, H. pollinaria (Pictured by T.Chanokkhun).

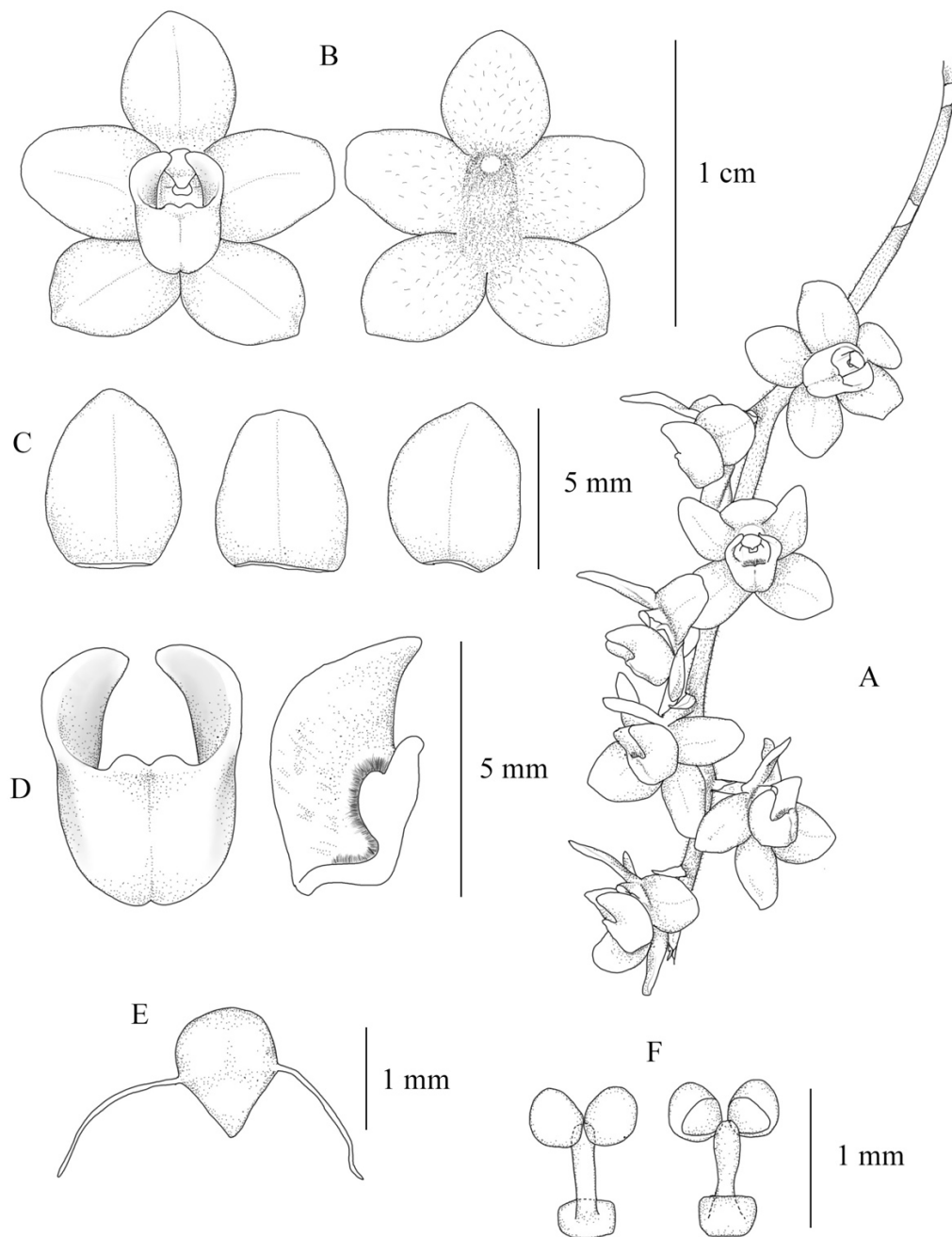


Figure 4.22 *Chiloschista viridiflava* Seidenf.: A. habit, B. flowers, front and back view, C. dorsal sepal, petal and lateral sepal (from left to right), D. labellum, front and side view, with longitudinal half cut showing inside, E. operculum, F. pollinaria (Drawn by T.Chanokkhun).

