


Flora *of* Pan-Himalaya

Volume 45(2)

Orobanchaceae (Pedicularis)

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Orobanchaceae (Pedicularis)

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Foreword

We are delighted to welcome the appearance of this highly significant regional flora and congratulate De-Yuan HONG and all of the others that worked together to make it possible. The Himalayas is one of the most beautiful, extensive, and revered ranges on earth, containing nine of our ten highest peaks, and its plants deserve the kind of inclusive and collaborative treatment that we have presented in these fine volumes.

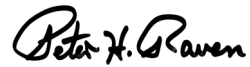
The mighty Himalayas were formed as the basaltic Indian plate plowed into the underbelly of Asia. Carrying the lighter rocks that would become the mountain ranges we see now, it broke out of the gigantic southern continent of Gondwanaland approximately 90 million years ago and started its journey northward to its current position. In the south, any part of India that rose above the ocean would have been covered with archaic southern vegetation similar to that which survives today in southern Australia and South America, New Zealand, and New Caledonia. As the fragment that includes India journeyed northward, it passed from the south across the equator and started crowding into the Asian plate perhaps 55–50 million years ago, continuing to thrust up the Himalayas from that time onward. The same movement folded what is now China into a series of accordion-like pleats that became the current mountain ranges of southern and southwestern China and its neighboring countries.

Crossing so many latitudes seems to have led to the extinction of virtually all of the plants and animals that occupied India when its position lay south of the equator, but when it came within reach of Asia and under the influence of a tropical and subtropical climate from the early Eocene Period onward. The plants and animals of southern Asia colonized the new lands, and more migrated from the north as the mountains of the region were thrust ever upward. Importantly, there was a great opportunity for the evolution of endemic plants and animals in the new mountains, and the mixture of all of these rich biological strands has combined to form the incredible biological richness of the area as we see it today.

Both because of the political subdivisions of the region and its complex floristic composition, it took very courageous and forward-looking leadership for De-Yuan HONG and his colleagues to undertake this monumental flora. Except for China, there are relatively few endemics in most of the countries of the Himalayan ranges and their bordering lowlands, but many in the region. This lack of national endemics, however, stems mainly from the artificial presence of countries in the area, which taken as a whole is an extremely rich one for endemics in virtually all groups of plants, animals, and fungi that occur there. The plants of some of the countries are reasonably well known, those of others poorly known, and our historical efforts to bring the available information together and improve its quality by transnational comparisons have been inadequate.

That situation is all the more unfortunate because of the severe threats that the ecosystems of the regions face from rapid human population growth and the even more rapidly rising expectations for increased consumption and especially from the climate change that threatens the ecosystems of the area, including the possible destruction of its glaciers and the disruptions of the monsoons on which so many depend for the food and livelihood. Sound knowledge of the plants and ecosystems of the region is the only way to win sustainability, even if the population, consumption levels, and the runaway use of malign technologies like burning coal are brought under control.

For all of these reasons, we declare once more our delight in the appearance of this flora and congratulate those who have worked together to make it a reality. It is a critically important first step in improving our knowledge of the plants of the area on a regional basis, and one of great and general importance.

A handwritten signature in black ink that reads "Peter H. Raven". The signature is written in a cursive, flowing style.

Peter H. Raven,
President Emeritus,
Missouri Botanical Garden

Introduction

—General Guideline of the *Flora of Pan-Himalaya*

The Himalayas and adjacent regions (Pan-Himalaya) form a natural phytogeographical unit, from the Vakhnan Corridor eastwards to the Hengduan Mountains *via* the Karakorum and the Himalayas. This region covers the northeastern corner of Afghanistan, northern Pakistan, northern India, Nepal, Bhutan, northern Myanmar, and southwestern China (S Tibet, SE Qinghai, SE Gansu, W Sichuan, and NW Yunnan). This region is divided into 17 subregions: Vakhnan, N Pakistan, Jammu & Kashmir, U Ganga & Indus, U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, Sikkim & Darjiling, Bhutan, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S Hengduan, and U Irrawaddy (see the map ‘Subdivisions of the Pan-Himalaya’).

The *Flora of Pan-Himalaya* (FLPH) will be published in English in two editions: printed and online. It treats all the native and naturalized vascular plants of this region.

The Flora will be published in 50 volumes with ca. 80 books, with the larger families divided into two to seven parts. The classification systems used in this Flora will reflect our current understanding of phylogenetic or phylogenomic relationships of the relevant groups. The third edition of the Angiosperm Phylogeny Group system (APG III) will be adopted for the angiosperms, and up-to-date phylogenetic or phylogenomic systems for the gymnosperms, ferns, and lycophytes will be followed for the treatments of those groups.

The natural and rational delimitation of species is the critical task of taxonomy and is the most important criterion for judging the scientific value and standard of a Flora. Population concepts should be employed in determining the taxonomy; character analysis should be considered as the basis for rational taxonomic treatment. Therefore, field observations at the population level and statistical analysis based on broad population sampling and collections are greatly encouraged to investigate the variation of characters and evaluate their taxonomic significance for the delimitation of taxa. Herbarium specimens kept at the following herbaria must be examined and identified: PE, KUN, K, BM, E, CDBI, and SZ. The authors are also encouraged to visit the herbaria of A, B, CAL, CAS, G, KATH, LE, P, TI, W, and HNWP.

Delimitation of closely related species should be based on correlated discontinuous (including statistically discontinuous) variation of at least two characters. As to apomicts (such as *Taraxacum* spp., *Sorbus* spp.) and vegetatively reproducing plants, “macrospecies” should be adopted instead of “microspecies”.

The use of subspecies is encouraged in infraspecific classifications, but varieties only in special cases. Subspecies are geographical races and horizontally or vertically vicarious, whilst varieties are prominent ecotypes. Genotype variants within populations should not be recognized as different taxa. The description of a species should cover all its elements. Variants that do not merit formal taxonomic recognition may be noted below the description of the species.

Larger families and genera may be concisely subdivided. These systems should reflect the current understanding of phylogenetic or phylogenomic relationships, especially those generated from solid molecular and genomic data.

The concept of the genus should reflect the current understanding of phylogenies. Generic concepts strongly supported by both molecular/genomic and morphological evidence should be adopted, but those with weak support in molecular/genomic analysis and no sound morphological evidence should not be accepted. The treatment of more poorly known groups should be conservative and any perceived problems indicated.

Identification keys are one of the most important products of classification, and the best reflection of its usefulness. Authors should construct a key based on the examination of all relevant specimens. Where possible, keys should not be based on a single character, and must avoid vague words, such as “relatively large” vs. “relatively small”, “longer” vs. “shorter”. It is important to use easily visible characters in keys. Dichotomous indented keys such as those in the *Flora of China* are to be used in this Flora.

Description of species should be concise with emphasis on diagnostic characters and should include habitat information and geographical distribution, plus chromosome numbers, phenology, and other biological features, as well as reliable economic uses and conservation information where available.

Literature citations for accepted names and their basionyms must be provided. Important references, such as monographs and Floras, should be cited, but not more than three titles (at most five if absolutely necessary). All synonyms based on types from within the Flora area should be listed along with other synonyms that have been widely used in relevant publications.

Detailed type information should be indicated after the nomenclatural citation of taxa. Designation of types is highly encouraged in this Flora.

A distribution map is given for each species. This will be a dot map based on the specimens seen for the Flora. The vouchers are to be cited to record the geographical distribution for each species, subspecies (or variety). At least one representative specimen is needed for each distribution unit (county in China, district in other countries). For the more widely distributed taxa (across nine or more subdivisions), a larger distribution unit can be used, no citation of vouchers is needed, and the distribution outlines are also acceptable.

The nomenclatural novelties (new taxa, new combinations, and *nomina nova*) may be published in the Flora or elsewhere.

Sterile hybrids, and those hybrids not forming populations, are to be briefly discussed after the descriptions of their parents. Plants only known from cultivation may be indicated at the end of the treatment of the genus, but should not be included in the identification keys.

All genera, and at least one-third of species, should be illustrated with good quality line drawings with scale bars to indicate magnifications. The illustrations can be drawn from herbarium materials, living materials, or images available, selected by the authors, or taken from publications with permission. Wherever possible the material used should be indicated. Diagnostic characters of the species should be clearly illustrated. One plate may hold illustrations of one, two, or three species. For larger genera, composite plates of diagnostic characters are encouraged.

The web edition of the Flora will follow the corresponding printed edition. Colour photographs, detailed citations of vouchers, and other sources of information are to be included only in the web edition.

The physical geography, history of studies of vascular plants from this region, biogeography, biodiversity conservation, general references, and key to families are to be included in the first (introductory) volume. A comprehensive index of taxa and other subjects is to be published in the last volume.

More detailed guidelines and a model treatment for the preparation of Flora accounts will be provided by the Editorial Committee.

The Editorial Committee of *Flora of Pan-Himalaya*

Preface

Volume 45 part 2 of the *Flora of Pan-Himalaya* is one of the 50 volumes that are divided into approximately 80 books. The nomenclatural novelties in this volume include 91 new synonyms of species and subspecies, 13 new synonyms of varieties, and five new names; 62 lectotypes are newly designated.

The genus *Pedicularis* L., including approximately 670 species, is a common element of alpine, subalpine, and tundra floras in Asia, Europe, and North America. Species of the genus are mostly perennial but some are annual or biennial hemiparasitic herbs. It is a typical group of adaptive radiation exhibiting extreme variation of corolla morphology, which may have resulted from a co-evolution with their pollinators that are almost exclusively bumblebees. The modern diversity center of the genus is in the Pan-Himalaya, where approximately 400 species and all major infrageneric groups with different corolla types gather. The genus and its close relatives have been reclassified with other hemi- and holo-parasites into the Orobanchaceae from the Scrophulariaceae, based on the results of molecular phylogenetic analysis (Olmstead *et al.*, 2001). *Pedicularis* is considered to have the greatest diversity of floral forms of angiosperm genera, yet its infrageneric taxonomy shows problematic with as many as ten classification systems proposed (Steven 1823; Bentham 1835; Bunge, 1841, 1946; Maximowicz 1888; Prain 1890; Bonati 1918; Limpricht 1924; Hurusawa 1948; Li 1948, 1949; Tsoong 1955, 1956a, 1956b, 1963).

When taxonomists delimited the primary infrageneric groups of *Pedicularis*, some emphasized floral morphology (Prain 1890; Bonati 1910, 1918; Tsoong 1955), while others paid more attention to vegetative traits (Steven 1823; Bentham 1835; Maximowicz 1888; Li 1948, 1949). Of these classifications, Li's (1948, 1949) and Tsoong's (1955, 1956, 1963) mainly focused on *Pedicularis* species of China. Li used phyllotaxy to delimit three primary infrageneric groups (grexes) among the *Pedicularis* of China. The grex *Cyclophyllum* (part I of the monograph) included all species with opposite or verticillate leaves, the grex *Allophyllum* (part II of the monograph) included species with alternate leaves, and the grex *Poecilophyllum* (part II of the monograph) included species with alternate or pseudo-opposite leaves. Tsoong's classification system focused on Asian *Pedicularis* species, while he also provided a taxonomic, biogeographic, and ecological analysis of the species of Europe and North America. He divided the genus into 13 grexes and 112 series, including 329 species of China.

Since 2000, the present author and his colleagues have made more than ten expeditions to the Pan-Himalaya for field observations and collections of materials from the Sichuan, Yunnan, Tibet, and Qinghai Provinces of China. The author and his research team (Prof. X.-Q. WANG's lab) used molecular data to reconstruct the phylogeny of the genus (Yang *et al.*, 2003, 2007), resolved the relationship of closely related species in *Pedicularis* section *Cyathophora* (Wang *et al.*, 2015, 2016), and analyzed the population genetic variation of wide-ranging species in the Pan-Himalaya (Yang *et al.*, 2008). Moreover, increasing molecular phylogenetic studies during the past decade (*e.g.* Ree, 2005; Yu *et al.*, 2011; Yu *et al.*, 2013; Robart *et al.*, 2015; Yu *et al.*, 2015) contributed much to the phylogenetic reconstruction of the genus and the delimitation of closely related species. The studies of Yang *et al.* (2003), Ree (2005), and Yu *et al.* (2015) focused on the *Pedicularis* species of Asia. Tkach *et al.* (2014) focused on the origin of the arctic *Pedicularis* species, and Robart (2015) tried to infer the evolutionary history of the North

American *Pedicularis* species. Wang *et al.* (2015, 2016) conducted a range-wide multilocus phylogenetic analysis of *Pedicularis* section *Cyathophora* by using single/low-copy nuclear gene sequences and RNA-seq data. The results of all these studies revealed a general pattern of low congruence between classic classifications, particularly at the section (grex) level, and molecular phylogenies. Only a few grexes or sections were supported as monophyletic. Molecular data also showed that most opposite-/whorled-leaved species form a monophyletic clade nested in a clade of alternate leaf species, while the resolution of backbone branches was generally poorly supported.

To date, it is still difficult to obtain a classification framework for this species-rich genus, which has experienced early radiation at a deep phylogenetic level. To provide convincing evidence for identifying the concept of series and delimiting species in the genus *Pedicularis*, we conducted a phylogenetic analysis of 1300 accessions of nrDNA ITS sequences (from all studies mentioned above) of the genus, representing more than 310 species from all grexes and major series. The result of phylogenetic analysis is generally congruent with those of previous studies focusing on the region- or lineage-specific species of *Pedicularis*, but more clades were recognized here. Thus, it is feasible that molecular data were combined for the first time with morphological and geographical data when compiling a monograph of the large genus *Pedicularis*, a comprehensive revision for the genus a half-century after the epochal publication of the *Flora Reipublicae Popularis Sinicae* (Tsoong, 1963).

The monograph of *Pedicularis* is divided into two books based on phyllotaxy, *i.e.*, alternate and opposite/verticillate leaves. This volume includes 173 species of alternate leaves, with 116 species endemic to the Pan-Himalaya. In this book, a statistical analysis of morphological traits was conducted for some confusing species with sufficient specimens, and evidence with strong support in molecular/genomic analysis is adopted in setting up a classification system of the genus and in revising confusing species distributed in the Pan-Himalaya. Names of some varieties are not included in this book because only subspecies are treated in infraspecific classification, but there should be worthy of varietal rank in some species.

Seventy-eight figures were selected from *Flora Reipublicae Popularis Sinicae*, three from *Iconographia Cormophytorum Sinicorum*, two from *Flora Xizangica*, ten were modified from literature (monographs), and three drawn by Miss Ai-Li LI. The distribution maps were automatically produced by Mr. Min LI and Mr. Jing XUAN based on the data from the cited voucher specimens.

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PEDICULARIS L.

Linnaeus, Sp. Pl. 2: 607. 1753. Type: *Pedicularis sylvatica* L.

Herbs perennial or biennial, rarely annual, dark black or not after dried. Hemi-parasitic. Leaves alternate, opposite, or whorled, usually pinnatifid to 1- or 2-pinnatisect, rarely entire or dentate; lower leaves usually long-petiolate; upper leaves more or less sessile. Inflorescences terminal or flower axillary; bracts usually leaf-like. Calyx tubular to campanulate, more or less bilabiate, usually deeply cleft anteriorly, (2–)5-lobed. Corolla red, purple, yellow, or white, strongly bilabiate, short or long; upper lip (galea) hooded, enclosing anthers, laterally compressed, rounded or truncate, or terminating in teeth or in a short, long or S-shaped beak; lower lip 3-lobed, usually spreading sometimes enclosing galea and beak. Floral nectary conical bulged or absent. Stamens 4, filaments glabrous or pubescent; anthers mucronate or not. Stigma capitate. Capsule moderately compressed or not, loculicidal. Seeds numerous, reticulate or costate.

Approximately 670 *Pedicularis* species are mainly distributed in the mountains of Southwest China and widespread in the alpine zones of the Northern Hemisphere, and approximately 400 species are in the range of the Pan-Himalaya. The species of *Pedicularis* in China are pollinated by bumblebees (rarely by bees and butterflies) gathering nectar and/or pollen on nectariferous non-beaked species, and pollen only, by scraping or vibrating, on beaked species including those with long corolla tubes.

The genus *Pedicularis* is traditionally placed in the snapdragon family Scrophulariaceae. Molecular phylogenetic results demonstrate that this genus along with the other hemiparasitic and parasitic members of the Scrophulariaceae should be transferred to the family Orobanchaceae. In the genus *Pedicularis*, the ranks “series” and “section” (or “Division”, “Grex”) have been traditionally used in the monographs since Prain’s work (Ann. Bot. Gard. Calc. 3: 1–196. 1890) and followed by later classification systems (e.g., Li, 1948–1949. *Proc. Acad. Nat. Sci. Philad.* 100–101; Tsoong, 1963. *Fl. Reipubl. Popularis Sin.* 68). In *Flora of China* (Yang *et al.*, 1998) only rank series was used, and in the monograph of *Pedicularis* in India (Husain *et al.*, 2010) the authors did not use any infrageneric ranks. In the present work, the category series is used and section (Grex) is not considered because a few sections (Grex) are supported as monophyly by molecular phylogenetic evidence.

Recent references: Yamazaki, 2000. Seven new species of the genus *Pedicularis* (Scrophulariaceae) from Tibet (Xizang) and its adjacent region in China. *J. Jap. Bot.* 75: 213–222; Olmstead *et al.*, 2001. The disintegration of the Scrophulariaceae. *Amer. J. Bot.* 88: 348–361; Yamazaki, 2003. Eight new species and four newly found species of *Pedicularis* (Scrophulariaceae) from Bhutan. *J. Jap. Bot.* 78: 71–80; Yang *et al.*, 2003. Unexpected high divergence in nrDNA ITS and extensive parallelism in floral morphology of *Pedicularis* (Orobanchaceae). *Pl. Syst. Evol.* 240: 91–105; Yang *et al.* 2003. A new species and a new specific synonym of *Pedicularis* (Scrophulariaceae) from the Hengduan Mountains, China. *Novon* 13: 363–367; Ree, 2005. Phylogeny and the evolution of floral diversity in *Pedicularis* (Orobanchaceae). *Int. J. Plant Sci.* 166: 595–613; Yang & Wang, 2007. Extensive length variation in the cpDNA *trnT-trnF* region of hemiparasitic *Pedicularis* and its phylogenetic implications. *Pl. Syst. Evol.* 264: 251–264; Yang *et al.*, 2008. Extensive population expansion of *Pedicularis longiflora* (Orobanchaceae) on the Qinghai-Tibetan Plateau and its correlation with the Quaternary climate change. *Mol. Ecol.* 17: 5135–5145; Husain *et al.*, 2010. Genus *Pedicularis* L. (Scrophulariaceae) in India. Bishen Singh Mahendra Pal Singh, Dehra Dun, India; Mill, 2010. New taxa and lectotypifications of *Pedicularis* (Orobanchaceae) are required for the Flora of Pakistan. *Edinb. J. Bot.* 67: 185–187; Mill, 2011. Revision of the limits of *Pedicularis* series *Megalanthae* (Prain) Bonati

(Orobanchaceae). *Edinb. J. Bot.* 68: 111–138; Yu *et al.*, 2013. Incongruence between nuclear and chloroplast DNA phylogenies in *Pedicularis* section *Cyathophora* (Orobanchaceae). *PLoS ONE* 8: e74828; Tkach *et al.*, 2014. High mountain origin, phylogenetics, evolution, and niche conservatism of arctic lineages in the hemiparasitic genus *Pedicularis* (Orobanchaceae). *Mol. Phylogenet. Evol.* 76: 75–92; Robart *et al.*, 2015. Phylogeny and biogeography of North American and Asian *Pedicularis* (Orobanchaceae). *Syst. Bot.* 40: 229–258; Wang *et al.*, 2015. Range-wide multilocus phylogenetic analyses of *Pedicularis* sect. *Cyathophora* (Orobanchaceae): implications for species delimitation and speciation. *Taxon* 64: 959–974; Yu *et al.*, 2015. Towards a comprehensive phylogeny of the large temperate genus *Pedicularis* (Orobanchaceae), with an emphasis on species from the Himalaya-Hengduan Mountains. *BMC Plant Biol.* 15: 176; Yu *et al.*, 2015. Typification of seven Chinese species of *Pedicularis* (Orobanchaceae) are described by Bureau and Franchet with taxonomic notes. *Plant Ecol. Evol.* 148 (1): 144–148; Wang *et al.*, 2016. Resolving interspecific relationships within evolutionarily young lineages using RNA-seq data: an example from *Pedicularis* section *Cyathophora* (Orobanchaceae). *Mol. Phylogenet. Evol.* 107: 345–355; Agnihotri *et al.*, 2018. A new species and typification in *Pedicularis* series *Curvipes* (Orobanchaceae). *Phytotaxa* 371 (4): 260–266; Yu *et al.*, 2018. Phylogenetic approaches resolve taxonomical confusion in *Pedicularis* (Orobanchaceae): reinstatement of *Pedicularis delavayi* and discovering a new species *Pedicularis milliana*. *PLoS ONE* 13: e0200372; Garg & Singh, 2020. Typification of fifty-one names in *Pedicularis* (Orobanchaceae). *Phytotaxa* 430 (2): 061–094; Garg *et al.*, 2020. *Pedicularis raghvendrae* (Orobanchaceae), a new species from Sikkim Himalaya, India. *Phytotaxa* 452 (1): 110–115; Kottaimuthu & Basu, 2020. *Pedicularis hongii* Kottaim., a new name for *P. multicaulis* W. B. Yu, H. Wang & D. Z. Li (Orobanchaceae). *Ann. Bot. Fenn.* 57: 209–210.

Distribution: About 670 species, mainly distributed in the Northern Hemisphere; about 400 species in the Pan-Himalaya. This volume includes 173 species of alternate leaves, belonging to 56 series.