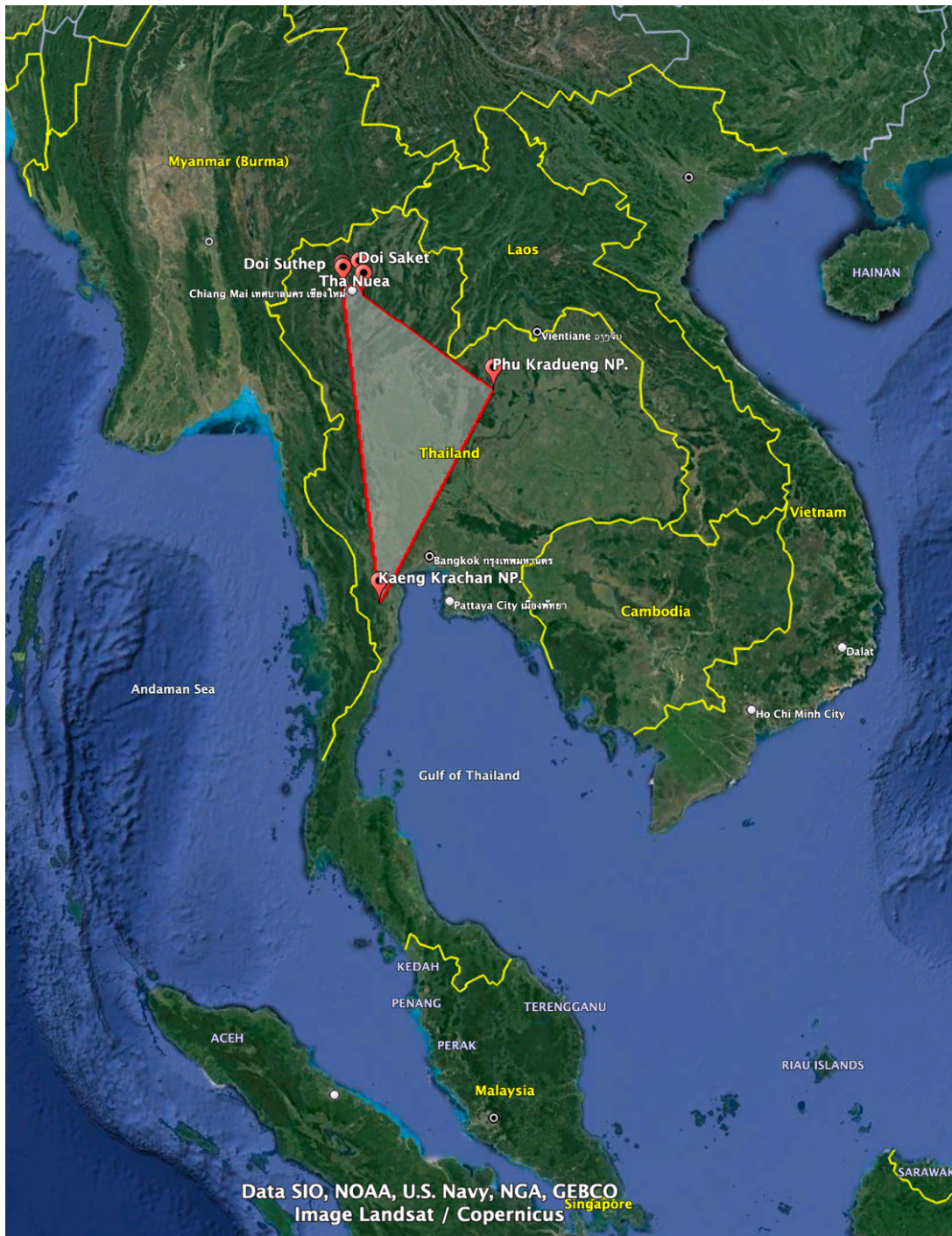


Figure 4.23 Distribution map of *Chiloschista viridiflava* Seidenf. with available location (The map was received from google map).

4.2 Phylogenetic analysis

In this study, I collected *C. extincitoriformis* (2 samples), *C. exuperei* (2 samples), *C. lunifera* (2 samples), *C. parishii* (3 samples), *C. rodriguezii* (1 sample), *C. usneoides* (2 samples), *C. viridiflava* (2 samples) and *Chiloschista* sp. (1 sample) for constructing the phylogenetic tree. The last unknown species, it was a vegetative specimen from Khao Yai Nation Park, aimed to use the phylogenetic analysis to test what it is. For *C. yunnanensis*, I employed the sequence from GeneBank. In this study, 2 endemic species, *C. extincitoriformis* and *C. rodriguezii* were extracted to new *matK* and ITS sequences based on specimens collected from Thailand and for example agarose gel electrophoresis for amplified *matK* and ITS gene test (Figure 4.24, 4.25). They could be used for further studies on systematics in the future, including species identification.

Before using all sequence of *Chiloschista* received from this study, I blasted to confirm that they belong to Orchidaceae with GenBank database sequences by using NCBI nucleotide BLAST (blastn) (<http://blast.ncbi.nlm.nih.gov>). As expect, the results confirmed that they are orchids. The aligned with Bioedit program and manual correction of *matK*, ITS, and combined *matK* and ITS matrices with gaps were 1,633, 1422 and 3,052 bases long, respectively. The number of parsimony-informative sites was performed by Paup program showed that *matK*, ITS and combined *matK* and ITS were 72, 153 and 225, respectively.

Based on *matK* sequences, the phylogenetic analysis revealed that there is high statistic support of 2 clades between ingroup and outgroup, congruent with previous study (Zou, L. H., Huang, J. X., Zhang, G. Q., Liu, Z. J., and Zhuang, X. Y., 2015). From this study, the genus *Choloschista* form a monophyletic group with strong bootstrap percentage (BP= 100) and Bayesian posterior probabilities (PP= 1), but the resolution infrageneric level is very poor (Figure 4.26). The samples of each species from different populations according to Seidenfaden's species circumscription (1988) showed that *C. exuperei*, *C. lunifera*, *C. parishii* and *C. viridiflava* form a monophyletic group. While *C. extincitoriformis* and *C. usneoides* are not form a monophyletic group based on *matK*, may cause of low informative site. For *C. yunnanensis* and *C. rodriguezii* which have only one sample included in this analysis are needed more sample to prove the monophyletic at the species level. The phylogenetic analysis based on *matK* evident

is often not showed the high resolution inside the genus. For example, the phylogenetic analysis based on *matK* on the genus *Pomatocalpa* (Watthana *et al.*, 2006).

Based on ITS, the result is rather congruent with of *matK* but it is quite better than of *matK*. *Chiloschista* spp. form a clade with high BP (100) and PP (1) which indicating a good genus (Figure 4.27). They are separated clade from the outgroup as same as of *matK* result. All species according to Seidenfaden's species circumscription (1988) which have more than one sample form a monophyletic group. One unknown species was a group of *C. useneoides* showing that ITS information is able to identify the species level which shall be useful for molecular identification of this genus.

The combined genes showed the result almost congruent with of ITS result. However, there is no distinctly subclade formation inside the *Chiloschista* clade, but specimen of each species forms a clade like of ITS, indicating a monophyletic group at the species level (Figure 4.28).