Key to series:

- 1a. Corolla beakless, or only small projection.
 - 2a. Corolla galea with a pair of big teeth near apex, or with several marginal teeth on each side.
 - 3a. Corolla galea with several marginal teeth on each side; inflorescence elongated, with sparse flowers.....45. *Rhynchodontae*
 - 3b. Corolla galea usually with a distinct marginal tooth on each side; inflorescence short, or if elongated, usually with dense flowers.
 - 4a. Corolla lip usually erect or slightly spreading, corolla tube usually not decurved; leaf segments ovate to ovate-lanceolate, margin dentate..... 15. *Hirtellae*
 - 4b. Corolla lip spreading, corolla tube usually decurved; leaf segments pinnatipartite to pinnatisect.
 - 5a. Plants usually 20–80 cm tall; leaf blade bipinnatipartite to bipinnatisect.....26. *Comosae*
 - 5b. Plants usually less than 15 cm tall; leaf blade pinnatipartite to pinnatisect.
 - 6a. Plants with persistent marcescent leaves at base; inflorescences short-spicate or capitate44. *Pseudo-oederianae*
 - 6b. Plants without persistent marcescent leaves at base; inflorescences more than 1/2 height of plants, centrifugal..... 33. *Merrillianae*
 - 2b. Corolla galea without marginal teeth.
 - 7a. Plants procumbent or usually 5–15 cm tall; corolla tube decurved apically, lower lip spreading; capsule oblique.
 - 8a. Plants usually cespitose or procumbent to ascending; flowers axillary apically.
 - 9a. Corolla 15–20 mm long; leaf blade 0.8–1.8 cm wide..... 42. *Corydaloides*
 - 9b. Corolla 30–40 mm long; leaf blade 2–2.5 cm wide..... 43. *Acaules*

- 8b. Plants erect; flowers in a spike.
 - 10a. Leaf segments 8–10 pairs; inflorescences short, capitate or flowers few, not distinctly centrifugal..... 32. *Roseae*
 - 10b. Leaf segments 10–30 pairs; inflorescences elongated, spicate, with dense flowers.....41. *Flammeae*
- 7b. Plants 30–100 cm tall; corolla tube usually erect or occasionally decurved at base, corolla lip not spreading; capsule not oblique.
 - 11a. Leaf segments usually 4–7 pairs; lower lip long stipitate at base 1. *Tsekouenses*
 - 11b. Leaf segments 15–20 pairs; lower lip not stipitate..... 2. *Tristes*
- 1b. Corolla beaked, with a straight or S-shaped long beak.
 - 12a. Corolla tube at least 2 times as long as calyx; plants usually 5–15 cm tall (except for *Megalanthae* usually 20–70 cm tall).
 - 13a. Plants usually diffuse; calyx lobes usually 5.
 - 14a. Plants more or less woody; leaves with linear segments; corolla galea usually abruptly constricted into a straight beak.....19. *Batangenses*
 - 14b. Plants herbaceous; leaves with ovate to oblong segments; corolla galea usually gradually constricted into a beak and twisted 20. *Muscicolae*
 - 13b. Plants erect or more or less stemless; if stems diffuse, calyx lobes 2 or 3, not 5.
 - 15a. Plants more than 10 cm tall; corolla often yellow, or corolla red-purple and less than 1.5 cm long.
 - 16a. Corolla lip spreading, not enveloping galea; plants usually 5–15 cm tall.
 - 17a. Flowers axillary, pedicels 3–4 cm long; calyx 3/4 cleft anteriorly 37. *Neolatitubae*
 - 17b. Proximal flowers axillary, distal ones dense, more or less sessile, pedicels 0.2–2 cm long; calyx 1/3 to 1/2 cleft anteriorly..... 53. *Longiflorae*
 - 16b. Corolla lip not spreading, usually enveloping galea, only slender beak projected; plants usually 20–70 cm tall54. *Megalanthae*
 - 15b. Plants less than 10 cm tall; corolla more or less red-purple.
 - 18a. Corolla tube expanded apically; roots branched, fusiform..... 40. *Wilsoniae*
 - 18b. Corolla tube not expanded apically; roots not fusiform.
 - 19a. Leaf blade usually 2–8 cm long (except for *P. microloba* 4–10 mm long), pinnatisect.
 - 20a. Corolla tube 2–3 time as long as calyx; beak of galea not downward; leaf segments usually 3–6 pairs.....56. *Regelianae*
 - 20b. Corolla tube not or slightly longer than calyx; beak of galea usually downward uncinat; leaf segments 5–20 pairs...48. *Robustae*
 - 19b. Leaf blade 1–4 cm long, entire or only pinnatifid.
 - 21a. Leaf blade ovate-lanceolate; corolla lip spreading.....51. *Pumiliones*
 - 21b. Leaf blade lanceolate-linear; corolla lip enclosing the galea..... 52. *Bellae*
 - 12b. Corolla tube less than 2 times as long as calyx; plants usually 15–100 cm tall.
 - 22a. Corolla galea marginally long-ciliate.
 - 23a. Corolla galea inflated-convex, navicular.
 - 24a. Leaves linear to linear-lanceolate or oblong-lanceolate; leaf blade pinnatilobate or dentate.....5. *Craspedotrichae*
 - 24b. Leaves not linear, shorter, and wider; leaf blade double-dentate to pinnatipartite.
 - 25a. Length-width ratio of leaf blade less than 3.....4. *Dolichocymbae*
 - 25b. Length-width ratio of leaf blade greater than 4 3. *Rudes*

- 23b. Corolla galea not navicular.
 - 26a. Beak of galea straight or bent downward, and shorter than lower lip.
 - 27a. Leaves mostly basal; leaf blade pinnatisect with lanceolate segments; beak of galea with an apical tuft of hairs13. *Lachnoglossae*
 - 27b. Leaves mostly cauline; leaf blade not pinnatisect; beak of galea without an apical tuft of hairs.
 - 28a. Leaf blade lanceolate-linear, pinnatilobate; lobes of corolla lip long stipitate at base, corolla galea more or less abruptly constricted into a slender beak..... 8. *Lasiophrydes*
 - 28b. Leaf segments pinnatipartite to pinnatisect; lobes of corolla lip not stipitate, corolla galea gradually constricted into a beak.
 - 29a. Plants usually 50–100 cm tall; corolla galea less than 3 mm wide, sparsely pubescent 6. *Imbricatae*
 - 29b. Plants usually less than 40 cm tall; corolla galea 4–5 mm wide, densely pubescent..... 7. *Trichoglossae*
 - 26b. Beak of galea obviously bent upward, and longer than lower lip.
 - 30a. Leaf blade linear or linear-lanceolate.
 - 31a. Plants usually more than 30 cm tall, up to 1 m; beak of galea not twisted; lobes of corolla lip narrowly lanceolate..... 9. *Kongboenses*
 - 31b. Plants less than 30 cm tall; beak of galea S-shaped; lobes of corolla lip short, wide..... 11. *Kialenses*
 - 30b. Leaf blade more or less ovate, linear-lanceolate to lanceolate-oblong.
 - 32a. Leaf blade more or less ovate, usually more than 3.5 cm wide..... 12. *Excelsae*
 - 32b. Leaf blade linear-lanceolate to lanceolate-oblong, usually less than 3.5 cm wide (except for *P. recurva*, 3–5.5 cm wide).
 - 33a. Corolla galea strongly twisted, glabrous or villous on lower margin and beak; lobes of corolla lip nearly square-shaped; leaf blade 0.5–2 cm wide 11. *Kialenses*
 - 33b. Corolla galea not twisted, densely villous at base and at margin; lobes of corolla lip not square-shaped; leaf blade 3–5.5 cm wide14. *Recurvae*
- 22b. Corolla galea not marginally long-ciliate.
 - 34a. Inflorescences distinctly centrifugal.
 - 35a. Beak of galea more than 3 times as long as corolla lip; inflorescence racemose, usually 10–18 cm long..... 47. *Macrorhynchae*
 - 35b. Beak of galea shorter or slightly longer than corolla lip; inflorescence racemose, 2–8 cm long..... 46. *Filiculae*
 - 34b. Inflorescences distinctly centripetal or indistinctly centrifugal.
 - 36a. Stems weak, slender, usually diffuse; flowers usually axillary.
 - 37a. Flowers usually in clusters at the base of stems; leaf blade 15–30 cm long 16. *Vagantes*
 - 37b. Flowers not in clusters at the base of stems, solitary; leaf blade less than 13 cm long.
 - 38a. Corolla galea with pairs of marginal teeth..... 35. *Odontophorae*
 - 38b. Corolla galea without marginal teeth.
 - 39a. Leaf blade 1–3.5 cm long; calyx lobes 2 or 3 55. *Curvipes*
 - 39b. Leaf blade 4–13 cm long; calyx lobes 5.
 - 40a. Leaf blade with distinct reticulate veins abaxially; calyx tube with reticulate veins apically..... 18. *Infirmae*

- 40b. Leaf blade without distinct reticulate veins abaxially; calyx tube without reticulate veins..... 17. *Axillares*
- 36b. Stems erect or ascending, or more or less stemless; flowers arising from a stock.
- 41a. Inflorescences usually elongated, not interrupted.
- 42a. Corolla lip usually 15–25 mm wide.
- 43a. Corolla lip not enclosing galea; leaf blade pinnatipartite to pinnatisect (except for *P. insignis*, with pinnatifid leaves).....49. *Klotzschianae*
- 43b. Corolla lip with two large semicircular lateral lobes, rotated and with one of the lateral lobes wholly or partly hiding galea; leaf blade pinnatifid to pinnatipartite.....50. *Bicornutae*
- 42b. Corolla lip often less than 13 mm wide.
- 44a. Stems usually 50–80 cm tall; beak of galea bent upward; corolla lip 1/3 to 1/2 as long as galea.....10. *Subsurrectae*
- 44b. Stems often shorter than 50 cm; beak of galea bent downward (except for *P. torta*); corolla lip as long as or longer than galea 29. *Oxycarpae*
- 41b. Inflorescences usually subcapitate, few-flowered, or elongated and interrupted at base.
- 45a. Plants less than 10 cm tall; leaf blade usually less than 6 cm long (except for *Robustae*).
- 46a. Leaves numerous, basal, persistent34. *Asplenifoliae*
- 46b. Leaves few, not persistent, basal and cauline.
- 47a. Corolla lip more than 2 cm wide; galea usually robust, apex of beak 2-cleft48. *Robustae*
- 47b. Corolla lip usually less than 1.8 cm wide; galea narrower, and the apex of beak not 2-cleft.
- 48a. Stems rigid; leaves alternate..... 27. *Paucifoliaetae*
- 48b. Stems usually weak, flexuous; leaves usually pseudo-opposite36. *Mychophilae*
- 45b. Plants more than 10 cm tall; leaf blade 5–15 (-20) cm long.
- 49a. Pedicel 3–11 cm long; corolla galea not twisted 38. *Franchetianae*
- 49b. Pedicel less than 3 cm long; corolla galea strongly twisted laterally.
- 50a. Flowers in a capitulum.
- 51a. Corolla 2.6–5 cm long; corolla lip relatively wide, often completely enveloping galea; roots conical, fleshy 39. *Pseudomacranthae*
- 51b. Corolla usually less than 2.5 cm; corolla lip relatively narrow, often spreading, not enveloping galea; roots branched, slender.
- 52a. Leaves 10–15 cm wide, stem leaves often ovate-elliptic.....21. *Phaceliifoliae*
- 52b. Leaves usually less than 3 cm wide, more or less oblong or lanceolate.
- 53a. Corolla more than 2 times as long as calyx; beak of galea very long, S-shaped or semi-circular 31. *Rhinanthoides*
- 53b. Corolla less than 2 times as long as calyx; beak of galea shorter, straight or bent downward.....28. *Oliganthae*

- 50b. Inflorescences racemose, or flowers more or less in a raceme.
 - 54a. Corolla galea strongly twisted laterally at base..... 30. *Dissectae*
 - 54b. Corolla galea not strongly twisted laterally at base.
 - 55a. Leaf blade pinnatifid to pinnatisect 24. *Microphyllae*
 - 55b. Leaf blade pinnatipartite, double-dentate or entire.
 - 56a. Calyx 2 lobes; leaf blade double-dentate or entire
 - 57a. Corolla tube right twisted; plant hirsute through 22. *Carnosae*
 - 57b. Corolla tube straight; plant glabrous or nearly glabrous 23. *Racemosae*
 - 56b. Calyx 5 lobes; leaf blade usually pinnatipartite 25. *Furfuriae*

Ser. 1. Tsekouenses

Ser. Tsekouenses H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 39. 1949.

Herbs perennial. Stems branched at base. Leaves alternate, petiolate, pinnatifid to pinnatipartite. Inflorescences often capitate. Corolla purple-spotted; throat expanded; galea falcate, rounded or obtuse apically, toothless; lower lip long-stipitate at base.

One species; endemic to the Pan-Himalaya.

Notes: The series *Tsekouenses* differs from the series *Gloriosae* (outside the Pan-Himalaya) in having remarkably unequal calyx-teeth which are distinctly dentate except the posterior tooth, having falcate galea which is hairy in front but not on the margin, deeply lobed lower lip, and hairy anterior filaments.

1. Pedicularis tsekouensis Bonati, Bull. Soc. Bot. France 54: 373. 1907; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 39. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 104. 1998. Type: China, Yunnan, Gongshan, 1903, *Soulié 1087* [**lectotype designated here:** P(P02968507); isolectotypes: P(P02968508, P02968509, P02968510, P02968511)].

Plants 10–60 cm tall. Stems branched at base with a rosette of basal leaves, pubescent throughout. Roots fascicled, slender. Basal leaves in a rosette; petiole (1-) 2–10 cm long; leaf blade lanceolate-oblong to ovate-elliptic, 2–8 cm long; segments 4–6 (-10) pairs, oblique-ovate to triangular, pubescent, margin double-dentate; cauline leaves absent or very few, similar to basal leaves but with shorter petiole. Inflorescences

capitate or racemose, elongated to more than 25 cm long, lax; bracts leaflike, membranaceous, petiolate, apex flabellate to triangular, 3–5-lobed. Calyx membranaceous, 5-dentate; teeth unequal, posterior one smaller, triangular, entire, others linear-oblong, sharply dentate. Corolla pale yellow to rose, and often purple-spotted, densely hairy distally, 2.5–3 cm long; tube about as long as calyx, cylindrical; galea erect, falcate, obtuse, lower margin glabrous and entire. Filaments 2 pubescent, 2 glabrous; anthers apiculate. Figure 45(2)–1.

Phenology: flowering from June to September.

Habitats: dry stony pastures among *Pinus* and *Rhododendron* scrubs; 3050–4200 m.

Distribution: endemic; S Hengduan, U Irrawaddy [Map 45(2)–1].

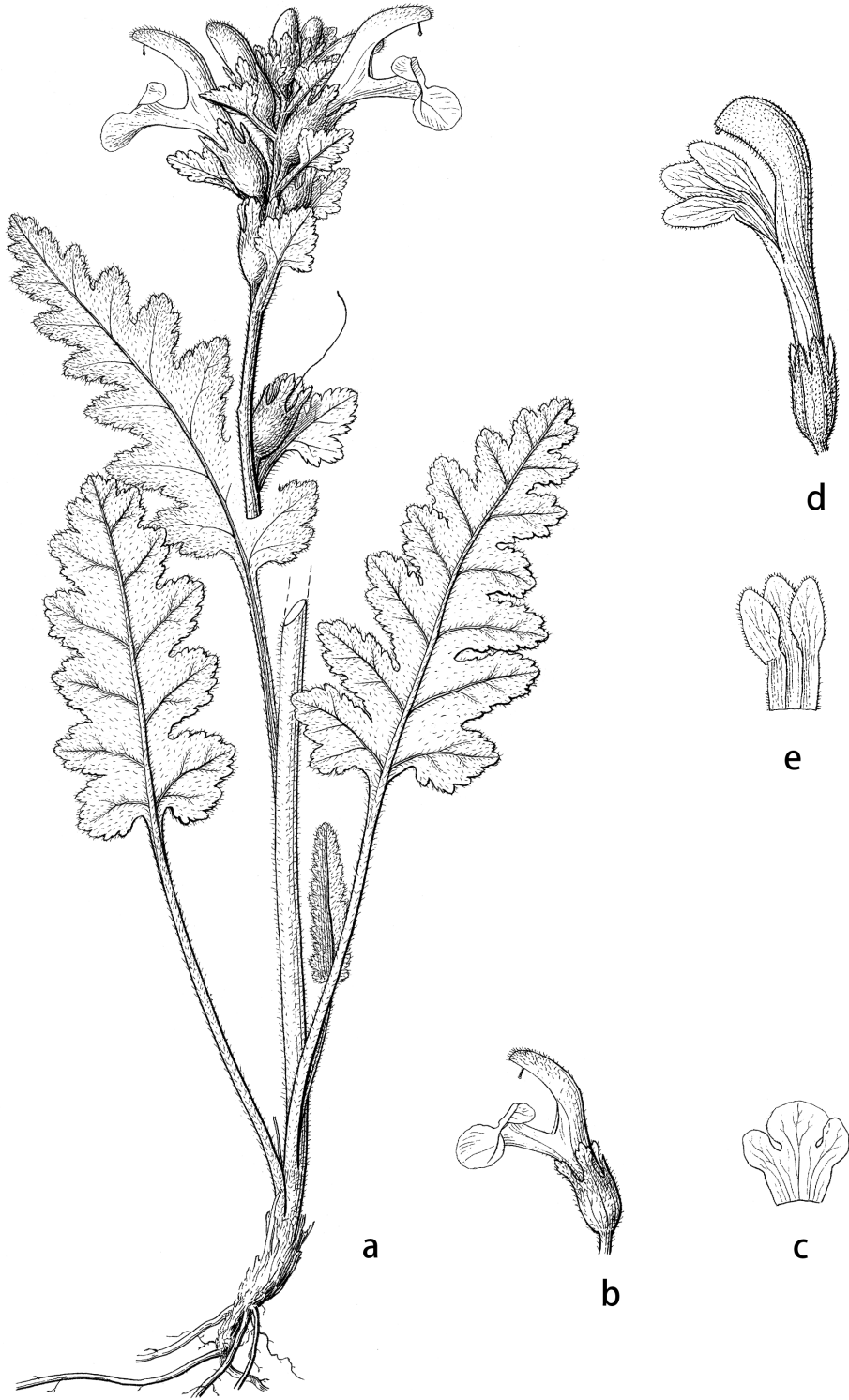
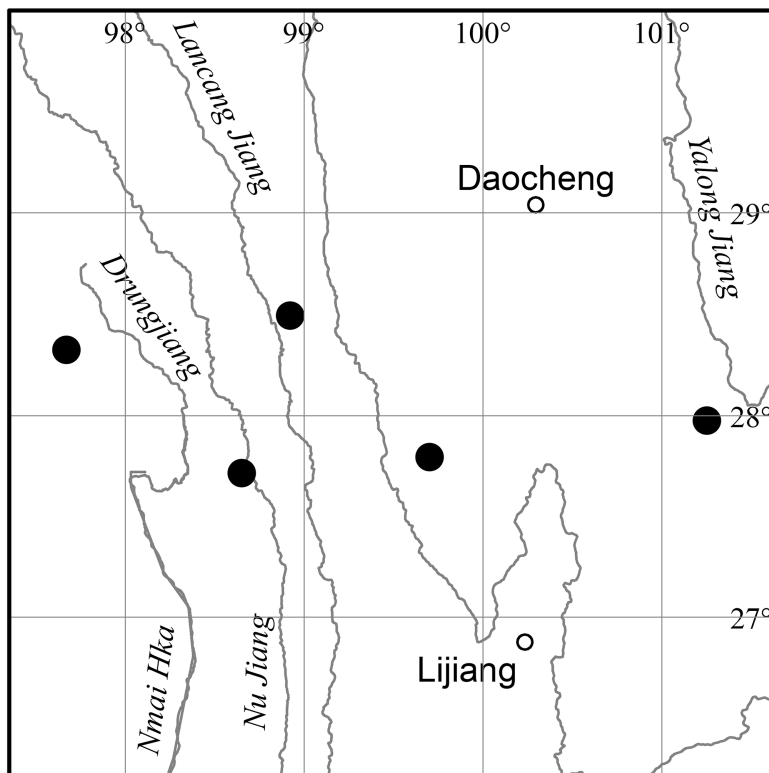


Figure 45(2)-1: **Pedicularis tsekouensis** Bonati. a-c: a, habit; b, flower; c, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 38, figure 1: 3-5. 1963]. **Pedicularis tristis** L. d-e: d, flower; e, corolla lip. Drawn by J.-Y. FENG for *P. paiana* H. L. Li [*Fl. Reipubl. Popularis Sin.* 68: 40, figure 2: 4-5. 1963].



Map 45(2)-1: *Pedicularis tsekouensis* Bonati

Notes: *Pedicularis tsekouensis* Bonati is a narrowly distributed species. Bonati (1907) in the protologue of this species gave brief information “Tsékou, 1903, No. 1087 Soulié”. Five specimens were found in the herbarium P, one of which is designated here as lectotype. Molecular phylogenetic results show that three individuals of *P. tsekouensis* Bonati form a well-supported clade, which occupies the basal position of a major clade including species of grex *Sceptrum*.

S HENGDUAN: Dêqên, Yongzi, 3700–3900 m, Aug. 1940, *K. M. Feng 6637* (PE); Dêqên, Baimaxue Shan, in alpine meadows, 4876 m, 15 Aug. 1922, *F. Kingdon-Ward 5340* (K); Dêqên, Mekong-Salween Divide, 4025–4375 m, 4 July 1916, *H. R. E. von Handel-Mezzetti 9661* (WU); Dêqên, Mekong-Salween Divide,

3960 m, July 1924, *Explorations of G. Forrest 25544* (K); Dêqên, Mekong-Salween Divide, mountain grassy slope, 3600 m, 5 Aug. 1938, *T. T. Yü 22863* (E); Dêqên, Mekong-Salween Divide, alpine meadows, 3950 m, June–July 1932, *J. F. Rock 23116* (K); Dêqên, Mekong-Salween Divide, alpine meadows, 4000 m, July 1924, *Explorations of G. Forrest 14532* (K). **Gongshan,** Anantong, 4000 m, Aug. 1938, *T. T. Yü 22802* (PE). **Muli,** Chabulang, 5 Sept. 1983, *Qinghai-Xizang Exped. 14412* (KUN). **Shangri-la** (Zhongdian), Hongshan, 22 Aug. 2011, *J. Cai et al. 11CS3284* (KUN); Shangri-la (Zhongdian), Habaxue Shan, Aug. 1939, no detailed information (K). **U IRRAWADDY:** **Adung Valley,** 3650–3962 m, 31 July 1931, *British Museum Exped., Burma-Tibet Frontier 1930–1931, F. Kingdon-Ward 9889* (BM).

Ser. 2. *Tristes*

Ser. *Tristes* Benth. in A. de Candolle, Prodr. 10: 579. 1846.

Herbs up to 1 m tall, black when dry. Roots single or sometimes branched apically, somewhat fleshy, with a tuft of fibrous roots near the top. Leaves alternate, sessile; leaf blade linear to linear-lanceolate, pinnatifid or pinnatifid. Inflorescences racemose or conical. Calyx short-cylindric, 5-dentate; teeth equal to subequal in size. deltoid to oblong, entire to serrate. Corolla yellow or pale yellow; galea falcate or navicular, toothless; corolla lip not spreading; stamens inserted near the middle of tube.

Notes: The series *Tristes* has been variously delimited by different authors. It was enlarged by Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 57) including nine species, but Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 40) grouped the nine species into four distinct series (*Tristes*, *Rudes*, *Galeatae*, and *Dolichocymbae*). Our molecular phylogenetic results indicate that the series *Tristes* is closely related to the series *Rudes* and *Lasiophrydes*, and *Galeatae* should be merged into *Dolichocymbae*.

Two species; one in the Pan-Himalaya.

2. *Pedicularis tristis* L., Sp. Pl. 2: 608. 1753; Steven, Monogr. *Pedicularis* in Mem. Soc. Nat. Mosc. 11. 57. 1823; Maximowicz, Bull. Acad. Saint-Pétersb. 32: 567. 1888; Limpricht, Repert. Sp. Nov. 20: 227. 1924; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 40. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 104. 1998. Type: "Habitat in Sibiria", *Herb. Linn. No. 763.9* [lectotype designated by Yu *et al.* (2014: 174): LINN].

Pedicularis paiana H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 61. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 41. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 104. **syn. nov.** \equiv *Pedicularis tristis* var. *macrantha* Maxim., Bull. Acad. St. Pétersb. 32: 567. 1888. Type: China, Sichuan, "Prov. Sze-tschuan septentrionali: trajectu mon-tano Gura-kika", precise information unavailable [**lectotype designated here:** K(K000708896); isolectotypes: P(P02968516, P02968487)].

Herbs perennial, 15–60 cm tall. Rhizome and root straight, and simple, with a tuft of fibrous rootlets on rhizome. Stems hollow, with lines of hairs. Leaves mostly cauline, few basal, alternate; leaf blade linear to linear-lanceolate, 6–8 cm long, 1.5–2 cm wide, abaxially with long hairs along midvein, adaxially white pubescent, pinnatifid; segments triangular to ovate, incised

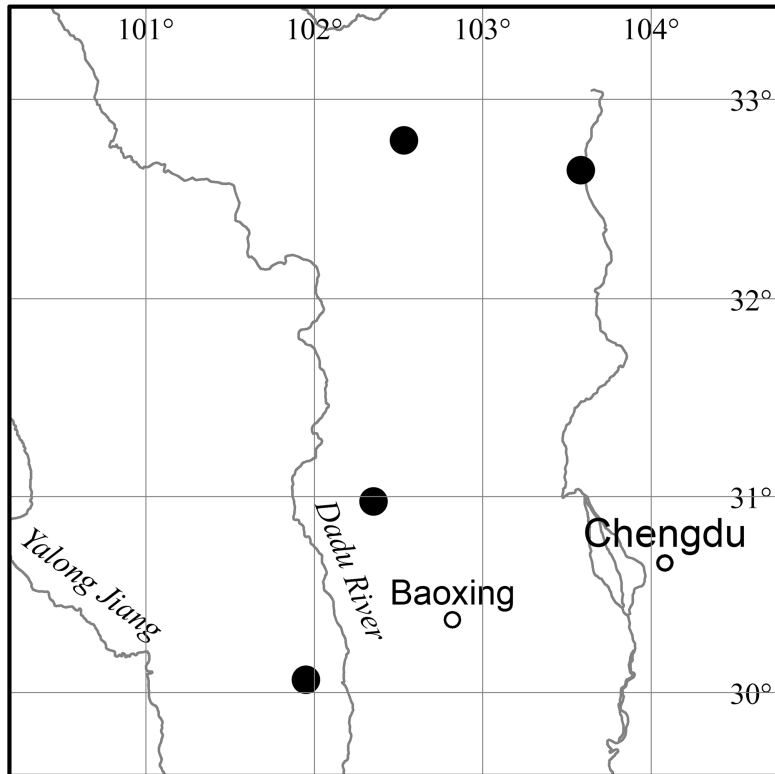
double-dentate, 15–20 pairs. Inflorescences usually 10–20 cm long, often interrupted at base; bracts triangular-ovate, shorter than flowers, pubescent. Calyx 12–15 mm long, membranaceous, densely pubescent to subglabrous; lobes 5, more or less equal, linear-lanceolate, entire or obscurely serrate. Corolla yellow, 25–48 mm long; tube exceeded to twice as long as calyx, more or less pubescent; galea 4–5 mm wide, margin densely pubescent, apex obtuse or acute. Filaments glabrous or sparsely pubescent. Figure 45(2)–1. **Chromosomes:** $2n = 16$.

Phenology: flowering from June to August.

Habitats: alpine and subalpine wet meadows, swamped larch forests, willow groves, shrubby grassland, along banks of rivers and near springs; 2000–3550 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–2]; also in N China, Mongolia, and Russia (Siberia, Far East).

Notes: Li described *P. paiana* H. L. Li as new and stated that it resembles *P. tristis* L. but differs in having larger flowers, distinctly serrate calyx-teeth, and sparsely hairy filaments. Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 41) thought that *P. paiana* could be distinguished from *P. tristis* by larger corolla and sparsely hairy filaments. We examined specimens of the two "species" and measured the corolla length of two taxa. The corolla length of *P. tristis* varies between



Map 45(2)-2: *Pedicularis tristis* L.

25–48 mm, with an average length of 33 mm, and the corolla length of *P. paiana* varies between 28–48 mm, with an average length of 39 mm. Calyx lobes of two species vary morphologically, with an edge from entire to obscurely serrate within and among populations. Although the morphological characters of corolla are somewhat different between two “species”, there are no morphological gaps between them. Hence, *P. paiana* H. L. Li is here merged into *P. tristis* L. Our molecular phylogenetic results show that *P. paiana* H. L. Li is nested within the clade of *P. tristis* L., supporting our taxonomic treatment based on morphological characters.

Plenty of specimens of north China, Mongolia, and Russia were examined and only those distributed in the Pan-Himalaya were here cited.

N HENGDUAN: Hongyuan, Longriba, 3550 m, 17 Aug. 1957, *X. Li* 72215 (PE). **Songpan**, Chuanzhusi, 3700 m, 1 July 2000, *Sino-Brit. Qinghai Alp. Gard. Soc. Exped.* 590 (E); Songpan, An-cha-tzu in prato herboso-fruticoso, 4200m, 10 Aug. 1922, *H. Smith* 3228 (PE). **Xiaojin**, Lianghekou, 3400 m, 25 July 1958, *X. S. Zhang & Y. X. Ren* 6199 (PE00123118–00123120). **S HENGDUAN:** Kangding, Dapao Shan, 4300 m, 20 Aug. 1934, *H. Smith* 11221 (PE).

Ser. 3. Rudes

Ser. Rudes Prain, *Ann. Roy. Bot. Gard. Calc.* 3: 83. 1890.

Herbs up to 150 cm tall, black when dry. Roots single or sometimes branched apically, with a tuft of fibrous roots near the top. Stems branched apically or unbranched. Inflorescences racemose. Calyx

short-cylindric, 5-dentate; teeth equal to subequal, deltoid to oblong, entire to serrate. Corolla yellow or pale yellow; galea falcate or navicular, shortly beaked; corolla lip not spreading; stamens inserted near middle of tube.

Four species; all in the Pan-Himalaya (3 endemics).

- 1a. Corolla lip stipitate at base; galea margin not bearded3. *P. prainiana*
- 1b. Corolla lip sessile; galea margin densely bearded.
 - 2a. Middle lobe of corolla lip equals to, or larger than lateral lobes; leaf segments 10–15 pairs.
 - 3a. Leaf blade pinnatipartite; corolla 20–25 mm long4. *P. duniana*
 - 3b. Leaf blade pinnatisect; corolla 30–40 mm long5. *P. dianmianensis*
 - 2b. Middle lobe of corolla lip smaller than lateral lobes; leaf segments 17–25 pairs.....
 -6. *P. rudis*

3. *Pedicularis prainiana* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 567. 1888; Prain, J. Asiat. Soc. Bengal 58(2): 277. 1889; Prain, Ann. Roy. Bot. Gard. Calc. 3: 162. 1890; Bonati, Notes Roy. Bot. Gard. Edinb. 13: 132. 1921; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 46. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 106. 1998. Type: China, Yadong, Chumbi, Lu-Ma-Poo, 20 July 1884, *King's collector 509* [lectotype designated by Garg & Singh (2020: 88): CAL(CAL0000018995); isolecotype: CAL(CAL0000018994)].

Herbs perennial, black when dry, with a dense tuft of short fibrous roots. Stems single, up to 60 cm tall, erect, rigid, hollow, and striate. Radical and lowest cauline leaves absent or withering; leaf blade linear-oblong, 7–10 cm long, 1–2 cm wide, auriculate at base, pinnatisect; segments 15–25 pairs, ovate-oblong, margin acute-dentate, 6–7 mm long, 4–6 mm wide, sparsely pilose above in flower, glabrous beneath except for puberulent midrib and main veins of segments, more or less glabrous on both surfaces in fruit. Inflorescence a creamy-lanate terminal spike-like raceme, 10–20 cm in flower, up to 30 cm in fruit; bracts linear-oblong, basal ones longer than flowers, upper ones shorter than calyx; pedicel 2–3 mm long. Calyx 14–16 mm long, 5 mm wide, membranous, hirtellous; lobes 5, unequal. Corolla tube 16–18 mm long, slightly longer than calyx; galea navicular, margin not bearded, sparsely pubescent abaxially; lower lip stipitate at base, ciliate. Capsule ovoid, 12–14 mm long, 6–7 mm wide, with recurved acuminate tips.

Seeds pale buff, irregularly ellipsoid-tetrahedral, 2–3 mm long, 1.2–1.5 mm wide, coarsely hollow-reticulate all over with no longitudinal striae. Stamens inserted at middle of corolla tube; filaments all glabrous. Figure 45(2)–2.

Phenology: flowering from June to August.

Habitats: scrubby slopes; 3000–3700 m.

Distribution: endemic; Bhutan, M Yarlung Zangbu [Map 45(2)–3].

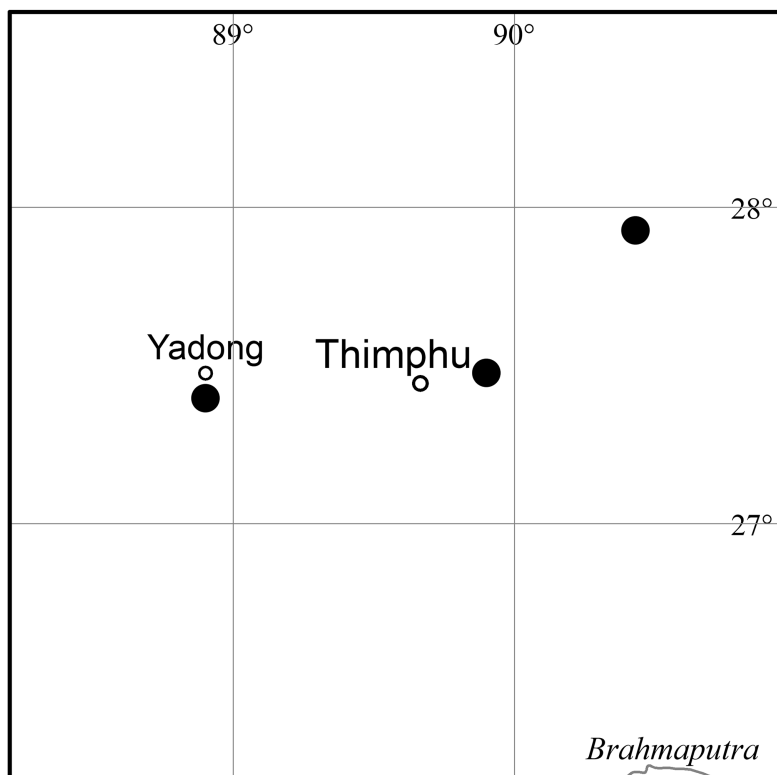
BHUTAN: **Thimphu**, near Chorten on summit ridge above Phajoding Monastery, 3900 m, 16 Aug. 1987, *J. R. I. Wood 5709* (E); Thimphu, ridge above Phajoding, 3900–4000 m, 19 Aug. 1990, *J. R. I. Wood 7312* (E). **Upper Mo Chu**, valley above Chew La, above Chebesa, 4130 m, 30 Sept. 1984, *I. W. J. Sinclair & D. G. Long 5440* (E). **M YARLUNG ZANGBU:** **Yadong**, 20 July 1884, *King's collector 509* (K).

4. *Pedicularis dunniana* Bonati, Notes Bot. Gard. Edinb. 8: 44. 1913; Limpricht, Repert. Sp. Nov. 20: 228. 1924; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 45. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 106. 1998. Type: China, Yunnan, divide between Lijiang and Heqing, 2500–3100 m, Oct. 1910, *G. Forrest 7389* [lectotype designated here: E(E00284014); isolecotype: E(E00284015)].

Pedicularis aequibarbis Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 57: 103. 1920; Symb. Sin. 7: 856. 1937; Limpricht, Repert. Sp. Nov. 20: 228. 1924;



Figure 45(2)–2: *Pedicularis prainiana* Maxim. a-b, habit; c, flower; d, corolla; e, corolla lip; f, sepal and pistil. A.-L. LI modified from D. PRAIN [Ann. Roy. Bot. Gard. Calc. 3: 162, plate 11: 8-11. 1890].



Map 45(2)-3: *Pedicularis prainiana* Maxim.

Bonati, Notes Bot. Gard. Edinb. 15: 157. 1926. Type: Handel-Mazzetti (1937: 856) recorded "Tannenbestände der Ktp. St. an der westseite des Gebirges Piepun se von Dschungdien China, Yunnan, Shangri-la (Zhongdian), 3600 m, 12 Aug. 1914, *H. R. E. von Handel-Mazzetti* (Diar. Nr. 758) 4796 [lectotype designated here: WU(0060238); isolectotypes: WU(0060239, 0060240)].

Herbs perennial, up to 160 cm tall, brown-pubescent throughout. Stems from single to several, sturdy, hollow, sometimes branched apically. Leaves clasping; leaf blade linear-lanceolate; middle leaves largest, 6–12 cm long, 1.5 cm wide, sparsely pubescent, pinnatipartite; segments 13–17 pairs, lanceolate-oblong, margin lobed or double-dentate. Inflorescences usually 10–20 cm long, elongated to 26 cm in fruit, glandular-pubescent; upper bracts slightly longer than calyx. Calyx up to 7 mm long, densely glandular-pubescent or not; lobes 5, serrate. Co-

rolla yellow, 20–25 mm long; tube 10–13 mm long, pubescent; galea navicular, margin densely bearded; lower lip more or less sessile; nearly as long as galea. Capsule ovoid-oblong, 15–17 mm long, 9 mm wide, apex acute. Seeds ca. 3 mm long, 1 mm wide, reticulate. **Chromosomes:** $2n = 16$.

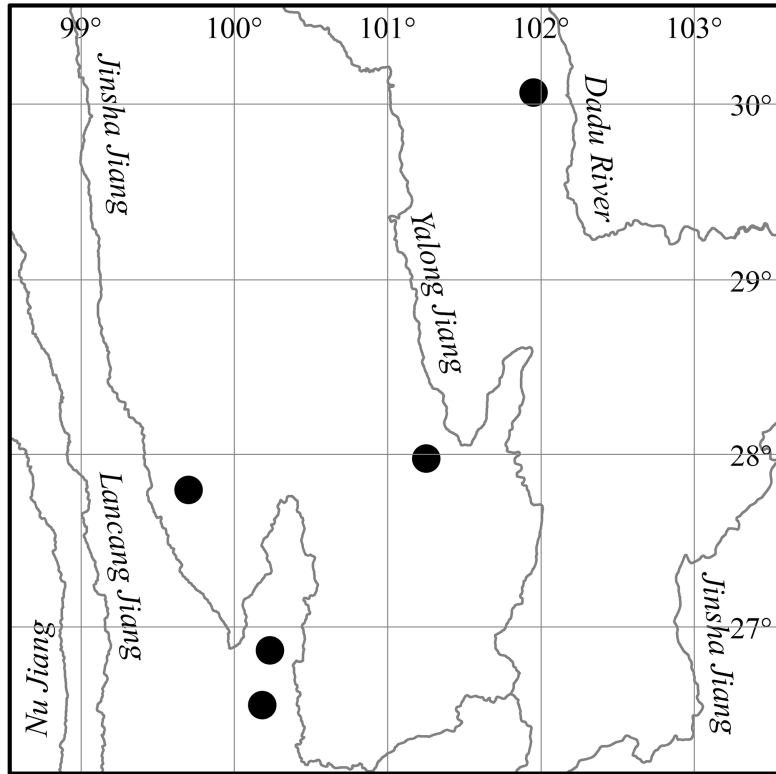
Phenology: flowering from June to July.

Habitats: grassy slopes; 2900–3400 m.

Distribution: endemic; S Hengduan [Map 45(2)-4].

Notes: *G. Forrest* 7389 is the only collection listed by Bonati in the protologue of *P. dunniana* Bonati, but its duplicates have been deposited in the herbaria E and PH. Our molecular phylogenetic results reveal a close relationship between *P. dunniana* Bonati and *P. rudis* Maxim.

S HENGDUAN: Heqing, 31 July 1929, *R. C. Ching* 23451 (PE). Kangding, Aug. 1938, *McLaren's collections* AC113 (KPH). Muli, Kulu,



Map 45(2)-4: *Pedicularis dunniana* Bonati

3100 m, 23 Sept. 1937, *T. T. Yü 14346* (BM). **Shangri-la** (Zhongdian), 3300 m, 28 July 1939, *K. M. Feng 1850* (PE); Shangri-la (Zhongdian), 3100 m, Sept. 2000, *J. Cai 21* (KUN); Shangri-la (Zhongdian), alpine grassland, 3500 m, 16 Sept. 1937, *T. T. Yü 13550* (BM); Shangri-la (Zhongdian), on the margin of shrubs, 3350 m, July 1913, *G. Forrest 10604* (BM); Shangri-la (Zhongdian), Alpine Botanic Garden, 3378 m, 22 July 2008, *X. Hai & A. F. Xie HX2008-16* (KUN); Shangri-la (Zhongdian), Napahai, 3300 m, 18 July 2008, *Q. E. Yang & Q. Yuan YangQE1901* (KUN); Shangri-la (Zhongdian), Sancun, 3322 m, 15 Sept. 2008, *Q. S. Yang et al. ZhouZK-07ZX-0397* (KUN). **Yulong** (Lijiang), divide between Lichiang and Hoching valleys, Oct. 1910, *G. Forrest 7389* (E); Yulong (Lijiang), 3000 m, 1914, purchased from the Arnold Arboretum, Harvard University, 1916, *C. Schenider 1829* (K).

5. *Pedicularis dianmianensis* F. S. Yang. nom. nov. \equiv *Pedicularis fischeri* P. C. Tsoong, Kew Bull. 9: 445. 1954, nom. illeg., non *Pedicularis fischeri* Nasarow, Byull. Moskovsk. Obsch. Isp. Prir., Otd. Biol. 32: 355. 1923-24. **syn. nov.** Type: Myanmar, Valley of Seinhku Wang, 3350 m, 29 July 1926, *F. Kingdon-Ward 7209* [holotype: K(K000739070)].

Herbs perennial, black when dry. Stems single, up to 100 cm tall, erect, rigid, hollow, striate. Leaf blade linear-oblong, 7–11 cm long, 2 cm wide, auriculate at base, linear-lanceolate; middle leaves largest, pinnatisect; segments 10–13 pairs, ovate-oblong, margin acute-dentate, 7–10 mm long, 4–7 mm wide. Inflorescences erect, up to 20 cm long; bracts linear-oblong, basal ones longer than flowers, upper ones shorter than calyx; pedicels 2–3 mm long. Calyx 10–12 mm long, 6 mm wide, membranous; tube

7–8 mm long; lobes 5, subequal, densely lanate on veins and margins. Corolla 3–4 cm long, tube 14–16 mm long, slightly longer than calyx, densely lanate externally; galea navicular, 22–25 mm long, 6–7 mm wide, sparsely pubescent; lower lip 16–18 mm long, ciliate; middle lobe 6–8 mm long, 4.5 mm wide, lateral lobes 3–5 mm long, 2 mm wide. Stamens inserted at middle of corolla tube; filaments all glabrous.

Phenology: flowering from June to July.

Habitats: open meadow; ca. 3350 m.

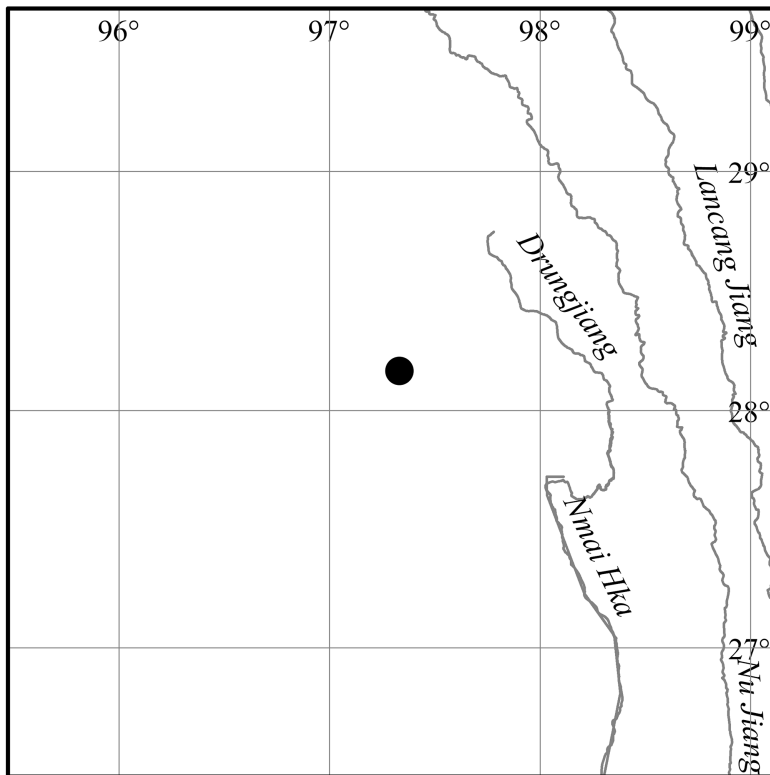
Distribution: endemic; U Irrawaddy [Map 45(2)–5].