From a previous report, Topik, H., Peter, W., Tomohisa, Y., and Motomi, I. (2005) and Topik, H., Peter, W., Tomohisa, Y., Motomi, I., and Rod, R. (2012) analyzed the phylogenetic of subtribe Aeridinae. They employed only *Chiloschista viridiflava* representative on thier study. It was show that that *Chiloschista* was a sister group with *Ornithochilus fiffformis*. The last update on *Chiloschista* phylogenetic position involvement was reported by Zou, L. H., Huang, J. X., Zhang, G. Q., Liu, Z. J., and Zhuang, X. Y. (2015), showed that the *Chiloschista* clade is a sister group with the clade of *Phalaenopsis*, *Thrixspermum*, *Vanda*, *Aerides*, *Trichoglottis*, *Abdominea*, *Gastrochillus* and *Cleisostoma*. It should be noted that another genus of leafless orchid, *Taeniophyllum* which having a vegetative morphological characteristic like to *Chiloschista*, is in the different clade with *Chiloschista* clade as same as the previous studies (Zou, L. H., Huang, J. X., Zhang, G. Q., Liu, Z. J., and Zhuang, X. Y., 2015; Carlsward, B. S., Whitten, W. M., Williams, N. H., and Bytebier, B., 2006), indicating the leafless character evolved more than one time in the subtribe Aeridinae. Thus, the information of my study and other previous studies supports the monophyly of the genus *Chiloschista*. However, the genus-level relationship based on combined ITS and *matK* data revealed that Thai *Chiloschista* does not reveal any subgroups.

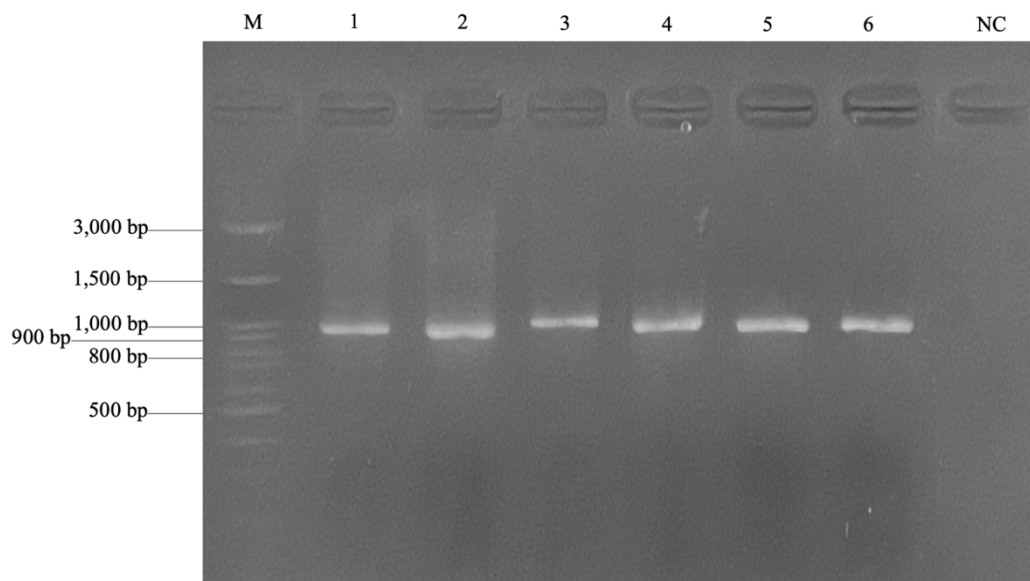


Figure 4.24 Example of agarose gel electrophoresis for amplified *matK* gene test. Bands were fractionated by 1.5 % TBE agarose gel (25 min., 100 V/cm); Lane: **M** = One Mark B DNA Ladder, **1** = *Vanda* sp.1, **2** = *Vanda* sp.1, **3** = *C. lunifera*, **4** = *C. extincitoriformis*, **5** = *C. exuperei*, **6** = *C. rodriguezii* and **NC** = Negative control.