Notes: Tsoong described *P. fischeri* P. C. Tsoong as new based on a collection from Myanmar, but he did not notice that the epithet “fischeri” had been preoccupied (*Pedicularis fischeri* Adams ex Nasaroff, a synonym of *P. rubens* Steph. ex Willd.).

U IRRAWADDY: Senighku Valley, 3350 m, 29 July 1926, *F. Kingdon-Ward* 7209 (K000739069).

6. *Pedicularis rudis* Maxim., Bull. Acad. St. Pétersb. 24: 67. 1878; Limpricht, Repert. Sp. Nov. 20: 228. 1924; Li, Proc. Acad. Nat. Sci. Philad. 101: 64. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 43. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 105. 1998. Type: China, Inner Mongolia, Alashan, 30 June 1873, *N. M. Przewalski* 186 [**Lectotype designated here:** LE; isolectotypes: LE].

Pedicularis princeps Bureau & Franch., J. (Morot) Bot. 5: 129. 1891; Bonati, Bull. Herb. Boiss. 2. 7: 544. 1907; Limpricht, Repert. Sp. Nov. 20: 228. 1924; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 45. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 106. 1998. **syn. nov.** Type: China,



Map 45(2)–5: *Pedicularis dianmianensis* F. S. Yang.

Sichuan, Kangding “entre Tatsien-lou et la frontiere du Yun-nan [recueillie pendant le voyage de M. Bonvalot et du Prince Henri d’Orleans en 1890]” [lectotype designated by Yu *et al.* (2015: 145): P(P02977300)].

Pedicularis decora Franch., Bull. Soc. Bot. France 47: 28. 1900; Limpricht, Repert. Sp. Nov. 20: 229. 1924; Li, Proc. Acad. Nat. Sci. Philad. 101: 65. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 44. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 105. 1998. **syn. nov.** Type: China, Sichuan, Kangding (Tchen-keou-tin), *R. P. Farges 719* [lectotype designated here: P(P02987201); isolectotype: P(P02987202)].

Pedicularis lasiantha H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 64. 1949. Type: China, Western Hubei, precise information unavailable, June 1901, *E. H. Wilson No. 2182* (Veitch & Sons) [holotype: US(00125634); isotype: E(E00284009)].

Herbs perennial, 70–160 cm tall, usually branched apically, pubescent. Stems hollow. Cauline leaves clasping; leaf blade lanceolate-linear, 3–15 cm long, 0.8–2.5 cm wide, pinatipartite; segments 17–25 pairs, oblong to lanceolate, pubescent, margin double-dentate. Inflorescences long spicate, more than 30 cm long, glandular-pubescent; bracts leaflike below, ovate above, longer than calyx. Calyx 5–7 mm long, densely white glandular-pubescent; lobes 5, more or less equal, serrate. Corolla yellow, 20–25 mm long; tube 10–12 mm long, pubescent externally; galea often purple-red apically, navicular, margin densely bearded, apex mucronulate, bent slightly upward; lower lip more or less sessile, ca. as long as galea, ciliate. Filaments glabrous or sparsely villous. Capsule broadly ovoid, compressed, 10–13 mm long, 8 mm wide, apex acute. Figure 45(2)–3. **Chromosomes:** $2n = 16$.

Phenology: flowering from June to August.

Habitats: grassy slopes, *Picea* forests, *Betula* forests; 2200–3700 m.

Distribution: Tangut, N Hengduan, S Hengduan [Map 45(2)–6]; also in N China.

Notes: It was stated (e.g. Li. 1949. Proc. Acad. Nat. Sci. Philad. 101: 59–66) that *P. rudis* Maxim., *P. decora* Franch., and *P. princeps* Bureau & Franch. could be distinguished by the size of corolla and more or fewer hairs on calyx and corolla. A statistic of the size of calyx and corolla indicates that all these characteristics vary within and among populations and there are no morphological gaps between these taxa. Therefore, these three “species” are merged into one species. Our molecular phylogenetic results show that *P. decora* Franch. is nested in a clade consisting of individuals of *P. rudis* Maxim., supporting our taxonomic treatment of these two taxa.

TANGUT: Garzê, Xise, 3800 m, 27 July 2004, *Y. H. Wu 30242* (HNWP). **N HENGDUAN: Barkam,** Jiafeiqiao, 2650 m, 11 July 1957, *Z. Y. Zhang & H. F. Zhou 22797* (PE). **Hongyuan,** Shuajingsi Temple, 3250 m, *Sichuan University Exped. 23683* (PE); Hongyuan, Longran Xiang, 3528 m, 18 Oct. 2008, *C. B. Zhang ZhangCB031* (KUN). **Jinchuan,** Anning, Tanchanggou, 2300 m, 10 July 1958, *X. Li 78744* (PE). **Lixian,** Shanjiaoba, 3300 m, 25 Aug. 1957, No more detailed information (PE). **Songpan,** 3300 m, 22 July 1914, *H. Smith 2898* (PE). **Xiaojin,** E of the city of Xiaojin near Shawu Xiang, 3100–3300 m, 27 July 2007, *D. E. Boufford et al. 38377* (PE). **S HENGDUAN: Baoxing,** Ganyanggou, 3200 m, 6 July 1933, *T. H. Tu 2206* (PE). **Kangding,** Zheduo Shan, 3370 m, 30 June 1953, *X. L. Jiang 36157* (PE); Kangding, Aladonggong, 19 July 1951, *W. G. Hu & Z. He 10440* (SZ). **Shangri-la** (Zhongdian), Tehgoh, 3400 m, 26 July 1937, *T. T. Yü 12471* (PE). **Yulong** (Lijiang), Ta-koo(Ta-chi) on Yangtze, 24 July 1939, *s.n.* (PE).

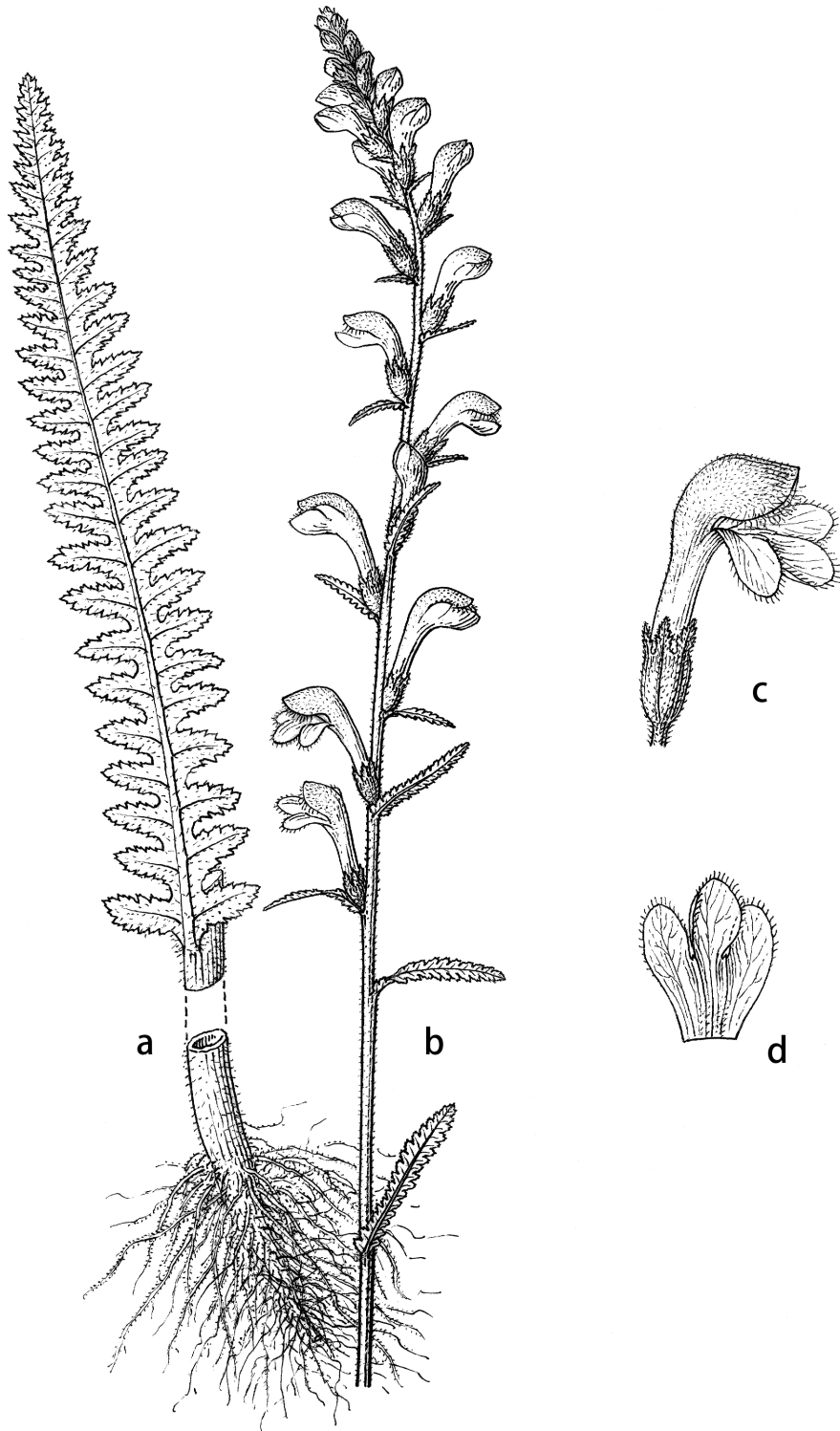
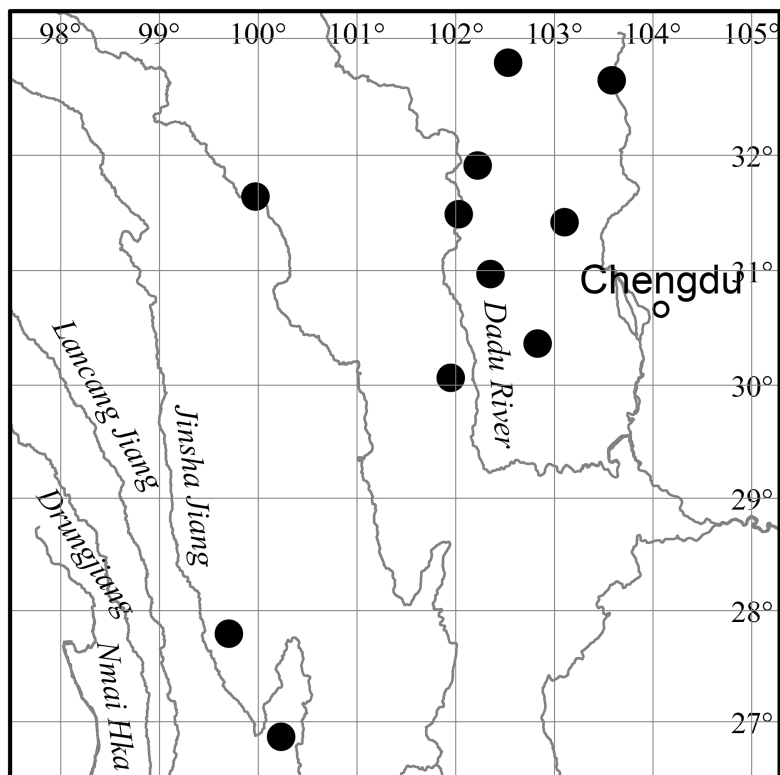


Figure 45(2)-3: **Pedicularis rudis** Maxim. a, root and basal leaf; b, inflorescence; c, flower; d, corolla lip.
Drawn by J.-Y. FENG [*Iconogr. Cormophyt. Sin.* 4: 62, figure 5537. 1975].



Map 45(2)-6: *Pedicularis rudis* Maxim.

Ser. 4. Dolichocymbae

Ser. Dolichocymbae P. C. Tsoong ex H. P. Yang, Acta Phytotax. Sin. 33: 244. 1995.

Herbs up to 50 cm tall, black when dry. Rhizomes distinct; rootstock developed, roots smooth. Stems erect, simple, or rarely branched. Cauline leaves alternate, sessile; leaf blade ovate to elliptic-oblong, lobed, or double-dentate. Corolla purple.

Two species; both in the Pan-Himalaya (2 endemics).

Notes: *Pedicularis dolichocymba* Hand.-Mazz. and *P. galeata* Bonati were placed in the series *Tristes* by Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 59-63). Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 1-55) removed these two species from the series *Tristes* and divided them into two monospecific series (Ser. *Dolichocymbae* and Ser. *Galeatae*) based on the distinguishing shape of corolla galea. This treatment was followed by Yang *et al.* (1998. Fl. China. 18: 105-108). Results of molecular phylogenetic analysis reveal that *P. dolichocymba* Hand.-Mazz. and *P. galeata* Bonati should be removed from the series *Tristes*, while a division of the two monospecific series is not supported. The series *Galeatae* are here merged into the series *Dolichocymbae*.

- 1a. Corolla galea falcate apically; corolla lip as long as, or longer than, galea 7. *P. galeata*
- 1b. Corolla galea boat-shaped, margin densely bearded; corolla lip much shorter than galea
 8. *P. dolichocymba*

7. *Pedicularis galeata* Bonati, Notes Bot. Gard. Edinb. 13: 130. 1921; Limpricht, Repert. Sp. Nov. 20: 228. 1924; Li, Proc. Acad. Nat. Sci. Philad. 101: 60. 1949; Handel-Mazzetti, Symb. Sin. 7: 855. 1936; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 42. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 105. 1998. Type: China, Yunnan, Mekong-Salween Divide, 4267 m, Aug. 1917, *G. Forrest 14697* [holotype: E(E00284008); isotype: K(K000708895)].

Herbs perennial, 15–35 cm tall. Stems hollow, with lines of hairs. Leaves alternate, sessile; leaf blade lanceolate-oblong to ovate-elliptic; middle leaves larger than basal and apical leaves, 3–4 cm long, 1.5–2 cm wide, adaxially brown-pubescent along midvein, abaxially sparsely villous along midvein, base broadly cuneate to rounded, apex obtuse to acute. Inflorescences a lax raceme, capitate at anthesis, elongated in fruit, more or less sessile; bracts leaflike. Calyx 10–12 mm long, sparsely villous along midvein; lobes 5, unequal. Corolla purple, 20–22 mm long; tube barely exceeding calyx, sparsely pubescent; galea 4–5 mm wide; lower lip 13–14 mm long, ciliate. Filaments all glabrous; anthers apiculate. Capsule broadly ovoid, compressed, 13–16 mm long, 10 mm wide, apex acute. Figure 45(2)–4.

Phenology: flowering and fruiting from July to September.

Habitats: alpine meadows, *Rhododendron* shrubs; 4000–4270 m.

Distribution: endemic; S Hengduan [Map 45(2)–7].

S HENGDUAN: Dêqên, Mekong-Salween Divide, 3600–3900 m, 1 Aug. 1940, *K. M. Feng 6171* (PE00118687-00118688); Dêqên, Mekong-Salween Divide, 4267 m, Aug. 1917, *G. Forrest 14697* (E); Dêqên, Mekong-Salween Divide, 4270 m, June–July 1932, *J. F. Rock 23113* (K, IBSC, NAS); Dêqên, Baimaxue Shan, 3500 m, Sept. 1935, *C. W. Wang 69643* (NAS). **Gongshan,** Cikai, Changputong, 3500–3700 m, 10 Sept. 1940, *K. M. Feng 7673* (PE00118689-00118690, KUN); Gongshan, Dulong, 3900 m, 11 Aug.

1938, *T. T. Yü 19886* (PE00118691–00118692); Gongshan, alpine meadow, 4000 m, Aug. 1917, *H. R. E. von Handel-Mazzetti 9921* (WU). **Shangri-la** (Zhongdian), Baimaxue Shan, 5000 m, 2 Oct. 1995, *J. Q. Liu et al. 314* (HNWP); Shangri-la (Zhongdian), Nixi, 4517 m, 15 Oct. 2002, *Z. D. Fang et al. K-2464* (SABG).

8. *Pedicularis dolichocymba* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 57: 102. 1920; Li, Proc. Acad. Nat. Sci. Philad. 101: 62. 1949; Handel-Mazzetti, Symb. Sin. 7: 855. 1936; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 47. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 106. 1998. Type: China, Yunnan, Shangri-la (Zhongdian), 4300 m, 7 Aug. 1914, *H. R. E. von Handel-Mazzetti 4543* [holotype: WU(0060230)].

Pedicularis tristiformis Bonati, Genre *Pedicularis*. 70: 73. 1918. Type: Not designated.

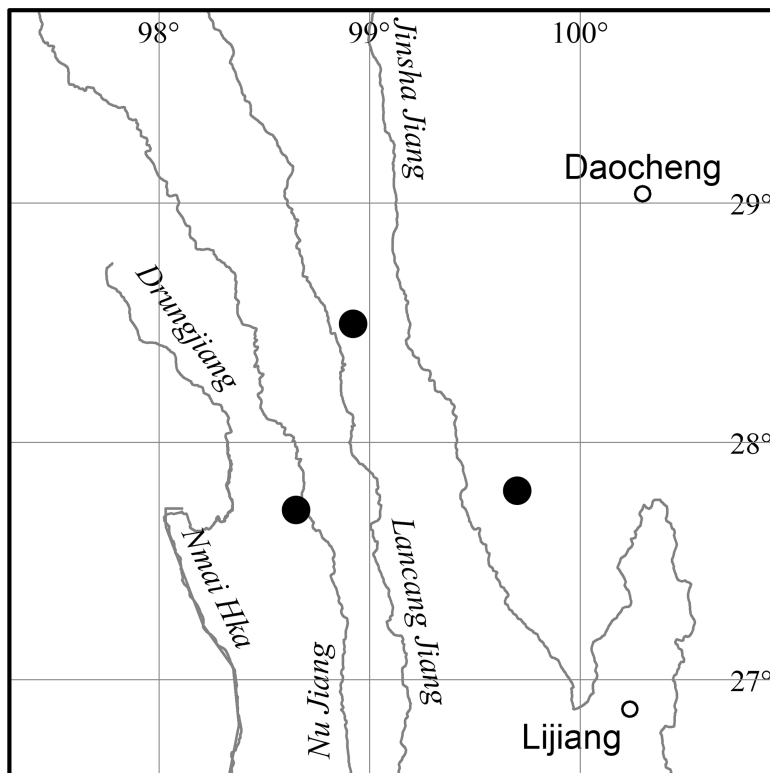
Pedicularis macrocalyx Bonati, Notes Bot. Gard. Edinb. 15: 156. 1926. Type: China, Yunnan, Lijiang, Yulongxue Shan, 4110 m, Aug. 1923, *J. F. Rock 10420* [holotype: E(E00284010); isotype: P(P00125640)].

Herbs perennial, 13–40 cm tall. Stems rarely branched, longitudinally grooved, with lines of brown hairs. Leaves alternate, sessile; basal leaves scalelike; cauline leaves ovate-oblong to lanceolate-oblong, 2–6 cm long, 3–20 mm wide; middle leaves largest, adaxially densely pubescent along midvein, abaxially sparsely villous along midvein, lobed or double-dentate. Inflorescences capitate and 3- or 4-flowered to short-racemose and more than 10-flowered, elongated to 12 cm in fruit; bracts leaflike. Calyx 8–10 mm long; lobes 5, ovate, serrate. Corolla deep-rose to blackish-purple, 23–28 mm long; tube ca. 1.5 times as long as calyx, glabrous; galea sparsely pubescent, margin densely bearded; lower lip much shorter than galea. Filaments all glabrous. Capsule compressed, ovoid, 17–20 mm long, 9 mm wide, apex acute. Figure 45(2)–5.

Phenology: flowering and fruiting from August to September.



Figure 45(2)–4: **Pedicularis galeata** Bonati. a, habit; b, inflorescence; c, flower. Drawn by J.-Y. FENG [Fl. Reipubl. Popularis Sin. 68: 42, figure 3: 1-3. 1963].



Map 45(2)-7: *Pedicularis galeata* Bonati

Habitats: alpine meadows, rocky slopes, among boulders; 3500–4300 m.

Distribution: endemic; S Hengduan [Map 45(2)–8].

Notes: Handel-Mazzetti did not list the record number in the protologue of *P. dolichocymba*, with “Handel-Mazzetti 4543” recorded in his later book (1936. *Symb. Sin.* 7: 855). Our molecular phylogenetic results show that four individuals of *P. dolichocymba* Hand.-Mazz. form a well-supported clade.

S HENGDUAN: Dali, Yongning, 1921, *G. Forrest* 20500 (BM). Dêqên, Jiansheju, Huanfuping, 3600 m, *C. W. Wang* 69013 (PE);

Dêqên, Mekong-Salween Divide, 1914, *G. Forrest* 13139 (BM). Muli, 3657 m, Aug. 1922, *G. Forrest* 22148 (K). Shangri-la (Zhongdian), Xiaozhongdian, 3700–4100 m, 10 Aug. 1981, *Hengduan Shan Exped. (PE)* 2842 (PE); Shangri-la (Zhongdian), 4380 m, 7 Aug. 1914, *H. R. E. von Handel-Mazzetti* 7543 (WU); Shangri-la (Zhongdian), Juatze, in the valley, margin of *Abies* forest, 3700 m, 8 Oct. 1937, *T. T. Yü* 13644 (BM). Weixi, Yeh-Chin, 3600 m, *C. W. Wang* 68648 (PE, KUN). Yulong (Lijiang), Yulongxue Shan, 4110 m, Aug. 1923, *J. F. Rock* 10420 (PH); Yulong (Lijiang), NE of the Yangtze bend, 4000 m, Aug. 1913, *G. Forrest* 10801 (PE).

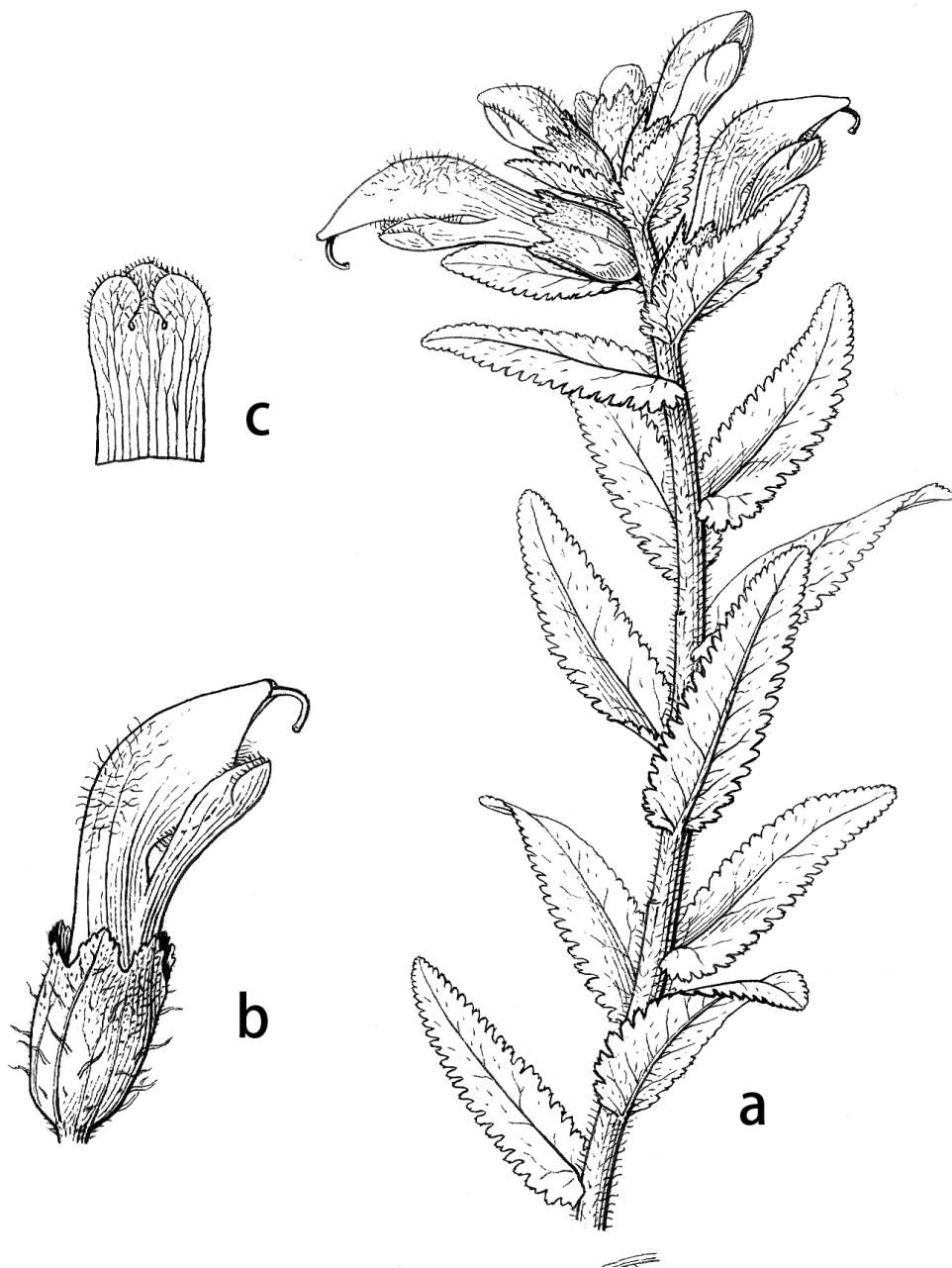
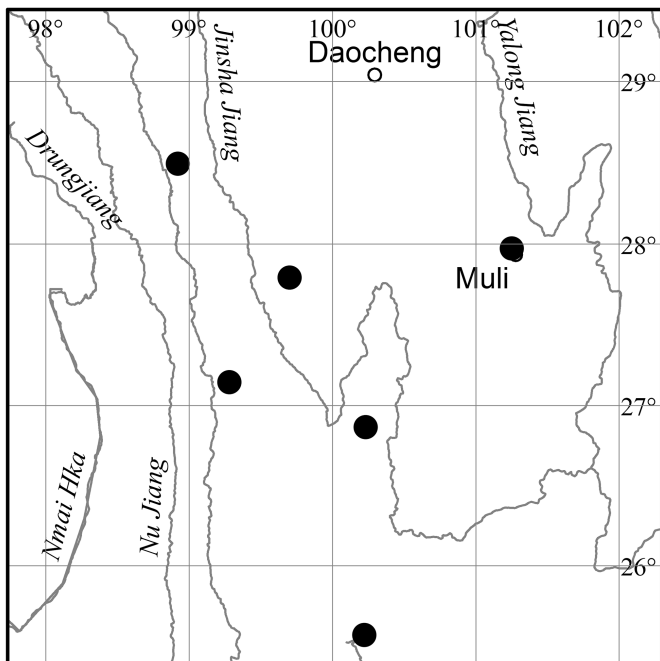


Figure 45(2)–5: *Pedicularis dolichoeymba* Hand.-Mazz. a. habit; b. flower; c. corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 42, figure 3: 4-6. 1963].



Map 45(2)-8: *Pedicularis dolichoymba* Hand.-Mazz.

Ser. 5. *Craspedotrichae*

Ser. *Craspedotrichae* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 8. 1949.

Herbs perennial, up to 100 cm tall. Stems erect or ascending, rarely branched. Leaves alternate; leaf blade linear to linear-lanceolate or oblong-lanceolate, pinnatifid or dentate. Corolla galea often navicular.

Eight species; all in the Pan-Himalaya (7 endemics).

Notes: Specimens of the series *Craspedotrichae* H. L. Li are quite limited. Our molecular phylogenetic results show that six species of the series form a weak-supported clade, where some members of the series *Tristes* and *Rudes* nested. However, the relationships of these species are largely poorly resolved.

- 1a. Galea conspicuously navicular, much enlarged.
 - 2a. Lobes of corolla lip 8–9 mm wide, lanceolate; filaments all pubescent or all glabrous.
 - 3a. Leaves 7–9 mm wide; filaments all pubescent.....9. *P. angustiloba*
 - 3b. Leaves 15–23 mm wide; filaments all glabrous.....10. *P. khoiyangii*
 - 2b. Lobes of corolla lip more than 11 mm wide, more or less rounded; filaments 2 pubescent, 2 completely glabrous 11. *P. trichomata*
- 1b. Galea inconspicuously navicular, slightly enlarged.
 - 4a. Calyx densely pubescent; calyx lobes distinctly serrulate.
 - 5a. Leaves usually 7–12 mm wide; filaments 2 pubescent, 2 glabrous 12. *P. ingens*
 - 5b. Leaves less than 5 mm wide; filaments all glabrous..... 13. *P. cholashanensis*

- 4b. Calyx glabrous or sometimes sparsely pubescent; calyx lobes entire or rarely serrulate.
 6a. Corolla tube as long as, or slightly longer than, calyx; leaves with 50 or more teeth on each side 14. *P. steingeri*
 6b. Corolla tube 1.5–2 times as long as calyx; leaves with less than 50 teeth on each side.
 7a. Leaves incised-dentate; filaments 2 pubescent, 2 glabrous..... 15. *P. trichocymba*
 7b. Leaves incised-lobed, 1/3 distance from margin to midvein; filaments all glabrous.....
 16. *P. tongolensis*

9. *Pedicularis angustiloba* P. C. Tsoong, Acta Phytotax. Sin. 3: 303. 1955; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 50. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 107. 1998. Type: China, Tibet, Kongbo, 3500 m, 22 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 4938* [holotype: BM(BM000997963); isotype: E(E00284105)].

Herbs perennial and black when dry. Stems usually 40–70 cm tall, erect, unbranched, and subglabrous. Basal leaves withering early; cauline leaves clasping; sessile, lanceolate-linear, 7–9 cm long, 6–9 mm wide, adaxially shiny; segments 27–40 pairs, double-dentate. Inflorescences 10–25 cm long, pubescent; bracts leaflike, longer than flowers. Calyx 10–12 mm long; tube 5–7 mm long, white villous; lobes 5, subequal, more or less entire. Corolla yellow; tube 8–10 mm long, slightly shorter than calyx; galea purple spotted, conspicuously navicular, margin pilose, apex slightly curved; beak decurved, 1–2 mm long; lower lip 13–15 mm long, 8–9 mm wide, more or less ciliate; lobes lanceolate, denticulate. Filaments all pubescent. Figure 45(2)–6.

Phenology: flowering from June to August.

Habitats: loose moraine screes, dry places in forests; 3400–4500 m.

Distribution: endemic; L Yarlung Zangbo [Map 45(2)–9].

Notes: Our molecular phylogenetic results show that two accessions of *P. angustiloba* P. C. Tsoong are nested into different clades, and further studies are necessary to clarify the relationships of *P. angustiloba* and its relatives.

LYARLUNG ZANGBO: Gongbo'gyamda, on loose moraine scree, 3350 m, 22 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 4938* (BM, E, PE);

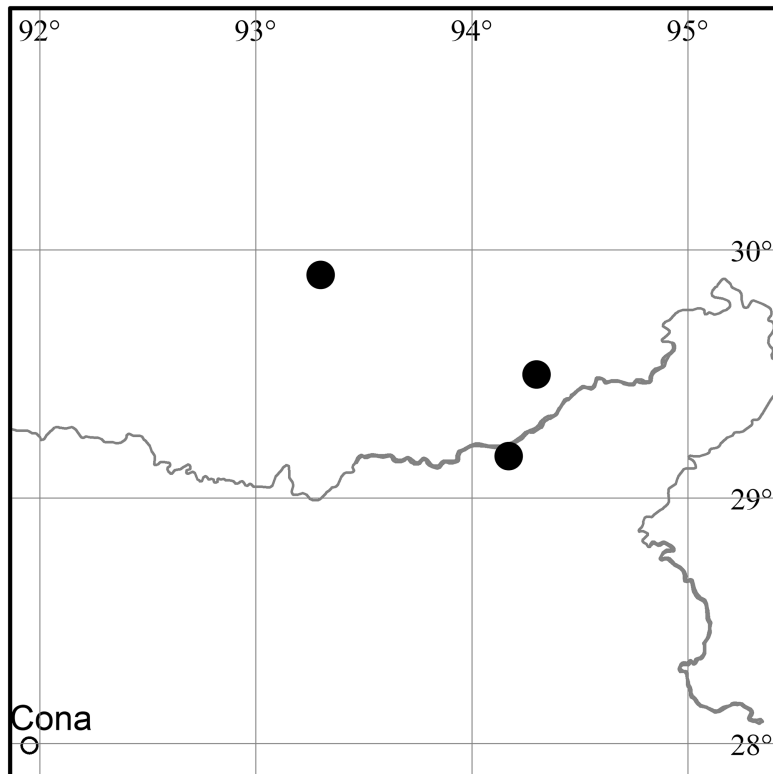
Gongbo'gyamda, Deyang La, 4115 m, 11 Aug. 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 14321* (E, PE); Gongbo'gyamda, Nambu La, 4115 m, 10 Aug. 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 15364* (PE). **Mainling**, Paiqu, Daduka, 4400 m, 24 July 1983, *B. S. Li, Z. C. Ni & S. Z. Cheng 05772* (PE); Mainling, NW slope of Namchararow, 4430 m, 12 Sept. 1989, *B. Dickoré 5016* (TI). **Nyingchi**, W slope of Sejila Shan, 4510 m, 2 Aug. 1975, *Qinghai-Xizang Exped. 751042* (PE, KUN).

10. *Pedicularis khoiyangii* D. Borah & R. Kr. Singh, Phytotaxa 430(4): 287–293. 2020. Type: Yarlung Zangbo-Brahmaputra, Sela Pass, 4200 m, 23 Aug. 2019, *D. Borah 0124* (holotype CAL; isotypes: ASSAM).

Perennial, erect herbs, up to 2 m tall, and black when dry. Stems terete, rigid, hispid; roots woody. Leaf blade linear-lanceolate, clasping, 8–15 cm long, 1.5–2.3 cm wide, pinnatipartite, apex acute, auriculate at base, adaxially sparsely pubescent, abaxially pubescent on midrib only; segments 18–22 pairs, ovate-oblong, margins irregularly double-dentate. Inflorescences terminal, 20–80 cm long, silky villous; distal bracts ovate, shorter than flower, both surfaces sparsely villous. Flowers 22–26 mm long; pedicels 0.6–1 mm long, silky villous. Calyx campanulate, densely villous outside, 10-nerved; tube 10–12 mm long, 5-toothed; teeth triangular, equal, 1.8–2.2 mm long, margins entire. Corolla yellow, 21–25 mm long; tube 11–13 mm long, sparsely pubescent outside; galea navicular, 9–11 mm long, bent away from labium, pubescent outside; beak 0.3–0.5 mm long, straight, pubescent, slightly emarginate at tip; lower lip as long as galea, 3-lobed, stipitate, margins ciliate, lateral lobes 4–5 mm long, 1.8–2.2 mm wide, obovate, mid-lobe 4.5–6 mm long, 2.5–3.5 mm wide, broadly obovate. Filaments all glabrous. Capsules



Figure 45(2)–6: *Pedicularis angustiloba* P. C. Tsoong. a, habit; b, flower; c, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 50, figure 4: 1-3. 1963].



Map 45(2)-9: *Pedicularis angustiloba* P. C. Tsoong

14–17 mm long, oblong-ovoid, apex short-acuminate. Seeds oblong, 2–2.5 mm long, reticulate.

Phenology: flowering and fruiting from August to September.

Habitats: alpine meadows and scrublands, rocky grassland and along stream loose beds moraine screes, dry places in forests; 3700–4200 m.

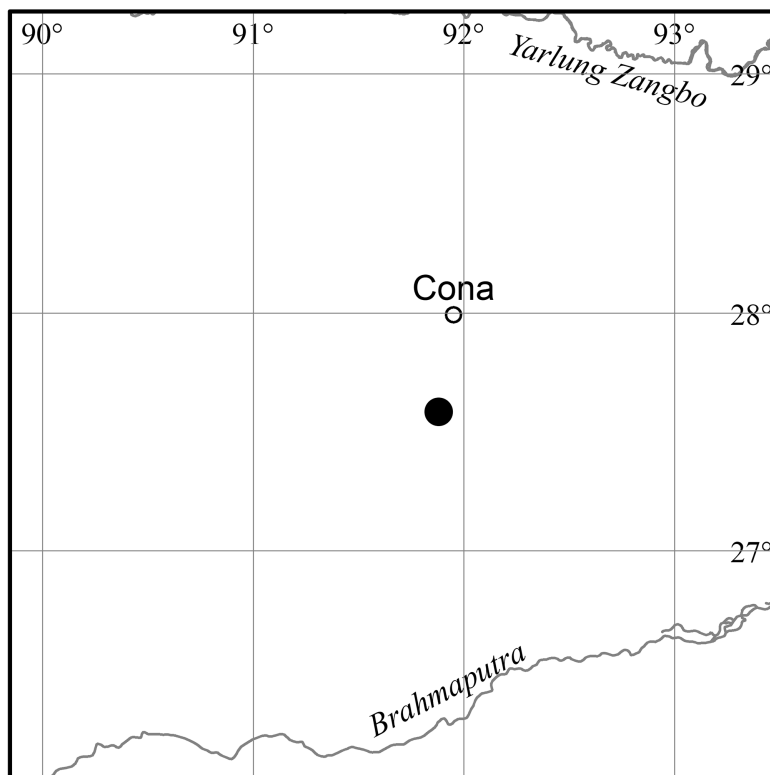
Distribution: endemic; Yarlung Zangbo-Brahmaputra [Map 45(2)–10].

Notes: *Pedicularis khoiyangii* D. Borah & R. Kr. Singh was described in 2020 (Phytotaxa 430: 287–293), and no additional specimen has been seen.

YARLUNG ZANGBO-BRAHMAPUTRA: Moindawang, Taktsang, 3700 m, 24 August 2019, *D. Borah 0126* (ASSAM).

11. *Pedicularis trichomata* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 70. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 52. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 104. 1998. Type: China, NW Yunnan (precise location unknown, it should be Muli or Yulong counties, based on Yü's exploration history), 1937, *T. T. Yü 6437* [holotype: A(00097290); isotype: PE(00032975)].

Herbs perennial and black when dry. Whip-like rhizome 5–10 cm long, with a tuft of fibrous rootlets near the upper end, lower part leading to a taproot, usually 8–13 mm in diameter. Stems 10–40 cm tall, erect, unbranched, densely brown-pubescent, with few ovate scales at base. Leaves more or less clasping, sessile, leaf blade linear-lanceolate, 3–5 cm long, 5–6 mm wide, auriculate at base, margin incised double-dentate,



Map 45(2)-10: *Pedicularis khoiyangii* D. Borah & R. Kr. Singh

apex acute. Inflorescences racemose, 5–15 cm long, dense; bracts leaflike; pedicels 1–1.5 mm long. Calyx oblong-ovate, 10–12 mm long; lobes 5, triangular, more or less entire. Corolla yellow; tube 10–12 mm long; galea conspicuously navicular, 13–15 mm long, 4–5 mm wide, margin densely long-pubescent; lower lip 10–12 mm long, 11–12 mm wide, lobes more or less rounded, denticulate. Filaments 2 pubescent, 2 completely glabrous. Ovary 4–5 mm long. Known only from the type collection.

Phenology: flowering from June to August.

Habitats: unknown.

Distribution: endemic; Tangut, S Hengduan [Map 45(2)–11].

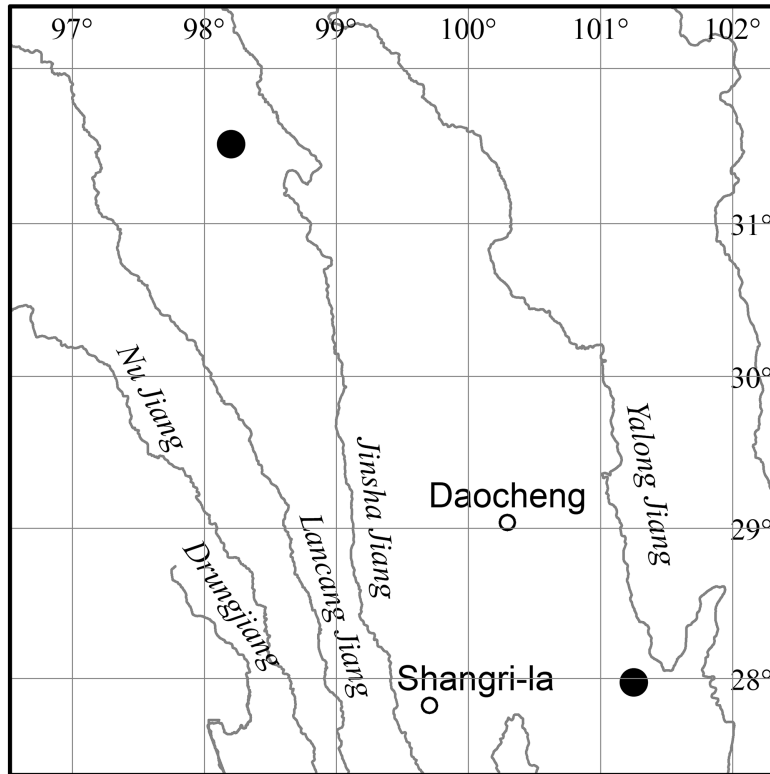
Notes: Li described *P. trichomata* H. L. Li as new but recognized that it is an uncertain species, and no more collections have been obtained since it was described as new. This species is closely

related to *P. steiningeri* Bonati, with bracts some longer than those of *P. steiningeri*. Because only a few specimens are available, more studies are needed to further confirm taxonomic status of *P. trichomata* H. L. Li.

TANGUT: Jomda, 3600 m, 22 July 1976, *Qinghai-Xizang Exped. 12398* (HNWP, PE). **S HENGDUAN:** Muli/Yulong (Lijiang), field records not available, 1937, *T. T. Yü 6437* (PE).

12. *Pedicularis ingens* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 565. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 50. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 107. 1998. Type: China, W Sichuan (Sze-tschuan parte boreali: ad flov. Nerechu), 26 July 1885, *G. N. Potanin s.n.* [holotype: LE].

Pedicularis pseudoingens Bonati, Notes Roy. Bot. Gard. Edinb. 8: 135. 1913; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 52.



Map 45(2)-11: *Pedicularis trichomata* H. L. Li

1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 108. 1998. **syn. nov.** Type: China, Yunnan, Dêqên, Atuntsi, 4260 m, July 1911, *F. Kingdon-Ward 130* [holotype: E(E00284012)].

Herbs perennial and black when dry. Whip-like rhizome 10–20 cm long, 3 mm in diameter, with a tuft of fibrous rootlets near the upper end, lower part leading to a long taproot, 5–10 mm in diameter. Stems more than 60 cm tall, erect, hollow, pubescent, with oblong scales at base. Basal leaves withering early; cauline leaves clasping, sessile; leaf blade oblong-linear, 6–9 cm long, 0.9–1.2 cm wide, auriculate at base, margin incised double-dentate; teeth more than 40 pairs, apex acute. Inflorescences usually 10–20 cm long; bracts leaflike. Calyx 10–12 mm long, densely pubescent; lobes 5, serrulate. Corolla yellow, 20–26 mm long; tube slender, 14–15 mm long; galea inconspicuously navicular, margin long-pubescent; beak short, indistinct,

apex 2-cleft; lower lip 7–8 mm long, 10 mm wide, lobes denticulate. Filaments 2 pubescent, 2 glabrous. Figure 45(2)–7.

Phenology: flowering and fruiting from July to September.

Habitats: high weedy slopes, grassy and scrubby slopes; 3000–4200 m.