Several species with comparable floral morphology, including *C. parishii*, *C. viridiflava*, and *C. usneoides*, share morphological traits such as the characteristic of the labellum. Although they only differ in color pattern, it can be hard to distinguish them from herbarium and spirit specimens. The phylogenetic tree produced by this analysis, however, revealed that each species belonged to a monophyletic group. In case of *C. parishii* has color marking on sepals and petals varied from small dots to rather large dots but the result from phylogenetic analysis they form in the same clade. The molecular region, which is based on the *matK* and ITS sections, is thus consistent with Seidenfaden species delimitation. (Seidenfaden, G., 1988). Nevertheless, more samples from more population should be added as well as more gene region to improve the phylogenetic tree of this genus.

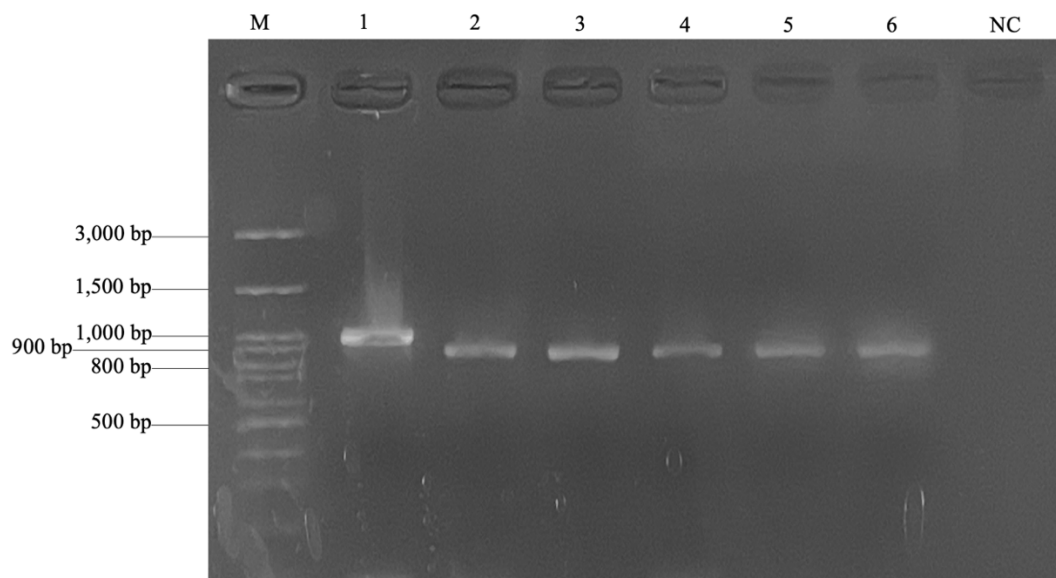


Figure 4.25 Example of agarose gel electrophoresis for amplified ITS gene test. Bands were fractionated by 1.5 % TBE agarose gel (25 min., 100 V/cm); Lane: **M** = One Mark B DNA Ladder, **1** = *Vanda* sp.1, **2** = *Vanda* sp.1, **3** = *C. lunifera*, **4** = *C. extinctoriformis*, **5** = *C. exuperei*, **6** = *C. rodriguezii* and **NC** = Negative control.