Distribution: Tangut, N Hengduan, S Hengduan; also in other regions of Qinghai and Gansu Provinces, China. [Map 45(2)–12].

Notes: Maximowicz in the protologue of *P. ingens* cited one collection “Prov. Sze-tschuan parte boreali: ad fl. Nerechu (Potanin, 1885)”. One sheet of this collection deposited in the herbarium LE was noted as “holotype”, attached is a drawing of a corolla. Bonati described *P. pseudoingens* as new and cited one collection “China: NW Yunnan, at Atuntsi, 4267 m, July 1911, *F. Kingdon-Ward. No. 130*”. A statistic of

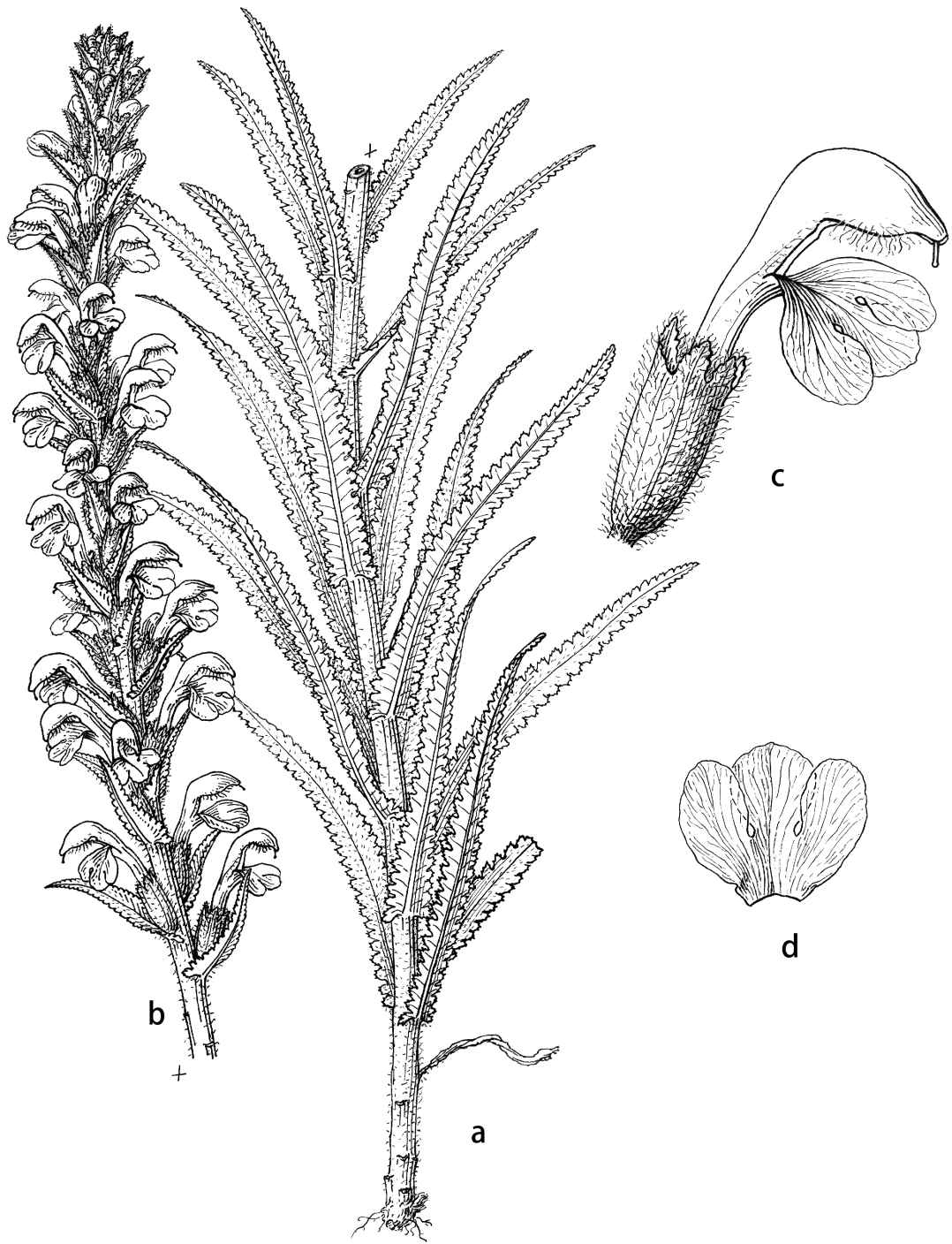
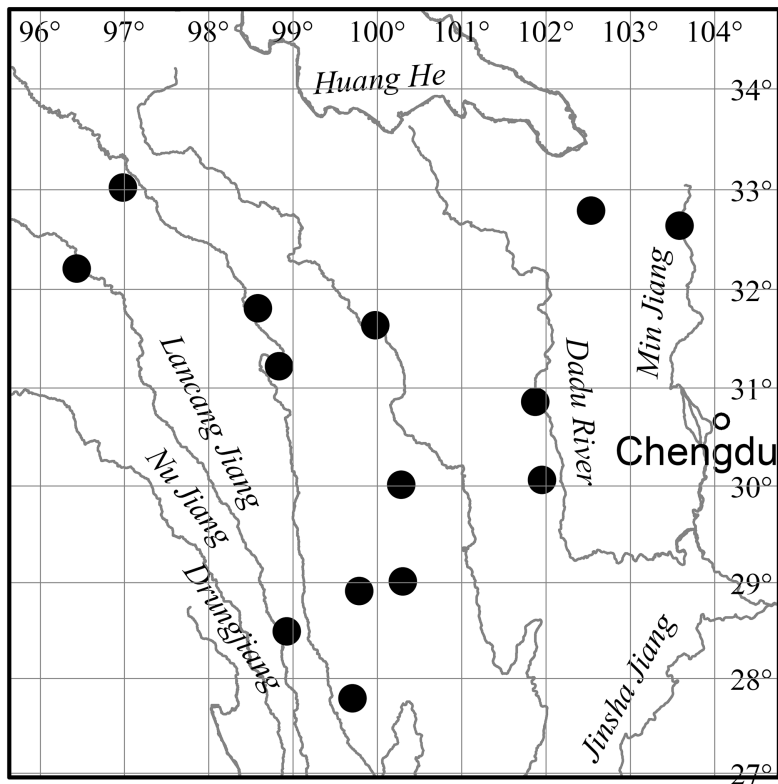


Figure 45(2)–7: *Pedicularis ingens* Maxim. a, habit; b, inflorescence; c, flower; d, corolla lip. Drawn by J.-Y. FENG [*Iconogr. Cormophyt. Sin.* 4: 63, figure 5540. 1975].



Map 45(2)-12: *Pedicularis ingens* Maxim.

morphological characters confirms that *P. ingens* and *P. pseudoingens* should be the same species. In *Fl. Reipubl. Popularis Sin.* (1963. 68: 52), Tsoong's description of *P. pseudoingens* as "corolla 12–15 mm in length" is not correct, because the corolla of the holotype (E00248012) reaches 23 mm in length.

TANGUT: **Dêgê**, 28 July 1951, *Y. W. Cui* 1989 (PE). **Garzê**, Zhuodala Shan, 3800 m, 1 Aug. 2001, *F. S. Yang* Y0123 (PE). **Nangqên**, W of Jiangxi Forest Station on W side of the Zi Qu, SE of Mozhong, 3450–3550 m, 28 Aug. 1996, *T. N. Ho, B. Barhtolomew, M. Watson et al.* 2510 (CAS, E, HNWP, MO). **Yushu**, 19 Aug. 1996, *T. N. Ho, B. Barhtolomew, M. Watson et al.* 2088 (CAS, E, HNWP, MO). **N HENGDUAN:** **Baiyü**, 4150 m, 14 Aug. 1982, *Z. X. Tang* 738 (PE). **Danba**, Bajiazhai, 2834 m, 26 Sept. 2011, *Y. Yu et al.* SCU-11-071 (KUN). **Hongyuan**, 3489 m, 18 Sept. 2009, *C. B. Zhang & X. H. Zheng*

ZhangCB0261 (KUN). **Litang**, 4200–4500 m, 9 Aug. 2006, *D. E. Boufford et al.* 36165 (PE). **Songpan**, 3400 m, 9 July 1922, *H. Smith* 2474 (PE). **S HENGDUAN:** **Daocheng**, Wuming Shan, 4100 m, 24 July 2001, *F. S. Yang* Y0237 (PE). **Dêqên**, Baimaxue Shan, 1917–1919, *G. Forrest* 14392 (K); Dêqên, Baimaxue Shan, 4260 m, July 1911, *F. Kingdon-Ward* 130 (E); Dêqên, Baimaxue Shan, 3000 m, Sept. 1935, *C. W. Wang* 69743 (PE); Dêqên, Jiansheju, 2700 m, 1935, *C. W. Wang* 70122 (PE); Dêqên, Atuntsi, Baimaxue Shan, 3500 m, 7 June 1937, *T. T. Yü* 8762 (PE). **Kangding**, Tapao Shan, 3900 m, 26 Aug. 1934, *H. Smith* 11533 (PE). **Shangri-la** (Zhongdian), near the county, 3200 m, 27 July 1937, *T. T. Yü* 12498 (PE); Shangri-la (Zhongdian), Daxue Shan, 3700 m, 31 July 1983, *Hengduan Shan Veg. Exped.* 4735 (PE). **Xiangcheng**, Dumukong, 3980 m, 26 June 1960, *Institute of KUN (CAS)* 9649 (PE).

13. *Pedicularis cholashanensis* T. Yamaz., J. Jap. Bot. 75: 220. 2000. Type: China, Sichuan, Dêgê, Manigange, 4380 m, 25 Sept. 1994, G. Miehe, S. Miehe & U. Wumdisch 94-412-26 [holotype: TI].

Herbs perennial and black when dry. Stems 20–35 cm tall, erect, pubescent, with oblong scales at base. Basal leaves withering early; cauline leaves alternate, clasping, sessile; leaf blade linear, 1.5–5 cm long, 2–4 mm wide, auriculate at base, margin incised double-dentate. Inflorescences 9–15 cm long, pubescent; bracts leaf-like, slightly shorter than flowers. Calyx 8–11 mm long, densely pubescent; lobes 5, triangle, margin entire. Corolla 20–22 mm long; tube erect, 13–15 mm long, 1.5 mm wide, glabrous; galea 8–9 mm long, 3 mm wide, inconspicuously navicular, margin long-pubescent; beak 3–4 mm long, apex 2-cleft; lower lip 7–8 mm long, 9–10 mm wide, margin glabrous. Filaments all glabrous.

Phenology: flowering and fruiting from July to September.

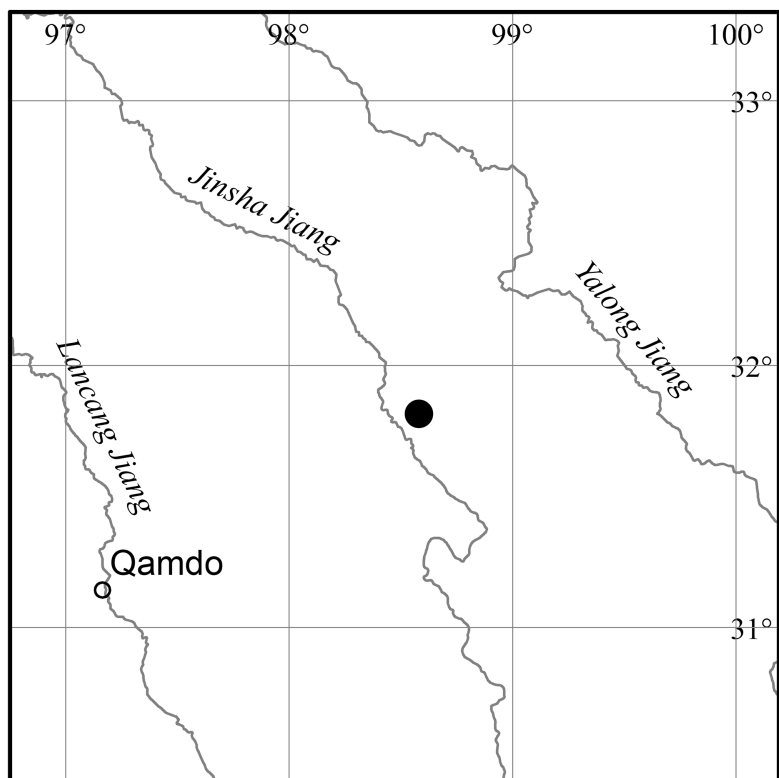
Habitats: gassy and scrubby slopes; 4000–4400 m.

Distribution: endemic; Tangut [Map 45(2)–13].

Notes: Based on the protologue, *P. cholashanensis* T. Yamaz. is similar to *P. ingens* Maxim. but differs in having narrower leaves, wider galea, and small capsules. It might be a variety of *P. ingens* Maxim. Known only from the original collection.

TANGUT: Dêgê, Dêgê to Garzê, 31°52' N, 99°07' E, 4280–4600 m, 25 Sept. 1994, G. Miehe, S. Miehe & U. Wumdisch 94-400-1 (GOET).

14. *Pedicularis steingeri* Bonati, Bull. Soc. Bot. France 55: 311. 1908; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 51.



Map 45(2)–13: *Pedicularis cholashanensis* T. Yamaz.

1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 107. 1998. Type: China, Sichuan, Yargong, Aug. 1903, *M. I. Soulié 3741* [holotype: P(P02969045)]; Yargong, Aug. 1903, *Soulié 3742* [paratype: P(P02969044)].

Pedicularis pseudosteineri Bonati, *Notes Roy. Bot. Gard. Edinb.* 15: 157. 1926; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 48. 1963. **syn. nov.** Type: China, Sichuan, Muli, 3000–4200 m, June 1922, *J. F. Rock 5560* [holotype: E; isotype: US].

Pedicularis lophotricha H. L. Li, *Proc. Acad. Nat. Sci. Philad.* 101: 71. 1949; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 49. 1963. **syn. nov.** Type: China, Sichuan, Kangding and adjacent regions, Mount Konka, Risonquemba, Konkaling, 4370–4700 m, June 1928, *J. F. Rock 16399* [holotype: PH(00020105); isotype: E(E00284011)].

Herbs perennial and black when dry. Stems 35–70 cm tall, erect, unbranched, hollow, hispid. Whip-like rhizome usually 7–10 cm long, 3 mm in diameter, with a tuft of fibrous rootlets near the upper end, lower part leading to a long tap-root, 5–10 mm in diameter. Basal leaves scalelike; cauline leaves clasping; leaf blade linear, linear-lanceolate, 5–7 cm long, 6–8 mm wide, adaxially glabrous except for pubescent midvein, broadly auriculate at base, margin crenate, apex acute; teeth 50–60 pairs. Inflorescences long racemose, 5–20 cm long, more or less dense; bracts ovate-lanceolate, ciliate. Calyx 10–11 mm long; lobes 5, triangular-ovate, ciliate, more or less entire. Corolla yellow, 26–32 mm long; tube 10–12 mm long, erect, 1.5–2 times as long as calyx; galea 12–18 mm long, margin densely long-pubescent; galea falcate, inconspicuously navicular, margin bearded; beak 2–4 mm long, indistinct, decurved, apex cleft; lower lip 7–8 mm long, 10–12 mm wide. Filaments all pubescent.

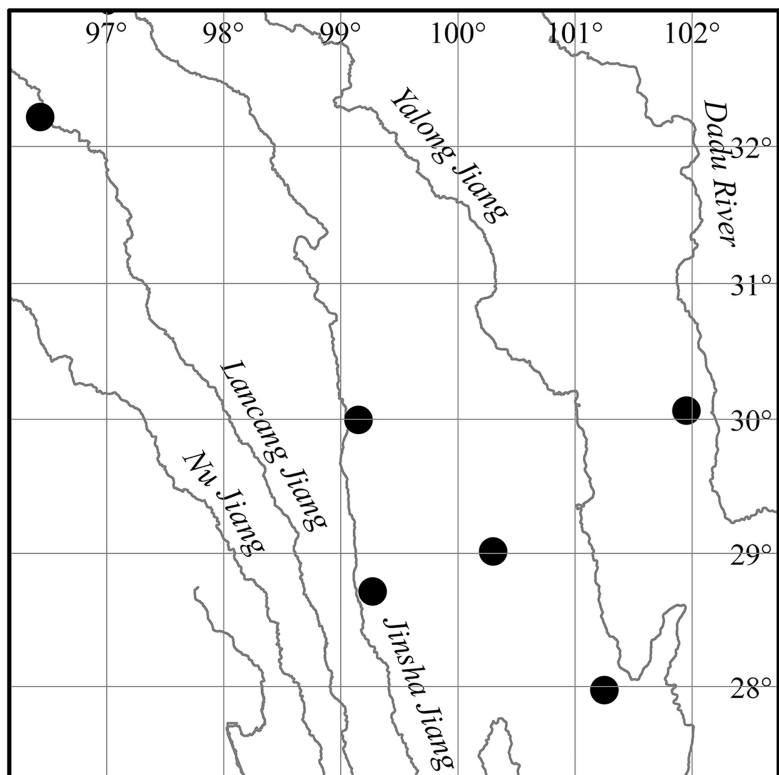
Phenology: flowering from June to August.

Habitats: open meadows, forest margins, *Picea* forests, amidst grass in shrubbery; 3000–4300 m.

Distribution: endemic; Tangut, N Hengduan, S Hengduan [Map 45(2)–14].

Notes: When Li described *P. lophotricha* H. L. Li as new, he stated that it is different from *P. pseudosteineri* Bonati in having a slight difference in leaves, size of calyx, and shape of corolla. However, Tsoong in *Fl. Reipubl. Popularis Sin.* considered that there is no obvious difference between *P. pseudosteineri* and *P. lophotricha*. Moreover, Li stated that *P. steineri* is an uncertain species, and more specimens are needed to clarify the taxonomic status. We find that there are no morphological gaps among *P. steineri*, *P. pseudosteineri*, and *P. lophotricha*, and these taxa should be treated as one species. Bonati (1908) cited one collection in describing *P. steineri* Bonati as new, i.e., “Yargong (*Soulié*) No. 3741, août 1904”. Two collections of *Soulié* [3741 (P02969045) and 3742 (P02969044)] are available (P), which were collected in 1903 in Batang, Sichuan, China. *Soulié 3741* (P02969045) should be a holotype and *Soulié 3742* (P02969044) should be a paratype.

TANGUT: Nangqên, just W of Jiangxi Forest Station, on W side of the Zi Qu, SE of Mozhong, 3550 m, 28 Aug. 1996, *T. N. Ho, B. Bartholomew, M. Watson et al. 2510* (E, HNWP, MO, PE). **N HENGDUAN:** Batang, 3600 m, 22 July 1883, *K. Y. Lang & L. Q. Li 2255* (PE). **S HENGDUAN:** Daocheng, Sangdui, 4200 m, 22 Aug. 1981, *Qinghai-Xizang Exped. 005147* (PE); Daocheng, Chonggu to Luorong, 4100 m, 28 Aug. 1981, *Qinghai-Xizang Exped. 545* (PE). **Dêrong**, 65 km to Batang, 4129 m, 26 Sept. 2010, *H. Sun et al., SunH-07ZX-2901* (KUN); Dêrong, Gajingxue Shan, NW of the city of Dêrong, 4200–4400 m, 19 July 2004, *D. E. Boufford, J. H. Chen, S. L. Kelley et al. 30866* (KUN). **Kangding**, 3550 m, 1 Aug. 1982, *K. Y. Lang & L. Q. Li 888* (PE); Kangding, 3500 m, 26 July 1963, *K. C. Kuan & W. T. Wang 975* (PE); Kangding, Mount Konka, Risonquemba, Konkaling, 4370–4700 m, June 1928, *J. F. Rock 16399* (PH); Kangding, Gongga Shan, 4150 m, 10 Aug. 2017, *X. F. Gao et al. THP-KD-5885* (CDBI). **Muli**, 3700 m, 11 July 1937, *T. T. Yü 7004* (KUN, PE).



Map 45(2)-14: *Pedicularis steingeri* Bonati

15. *Pedicularis trichocymba* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 72. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 52. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 108. 1998. Type: China, Sichuan, Kangding, Baurong to Tachienlu, 2750–4730 m, May–June 1929, *H. Stevens* 535 [holotype: PH(00020200); isotype: US(00125638)].

Herbs perennial. Stems 40–60 cm tall, erect, sturdy, unbranched, glabrous, striate, and leafy throughout. Leaves sessile; leaf blade linear-lanceolate, 6.5–7.5 cm long, 7–10 mm wide, glabrous, auriculate at base, margin incised-dentate; teeth 25–40 pairs. Inflorescences racemose, 10–15 cm long, interrupted at base; bracts leaflike, exceeding flowers; pedicels 1–2 mm long. Calyx 8–10 mm long, glabrous; lobes 5, equal. Corolla yellow, 24–26 mm long; tube erect, ca. 2 times as long as calyx; galea curved apically, inconspicuously navicular, 8–10 mm long; beak scarcely

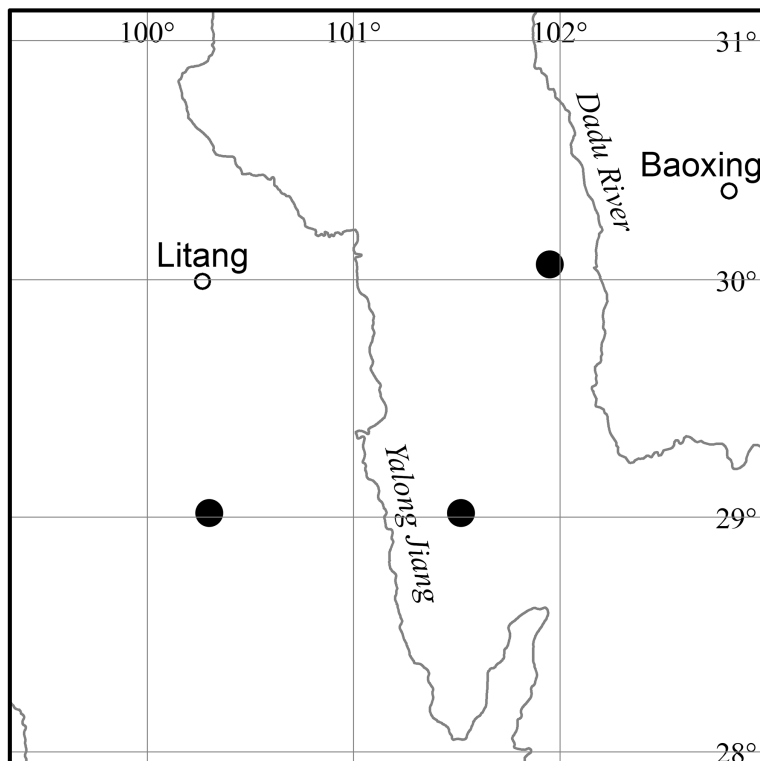
2 mm long; lower lip ca. as long as galea. Filaments 2 pubescent, 2 glabrous.

Phenology: flowering and fruiting from May to September.

Habitats: scrubs, grassy slopes; 2700–4750 m.

Distribution: endemic; S Hengduan [Map 45(2)-15].

Notes: When Li described *P. trichocymba* H. L. Li as new he stated that “The species is probably related to *P. tongolensis* Franch. which it resembles especially in the relatively long corolla tube, though otherwise, the corollas of the two plants are different. *Pedicularis tongolensis* was described as having glabrous filaments, while in this new species the anterior filaments are hairy distally. *Pedicularis trichocymba* is also characterized by the stipitate lower lip, the more or less narrowed and elongated base being somewhat erect and parallel to the lower



Map 45(2)-15: *Pedicularis trichocymba* H. L. Li

part of the galea". Morphologically, *P. trichocymba* is quite similar to the next species *P. tongolensis* Franch., further studies are necessary to clarify the taxonomic status of *P. trichocymba* H. L. Li.

S HENGDUAN: Daocheng, on roadside of S216, km-stone 66, 3901 m, 5 Aug. 2010, *T. Zhang et al.* 10 CS 2253 (K, KUN); Daocheng, Riwa, E-chu Shan, 3900 m, 1 Aug. 1982, *Q. Q. Wang* 29193 (CDBI0127296-CDBI0127299). **Jiulong,** Naiqu, 1 Aug. 1979, *Q. Q. Wang* 21033 (CDBI). **Kangding,** Baurong to Tachienlu, 2750–4730 m, May–June 1929, *H. Stevens* 535 (PH); Kangding, Gongga Shan, 4000 m, 2 July 1979, *X. H. Hu* 20709 (CDBI0127300, CDBI0127301).

16. *Pedicularis tongolensis* Franch., Bull. Soc. Bot. France 47: 29. 1900; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 53. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 108. 1998. Type: China, Kangding (Tongolo) (no more detailed information), 1893, *J. A. Soulié* 306

[lectotype designated here: P(P02968472); isolectotype: P(P02968473)].

Herbs perennial and black when dry. Whip-like rhizome 5–10 cm long, with a tuft of fibrous rootlets near the upper end, lower part connecting to a taproot, 5–10 mm in diameter. Stems 30–60 cm tall, erect, unbranched, long-pubescent, leafy throughout. Leaves sessile; leaf blade lanceolate-linear, 5–7 cm long, 3–6 mm wide; segments 20–30 pairs, margin densely incised. Inflorescences spicate, 10–18 cm long, loose. Calyx membranous, sparsely pubescent; lobes 5, ovate-lanceolate, ca. 3 times shorter than the tube, long ciliate, entire. Corolla yellow, 22–30 mm long, erect; tube ca. 2 times longer than calyx; galea curved, inconspicuously navicular, 10–12 mm long, 4 mm wide, margin densely red pubescence; beak curved, 2–3 mm long; lower lip scarcely shorter than galea. Filaments all glabrous.

Phenology: flowering and fruiting from May to August.

Habitats: scrubs, grassy slopes; 3100–4000 m.

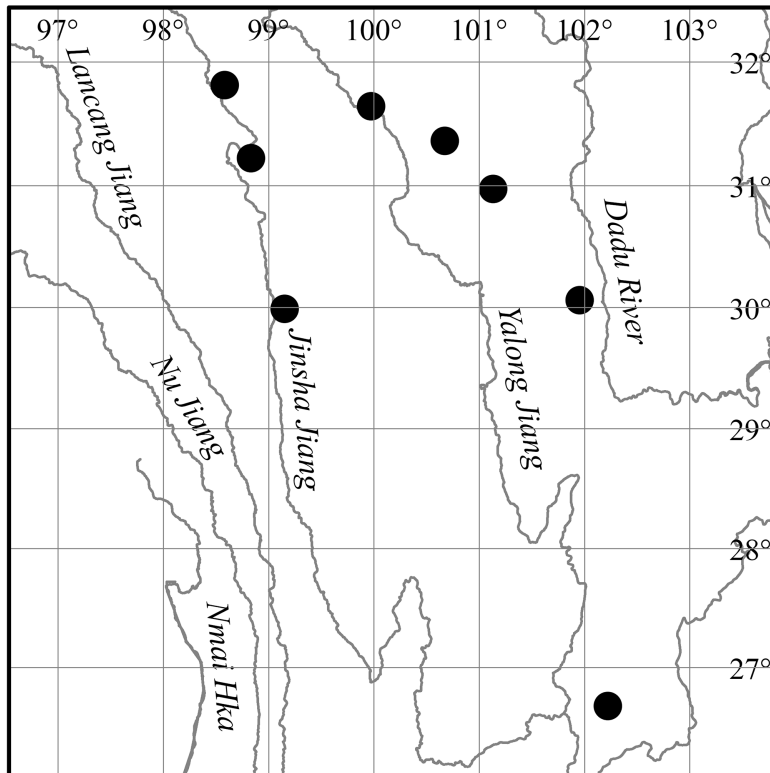
Distribution: endemic; Tangut, N Hengduan, S Hengduan [Map 45(2)–16].

Notes: Franchet cited four collections in the protologue of *P. tongolensis* Franch., and *J. A. Soulié 306* deposited in the herbarium P(P02968472) is designated here as lectotype. Our phylogenetic study shows that several accessions of this species do not form a monophyletic clade, and further studies are necessary to clarify the confusion.

TANGUT: Dêgê, near the city, 3450 m, 27 July 1927, *S. Jiang & C. L. Jiang 2467* (PE); Dêgê, 5 Aug. 1951, *Y. W. Cui 5144* (PE). **Garzê**, Ganbai road, 15 km to Baiyu, 3973 m, 26 Sept. 2011, *H. Sun et al. SunH-07ZX-3968* (KUN).

N HENGDUAN: Baiyü, Anzi, 155 km of Ganbai road, 3828 m, 22 Sept. 2011, *H. Sun et al. SunH-07ZX-3665* (KUN). **Batang**, Zhongzaqulipu, 3600 m, 30 July 1963, *K. C. Kuan & W. T. Wang 592* (PE); Batang, Zhongzaqulipu, 3600 m, 30 July 1963, *K. C. Kuan, L. Q. Li & Y. Huang 2273* (PE). **Dawu**, Gekachanglanggou, 4320 m, 6 Sept. 1960, *Z. T. Guan 610181* (PE); Dawu, Sept. 1960, *Z. T. Guan 60020* (PE). **Luhuo**, Zhuwei, 3480 m, 23 July 1959, *South-to-North Water Divers. Proj. Exped. 02374* (PE).

S HENGDUAN: Huili, Baimamiao, 2200 m, 5 Sept. 1933, *T. T. Yü 1408* (PE). **Kangding**, Zhonggudagaigou, 3500 m, 27 July 1963, *K. C. Kuan & W. T. Wang 442* (PE); Kangding, Xinduqiao, July 1893, *J. A. Soulié 306* (K).



Map 45(2)–16: *Pedicularis tongolensis* Franch.

Ser. 6. Imbricatae

Ser. Imbricatae P. C. Tsoong ex H. P. Yang, Acta Phytotax. Sin. 33: 244. 1995. Type: *Pedicularis clarkei* Hook. f.

Herbs usually 30 cm to 1 m tall, and black when dry. Stems erect, rarely branched. Leaves alternate, mostly cauline, sessile; leaf blade linear to linear-oblong, pinnatifid. Inflorescences racemose. Corolla galea crescent-shaped, less than 3 mm wide, sparsely pubescent; beak distinct.

Two species; both in the Pan-Himalaya (2 endemics).

Notes: Tsoong [1955. Bull. Brit. Mus (Nat. Hist.) Bot. 2. 1: 3–34] described three species (*P. mucronulata* P. C. Tsoong, *P. imbricata* P. C. Tsoong, and *P. platychila* P. C. Tsoong) as new, which were placed in the series *Rudes*. In the updated classification system of Tsoong & Yang (1995. Acta Phytotax. Sin. 33: 244), these taxa were transferred to the series *Imbricatae* P. C. Tsoong ex H. P. Yang. Yamazaki [1963. Acta Phytotax. Geobot. 19(4–6): 110–111] described *P. anserantha* T. Yamaz. as new, and he stated that it assembles *P. rudis* Maxim. but differs in having glabrous calyx tube and larger capsule, and he placed *P. anserantha* in the series *Rudes* (Yamazaki might have not seen Tsoong's new system published in the same year). However, *P. anserantha* is characterized by narrow and falcate galea, with long pubescence on the back and margin; whereas species in the series *Rudes* are characterized by wide and boat-shaped galea, with long pubescence on the margin. The diagnostic characteristics of *P. anserantha* T. Yamaz. are similar to those of *P. clarkei* Hook. f. (Ser. *Imbricatae*), and *P. anserantha* should be transferred to the series *Imbricatae*. The series *Imbricatae* is different from the series *Craspedotrichae* by pinnatipartite leaves and crescent galea.

These “species” mentioned above were mainly distinguished by more or less of hairs on calyx, more or less pubescence of filaments, and decurved or incurved or straight beak of corolla. However, hairs of plants vary greatly within or among populations, and beak angle varies among populations and “species”. It is difficult to identify all of these taxa based on these “diagnostic” characters. After extensive examinations of specimens, we find that these taxa can be determined as two species (*P. clarkei* Hook. f. and *P. anserantha* T. Yamaz.) based on the variation of galea and filaments (see the key). Our molecular phylogenetic results reveal that *P. clarkei* Hook. f. and *P. anserantha* T. Yamaz. form a well-supported clade outside the clade of the series *Rudes*, supporting the separation of the series *Imbricatae* from the series *Rudes*.

- 1a. Galea slightly intumescent, 3–5 mm wide; 2 posterior filaments pilose, 2 anterior filaments glabrous or pilose.....17. *P. anserantha*
1b. Galea crescent, 2–3 mm wide; filaments all glabrous or pilosa at base.....18. *P. clarkei*

17. *Pedicularis anserantha* T. Yamaz., Act. Phytotax. Geobot. 19: 110. 1963; J. Jap. Bot. 53: 323. 1973; Hara *et al.*, Enum. Fl. Pl. Nepal 3: 122. 1982. Type: Nepal, 3780 m (no more detailed information), 22 Sept. 1958, O. Namikawa 356 [holotype: KYO].

Pedicularis ingentoides T. Yamaz., J. Jap. Bot. 45: 167. 1970. Type: Nepal, Tukicha, Kali Gandaki, 3657 m, J. D. A. Stainton, W. R. Sykes & L. H. J. Williams 1886 [holotype: BM (BM000521611)].

Pedicularis anserantha var. *elevatogaleata* (T. Yamaz.) T. Yamaz., in H. Ohba & S. B. Malla, Himalayan Pl. 1 (Univ. Mus. Univ. Tokyo Bull. 31) 128. 1988. **syn. nov.** ≡ *Pedicularis elevatogaleata* T. Yamaz., J. Jap. Bot. 45: 166. 1970. Type: Nepal, near Balangra Pass, 4420 m, J. D. A. Stainton, W. R. Sykes & L. H. J. Williams 7260 [holotype: BM(BM000521613); isotype: TI].

Perennial herbs, 40–80 cm tall. Roots straight, sparsely branched, fleshy. Stems stout, simple,

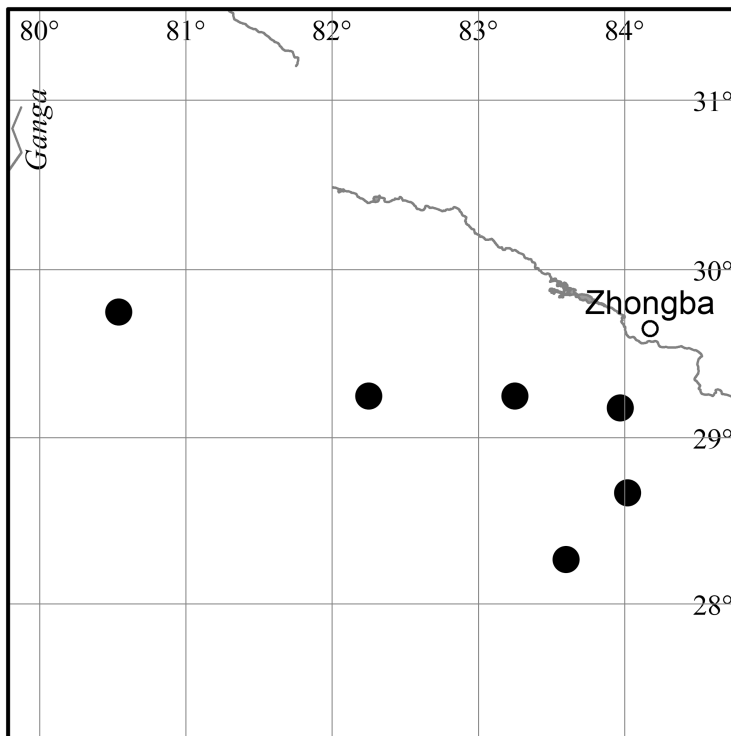
erect, white-lanate. Leaves alternate, sessile; leaf blade linear or linear-lanceolate, 4–8 cm long, 0.5–2 cm wide, subcordate or truncate and semi-amplexicaul at base, acuminate at apex, pinnatifid, segments deltoid-ovate, doubly acute-serrate. Inflorescences spicate, 15–25 cm long; bracts leaf-like. Calyx tubular-campanulate, 12–15 mm long, densely lanate, 5-lobed, lateral lobes lanceolate, acute at apex, 3–4 mm long, 1.5 mm wide, posterior lobe smaller. Corolla pale yellow; tube 10–13 mm long, 2.5 mm wide; galea decurved near the base, 13–15 mm long, 3–4 mm wide, ending in a sub-acute apex, densely lanate on margins; lower lip 10–12 mm long, 10 mm wide, pilose on margins; posterior 2 filaments pilose, anterior 2 glabrous or pilose. Capsule obliquely oblong-ovate, 15–20 mm long, 6–8 mm wide. **Chromosomes:** $2n = 28$.

Phenology: flowering from June to August.

Habitats: on steep open slopes, among *Rhododendron* scrubs; 3900–4000 m.

Distribution: endemic; W Nepal, C Nepal [Map 45(2)–17].

Notes: Yamazaki [1970. J. Jap. Bot. 45(6): 166–179] described *P. elevatogaleata* T. Yamaz. and *P. ingentoides* T. Yamaz. as new based on several collections from Nepal, and he also stated that the latter is similar to the former, or it is a variety of the former. In the protologue, Yamazaki mistakenly recorded that corolla of *P. ingentoides* T. Yamaz. is 10 cm long (it should be 10 mm). In 1988, Yamazaki [In Ohba, H. & Malla, S. B. (eds.). The Himalayan Plants. Vol. 1: 91–161] made a revision of *Pedicularis* in Nepal, and he treated *P. ingentoides* T. Yamaz. as a new synonym of *P. anserantha* T. Yamaz., and treated *P. elevatogaleata* T. Yamaz. as a variety of *P. anserantha* T. Yamaz. based on the chief difference “Corolla with upcurved acute beak, lemon yellow with purplish tipped galea”. After examinations of types and more specimens, we find that shape and color of corolla vary between and within populations, hence *P. elevatogaleata* T. Yamaz. (*P. anserantha* var. *elevatogaleata*) is here treated as new synonyms of *P. anserantha* T. Yamaz.



Map 45(2)–17: *Pedicularis anserantha* T. Yamaz.

W NEPAL: Karnali, Dolpa, Balangra La, 4390 m, 26 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams* 2577 (BM); Karnali, Dolpa, Jangla Bhanjyang, 3900 m, 15 Aug. 1973, *S. Einarsson, L. Skärby & B. Wetterhall* 3248 (BM); Karnali, Dolpa, Lulo Khola, 4560 m, 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams* 3519 (BM); Karnali, Mugu, 3920 m, 4 Aug. 1983, *D. P. Joshi, K. Tsuchiya, N. Fujita et al.* 17943 (BM); Karnali, Jumla, Bhurchula Lekh, 3657 m, 16 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams* 4722 (BM). **C NEPAL:** Dhawalagiri, Baglung, Phagune Dhuri, 3640 m, 7 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3412 (BM); Dhawalagiri, Mustang, Ommang, 3730 m, 2 Aug. 1996, *T. Hoshino, M. Amano, H. Koba et al.* 9666134 (E). Gandaki, Manang, 4000 m, 1 Aug. 1983, *H. Ohba, H. Kanai, M. Wakabayashi et al.* 8310934 (E); Gandaki, Manang, Yak Kharka, 3750 m, 18 Aug. 1994, *M. Mikage, N. Fujii, T. Kajita et al.* 9485472 (BM).

18. *Pedicularis clarkei* Hook. f., Fl. Brit. Ind. 4: 310. 1885; Prain, Ann. Roy. Bot. Gard. Calc. 3: 161. 1890. Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 54. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 108. 1998. Type: India, Sikkim, Jongri, 3650 m, 15 Oct. 1875, *C. B. Clarke* 25935 [lectotype designated by Husain *et al.* (2010:133): K].

Pedicularis imbricata P. C. Tsoong, Acta Phytotax. Sin. 3: 301, 328. 1955; Bull. Brit. Mus. (Nat. Hist.), Bot. 2: 24. 1955. **syn. nov.** Type: Bhutan, Ju La, Bumthang Chu, 4260 m, amidst grass in shrubbery, 20 July 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 16914 [holotype: BM(BM000885921); isotypes: E(E00273613), PE(00031370)].

Pedicularis platychila P. C. Tsoong, Acta Phytotax. Sin. 3: 301. 328. 1955; Bull. Brit. Mus. (Nat. Hist.), Bot. 2: 24. 1955. **syn. nov.** Type: Yarlung Zangbo-Brahmaputra, Ze La, 4260 m, 19 Aug. 1938, *F. Kingdon-Ward* 14119 [holotype: BM(BM000629748)].

Pedicularis mucronulata P. C. Tsoong, Bull. Brit. Mus. (Nat. Hist.), Bot. 2: 23. 1955; Acta Phytotax. Sin. 3: 300, 328. 1955. **syn. nov.** Type: Bhutan, Upper Kulong Chu district,

Shingbe Dzong, 2438 m, 21 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 21313 [holotype: BM(BM000885879); isotype: E(E00273601)].

Pedicularis sanguilimbata R. R. Mill, Edinb. J. Bot. 58: 73. 2001. **syn. nov.** Type: Bhutan, Upper Kuru Chu district, Singhi Kurted, 3810 m, *R. E. Cooper* (collector for *A. K. Bulley, Esq. Cheshire*) 4304 [holotype: E(E00273579)]. It was determined as '*cf. P. mucronulata* Tsoong' by *A. J. C. Grierson & D. G. Long* in Nov. 1978.

Pedicularis melalimne R. R. Mill., Edinb. J. Bot. 58(1): 71. 2001. **syn. nov.** Type: China/Bhutan border, upper Kulong Chu district, Shingbe (Me La), 3963 m, 22 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 21058 [holotype: BM(BM000797966)].

Perennial herbs, 30–90 cm tall. Stems stout, simple, erect, sparsely white-lanate. Leaves alternate, sessile; leaf blade truncate and semi-amplexicaul at base, linear to linear-lanceolate, 4–10 cm long, 1–2 cm wide, acute at apex, deeply pinnatifid; segments 8–25 pairs, ovate, acute, doubly incised-serrate. Inflorescences spicate, terminal, 8–25 cm long, subdensely lanate; bracts leaf-like, linear, lanate. Calyx tubular-campanulate, 10–12 mm long, 3–4 mm wide, subdensely lanate, 5-lobed. Corolla purple or yellow, with white or pinkish lip, tube 12–15 mm long; galea abruptly decurved from the middle, erect part 4–6 mm long, anther-bearing part ca. 3 mm wide, leading to a straight acute beak, sparsely to subdensely lanate on upper side and margins; lower lip 8–10 mm long, 8 mm wide, subequaling galea, pilose on margins, 3-lobed, lobes subequal, oblong, 3–4 mm long, 2 mm wide; filaments all glabrous. Capsule obliquely ovate, acuminate, 13–15 mm long, 7–8 mm wide. Figure 45(2)–8.

Phenology: flowering and fruiting from June to August.

Habitats: among shrubs, on open slopes; 2400–4200 m.

Distribution: endemic; C Nepal, E Nepal, Sikkim, Bhutan, Yarlung Zangbo-Brahmaputra [Map 45(2)–18].