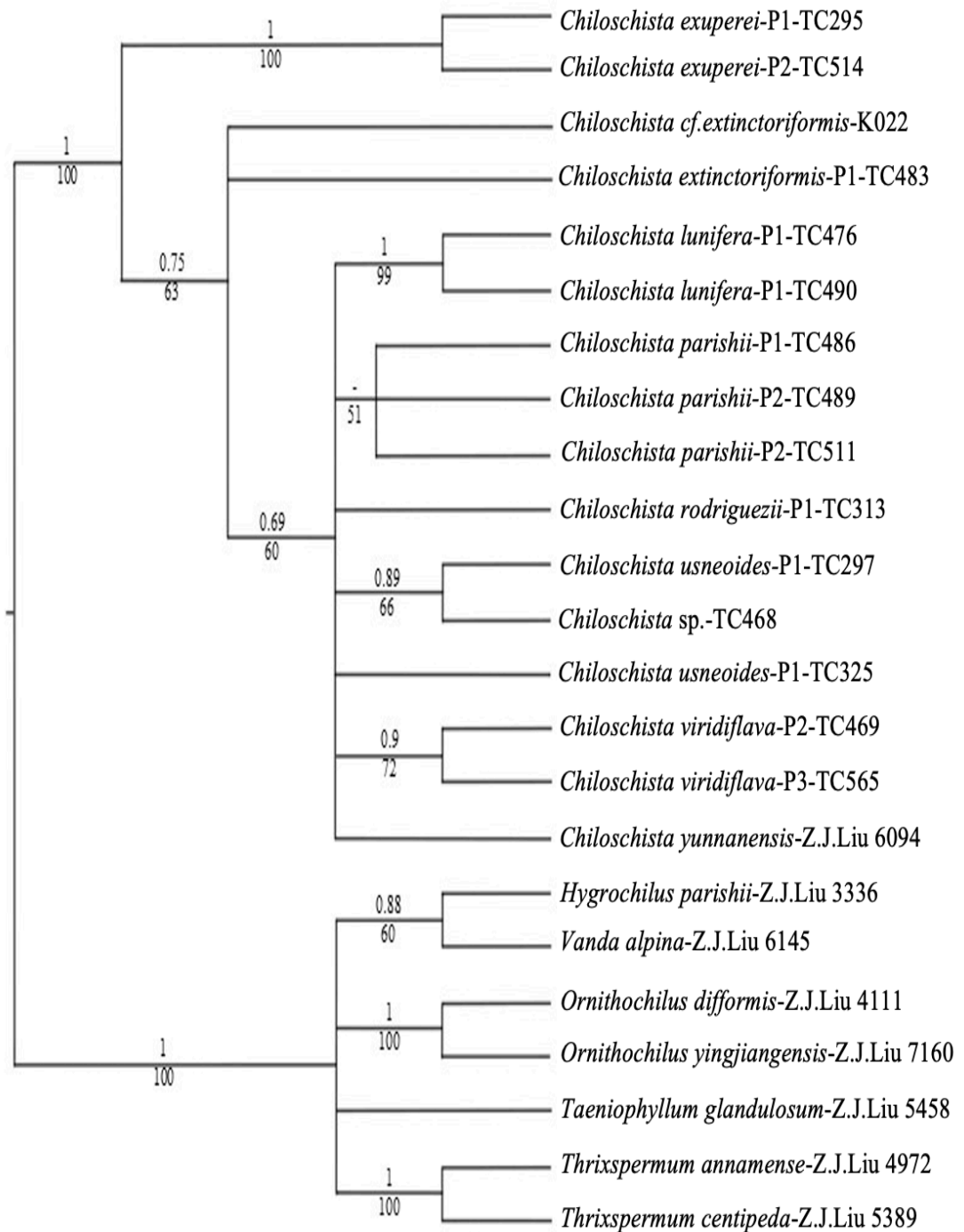


Figure 4.26 Phylogenetic tree based on *matK*, showing bootstrap percentage (BP) and Bayesian posterior probabilities (PP). The number indicated above the branch is the Bayesian posterior probabilities (PP) and the lower one is the bootstrap percentage (BP).

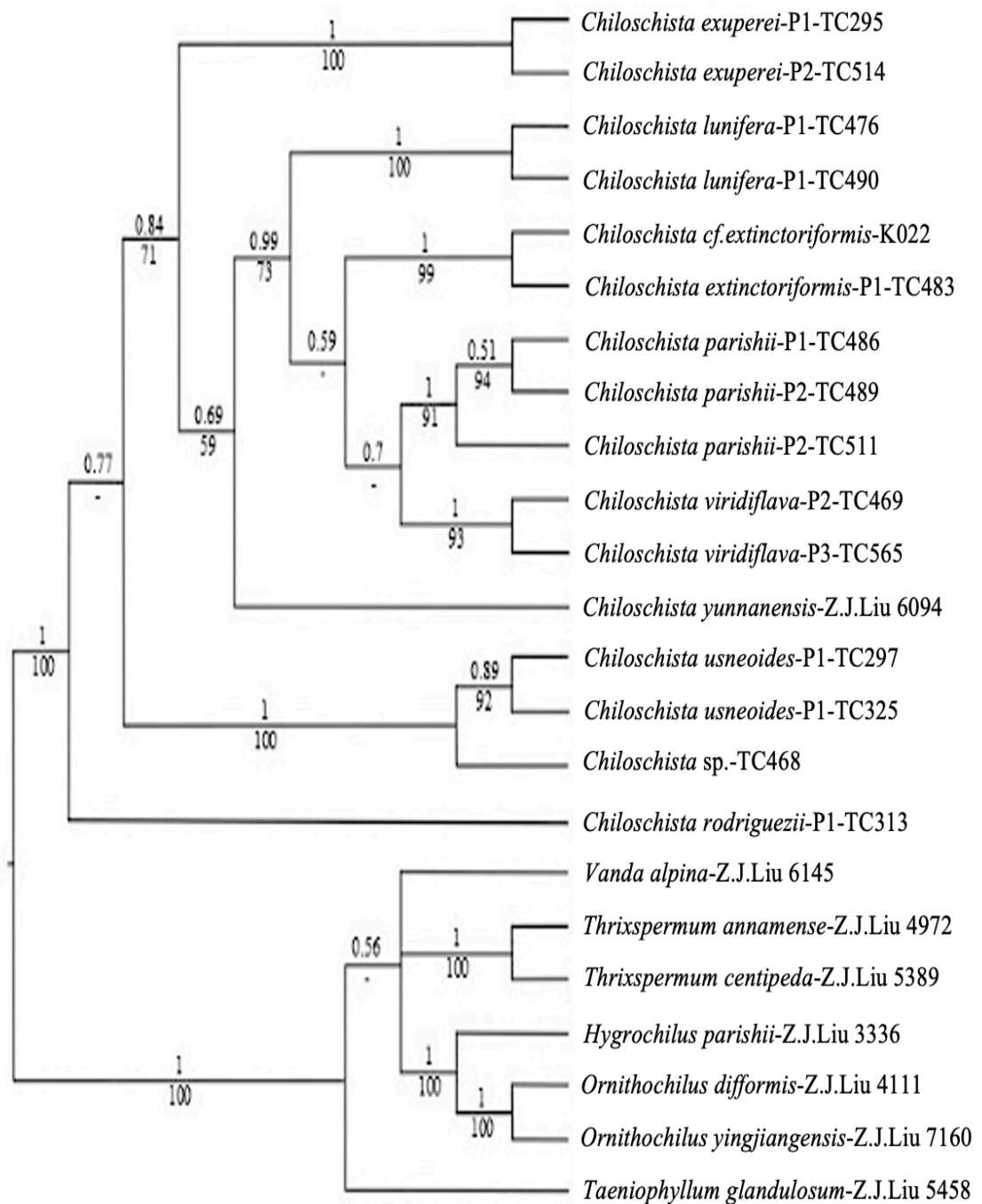


Figure 4.28 Phylogenetic tree of *Chiloschista* based on the combined nuclear (ITS) and plastid (*matK*) markers, showing bootstrap percentage (BP) and Bayesian posterior probabilities (PP). The number indicated above the branch is the Bayesian posterior probabilities (PP) and the lower one is the bootstrap percentage (BP).