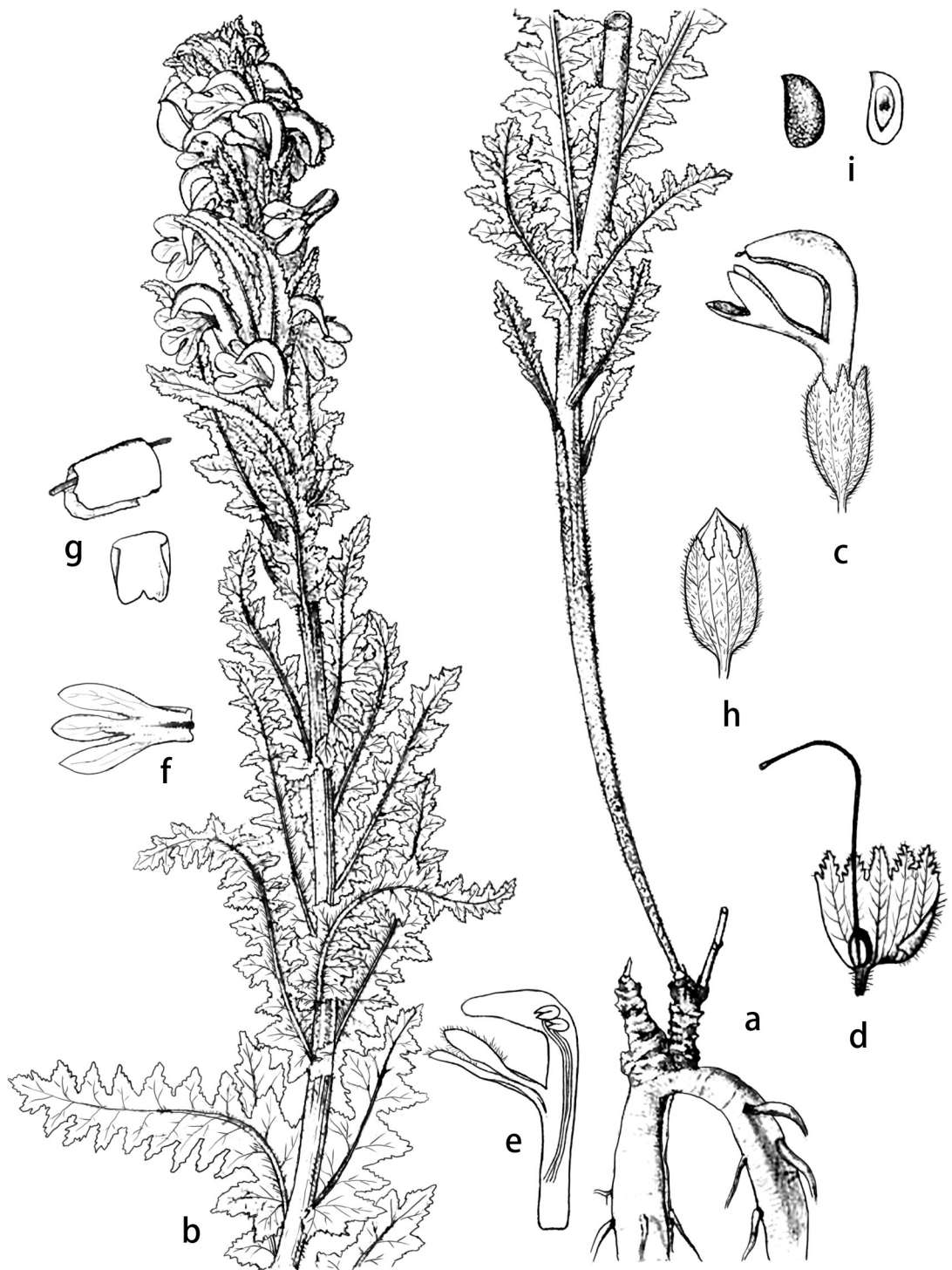
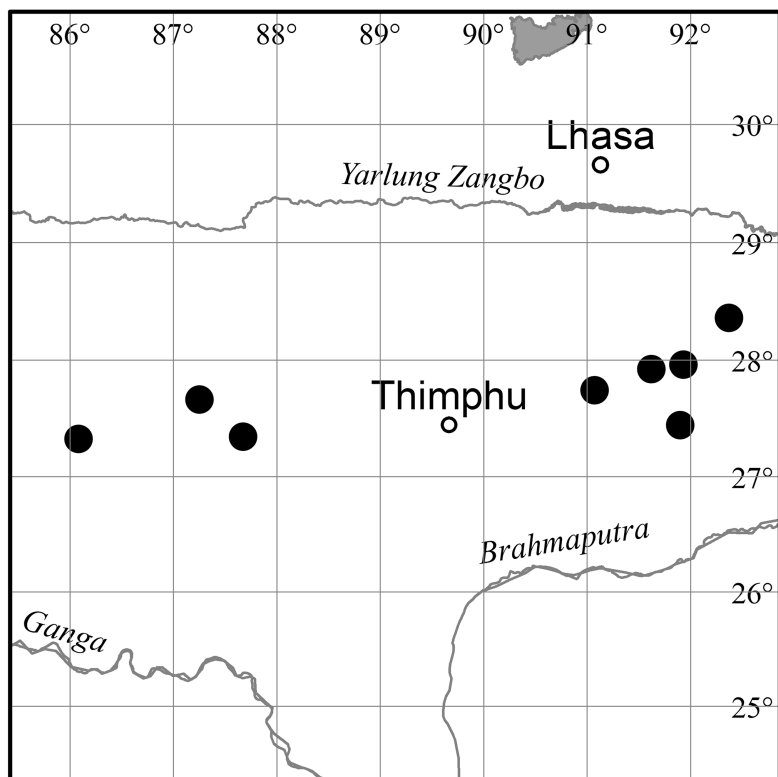


Figure 45(2)–8: *Pedicularis clarkei* Hook. f. a-b, root and habit; c, flower; d, calyx; e, corolla; f, corolla lip; g, beak; h, capsule; i, seed. A.-L. LI modified from D. PRAIN [*Ann. Roy. Bot. Gard. Calc.* 3: 161, plate 11: 1-7. 1890].



Map 45(2)-18: *Pedicularis clarkei* Hook. f.

Notes: When Hooker described *P. clarkei* Hook. f. as new, he cited a type collection “*Pedicularis n. 28*, herb. Ind. Or. H. f. &T”. In addition, he listed another two collections “Alpine Sikkim Himalaya, 12000–13000 ft; Yumthang and Thangu, J. D. H. Jongri; Clarke” but did not provide record number. *Clarke 25935* in the herbarium K was designated by Husain *et al.* [2010. Genus *Pedicularis* L. (Scrophulariaceae) in India] as lectotype. We found one sheet of “J. D. Hooker, *Pedicularis 28*” (P02995870) in the herbarium P, which likely was not examined by Husain when they designated the lectotype. Extensive examinations of specimens reveal that *P. imbricata* P. C. Tsoong, *P. platychila* P. C. Tsoong, *P. mucronulata* P. C. Tsoong, *P. sanguilimbata* R. R. Mill, *P. melalimne* R. R. Mill should be merged into *P. clarkei* Hook. f. Field investigation found that *P. clarkei* Hook. f. is a color-rich species, and there should be worthy of varietal rank in this species.

C NEPAL: Janakpur, Ramechhap, Botase Kharka, 4000 m, 21 July 1985, *H. Ohba, T. Kikuchi, M. Wakabayashi et al.* 8570596 (E). **E NEPAL:** Kosi, Sankhuwasabha, 3700 m, 11 Aug. 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 770672 (BM); Kosi, Sankhuwasabha, Barun Nadi, 3500 m, 24 Aug. 1981, *C. Grey-Wilson* 4192 (K); Sankhuwasabha, Tashigaon, 3700 m, 17 Aug. 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 770866 (BM). **Mechi,** Taplejung, Mane Bhanjyang, 3490–4080 m, 8 Aug. 1999, *Y. Omori, N. Acharya, K. Fujikawa et al.* 9950025 (E); Taplejung, Topke Gola, 3700 m, 8 Aug. 1991, *M. N. Subedi 244-1991*(KATH). **SIKKIM:** Jongri (Dzongri), *J. D. Hooker, Pedicularis 28* (P02995870). **BHUTAN:** Shingbe Dzong, 2438 m, 21 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 21313* (E). **Shingbe** (Me La), 3963 m, 22 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 21058* (E). **Upper Kuru Chu,** Singhi Kurted, 3810 m, *R. E. Cooper* (collector for

A. K. Bulley, Esq. Cheshire 4304 (BM). **YAR-LUNG ZANGBO-BRAHMAPUTRA: Cona,** 2800 m, 16 Aug. 1977, *B. Y. Guo & W. Y. Wang*

23038 (HNWP). **Lhünzê,** Subansiri tributary, Xezar, W of Sanggagqoiling, 4070 m, 27 July 1994, *B. Dickoré* 10076 (TI).

Ser. 7. *Trichoglossae*

Ser. *Trichoglossae* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 8. 1949.

Herbs usually less than 30 cm tall and black when dry. Stems erect, unbranched. Cauline leaves alternate; leaf blade lanceolate-linear to lanceolate-oblong, pinnatifid to pinnatisect. Inflorescences capitate to racemose. Corolla purple-red or blackish-purple; tube shorter or slightly longer than calyx; galea strongly curved, 4–5 mm wide, densely long-pubescent at margin and back; beak cylindrical, bent downward.

Two species; both endemic to the Pan-Himalaya.

Notes: Our molecular phylogenetic results indicate that two species of the series *Trichoglossae* form a strongly supported clade.

- 1a. Leaves 2–7 cm long; segments of leaf blade 20–25 pairs; corolla tube bent at base; beak of galea very long; lower lip glabrous..... 19. *P. trichoglossa*
1b. Leaves usually 1–3 cm long; segments of leaf blade 8–12 pairs; corolla tube erect, bent slightly apically; beak of galea short; lower lip ciliate..... 20. *P. rhodotricha*

19. *Pedicularis trichoglossa* Hook. f., Fl. Brit. Ind. 4: 310. 1884; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 55. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 109. 1998. Type: India, Sikkim Tungu, 3657–3962 m, 23 July 1849, (*Pedicularis* No. 29) Hook. f. s.n. [lectotype designated by Garg & Singh (2020: 91): K(K000739062)].

Herbs perennial, 13–60 cm tall. Whip-like rhizome 5–15 cm long, with a tuft of fibrous rootlets near the upper end, and lower part leading to a taproot, 0.8–1.5 cm in diameter. Stems with 2 lines of hairs, striate. Leaves clasping, sessile; leaf blade linear-lanceolate, 2–7 cm long, 3–15 mm wide, pinnatifid to pinnatipartite; segments 20–25 pairs, subglabrous except for pubescent midvein, margin double-dentate. Inflorescences racemose, 6–18 cm long; axis densely pubescent; bracts linear, inconspicuous, densely pubescent; pedicels 2–4 mm long, pubescent. Calyx 12–16 mm long, densely blackish purple villous, 5-lobed; tube 8–10 mm long. Corolla blackish purple; tube bent at base; galea densely long-pubescent apically, with purple-red hairs; beak slender, incurved, glabrous; lower lip glabrous;

lobes broadly rounded. Capsule broadly ovoid, 12–15 mm long, 9 mm wide, slightly exceeding calyx. Figure 45(2)–9.

Phenology: flowering and fruiting from July to August.

Habitats: open stony meadows in forests, amidst boulder screes; 3500–5000 m.

Distribution: endemic; W Nepal, C Nepal, E Nepal, Sikkim, L Yarlung Zangbo, N Hengduan, S Hengduan [Map 45(2)–19].

Notes: In the protologue of *P. trichoglossa* Hook. f., Hooker provided type information “*Pedicularis* No. 27, Herb. Ind. Or. H. f & T”. Garg & Singh (2020. Phytotaxa 430: 91) designated one sheet (K000739062) of *Pedicularis* No. 29 as lectotype, but collection “*Pedicularis* No. 29” was not listed by Hooker when he described *P. trichoglossa* as new. Here, one sheet in the herbarium P(P02968489) with “27. *Pedicularis*, Hab. Sikkim” was examined and it should be the origin type designated by J. D. Hooker. Our molecular phylogenetic results indicate that eight individuals of *P. trichoglossa* form a monophyletic clade.

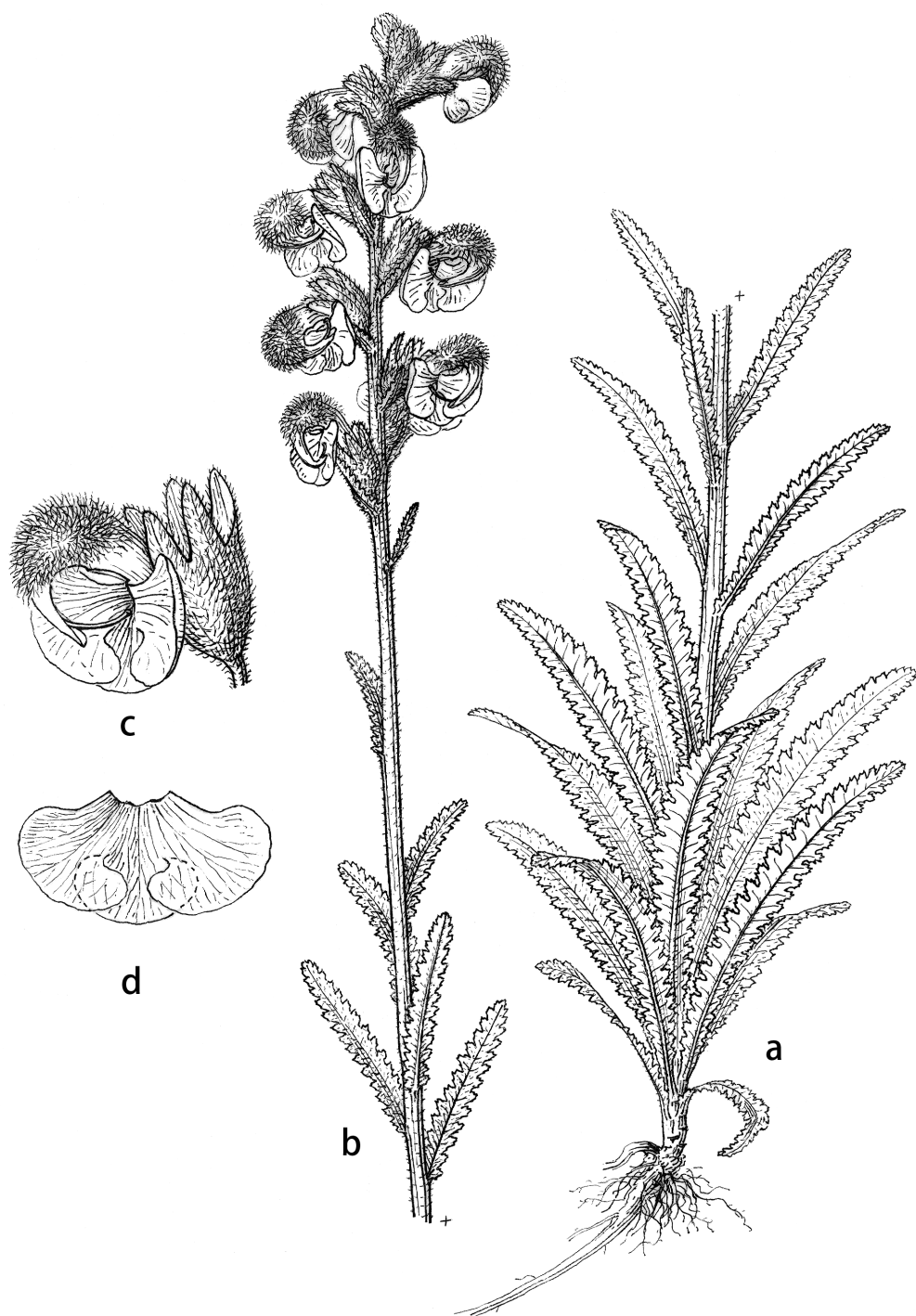
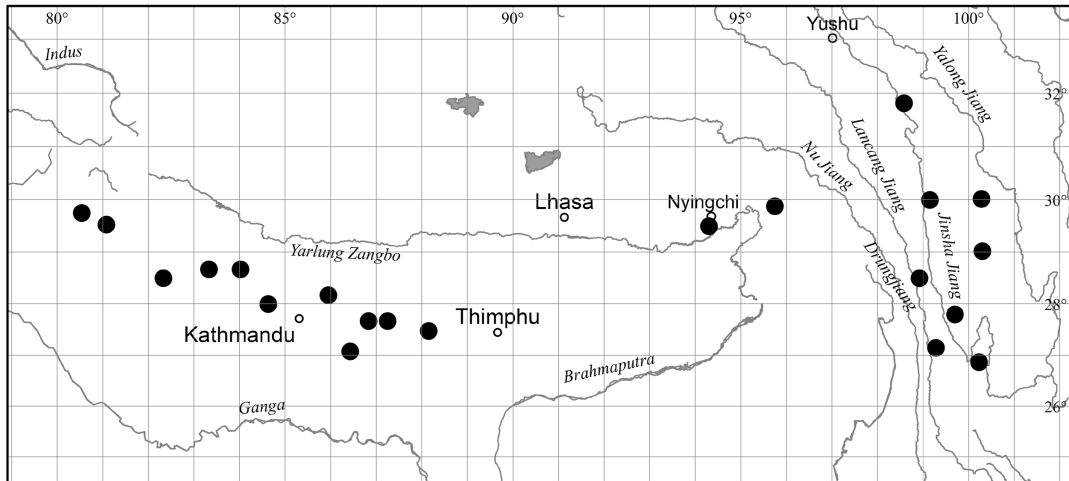


Figure 45(2)–9: *Pedicularis trichoglossa* Hook. f. a, habit; b, inflorescence; c, flower; d, corolla lip. Drawn by J.-Y. FENG [*Iconogr. Cormophyt. Sin.* 4: 64, figure 5541. 1975].



Map 45(2)-19: *Pedicularis trichoglossa* Hook. f.

U YARLUNG ZANGBO: **Nyalam**, 4600 m, 5 Sept. 1972, *Tibet Chin. Medic. Herb. Exped. 1818* (PE, HNWP). **W NEPAL:** **Seti**, Bajhang, Saipal, 5150 m, 31 Aug. 1954, *J. E. M. Arnold 285* (BM). **Karnali**, Mugu, Khaptang, 4550 m, 22 July 1954, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 5361* (BM). **Rapti**, Rukum, Dogari Khola, 27 Sep. 1954, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 4613* (BM). **C NEPAL:** **Bagmati**, Rasuwa, Mailung, 3600 m, 20 Aug. 1974, *de Haas, J. H. 2435* (BM). **Dhawalagiri**, Myagdi, Sauwala Khola, 3640, 22 July 1954, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 3572* (E). **Gandaki**, Gorkha, Samdo, 3900 m, May 1974, *Y. Bernard 158* (E); Gandaki, Manang, Bimtang, 4090 m, 27 Aug. 1950, *D. G. Lowndes 1475* (BM). **E NEPAL:** **Kosi**, Sankhuwasabha, 4500 m, 28 Aug. 1981, *C. Grey-Wilson et al. 4288* (K). **Sagarmatha**, Solukhumbu, Imja Khola Valley, Tengboche, 3640–4240, 1930 summer, *L. Dhwoj 185* (BM). **SIKKIM:** Jongri (Dzongri), 3658 m, (*Pedicularis* n. 27) *Hook. f. s.n.* (P02968489). **L YARLUNG ZANGBO:** **Bomi**, 4100 m, 15 Aug. 1965, *T. S. Ying & D. Y. Hong 651181* (PE). **Nyingchi**, Sejila Shan, 4720 m, 4 Aug. 1983, *B. S. Li & S. Z. Cheng 6097* (PE). **TANGUT:** **Dêgê**, W Que-er Shan, ca. 4500 m, 30 July 1952, *P. C. Tsoong 5169* (PE); Dêgê, road from Manigange to Dêgê, Que-er Shan, 4625–4700 m, 17 Aug. 2006, *D. E. Boufford*

et al. 36786 (PE); Dêgê, Que-er Shan, 4500 m, 6 Aug. 2001, *F. S. Yang 2057* (PE); Dêgê, Que-er Shan, 4500 m, 9 Aug. 2001, *F. S. Yang 2071* (PE). **N HENGDUAN:** **Batang**, road from Litang to Batang, Haizi Shan, 4500–4600 m, 8 Aug. 2006, *D. E. Boufford et al. 36073* (PE). **Litang**, Haizi Shan, ca. 4300 m, 24 July 1951, *Y. W. Cui 5915* (PE). **S HENGDUAN:** **Daocheng**, Gongga Shan, 4600 m, 29 Aug. 1981, *Qinghai-Xizang Exped. 0829* (PE). **Dêqên**, 4000 m, 1 Aug. 1940, *K. M. Feng 6026* (PE). **Shangri-la** (Zhongdian), Habaxue Shan, 4100 m, 31 Aug. 1962, *Zhongdian Exped. 1714* (PE, KUN). **Weixi**, Kangpuyunling Mountain, 20 Aug. 1987, 3820 m, *Z. D. Fang 0364* (ASBG). **Yulong** (Lijiang), 3400 m, 1914, *C. Schneider 3352* (K).

20. *Pedicularis rhodotricha* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 566. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 56. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 109. 1998. Type: China, Yunnan, Heqing (supra Hokin monte Koua-la-po), 3500 m, 13 July 1886, *J. M. Delavay 2086* [**lectotype designated here:** P(P02976899); isolectotypes: P(P02976893), LE].

Pedicularis ramalana Britten, The River of Golden Sand. 426. 1924.

Herbs perennial, 8–35 cm tall. Whip-like rhizome 5–15 cm long, with a tuft of fibrous rootlets near the upper end, leading to a taproot, 5–15 mm in diameter. Stems with 2 lines of hair. Leaves short-petiolate, more or less clasping; blade linear-lanceolate, 2–3 (-5) cm long, 0.6–1.1 (-2) cm wide, subglabrous, pinnatifid to pinnatisect; segments 8–12 pairs, oblong to ovate, margin double-dentate. Inflorescences capitate to racemose, 3–8 cm long, usually dense; bracts leaflike. Calyx purplish red, 8–10 mm long; lobes 5, triangular-ovate, ciliate. Corolla purple-red; tube erect, slightly bent apically, ca. as long as calyx; galea 1/2 moon-shaped, densely long-pubescent apically, with pale red hairs; beak bent downward only, 4–5 mm long; lower lip ciliate. Figure 45(2)–10. **Chromosomes:** $2n = 16$.

Phenology: flowering and fruiting from June to August.

Habitats: stony alpine meadows, screes; 2600–4200 m.

Distribution: endemic; Tangut, N Hengduan, S Hengduan [Map 45(2)–20].

Notes: Two collections were listed in Maximowicz's monograph, "Sze-tschuan district Mou-pine, 5000 m (*David!* In herb. Paris.)" and "Prov. Yunnan, super Hokin monte Koua-la-po 3500 m (*Delavay!*)". A sheet *J. M. Delavay 2086* in the herbarium P is designated here as lectotype. *David 1869* deposited in the herbarium P(P02976885) collected from Mou-pine was also examined. Our molecular phylogenetic results show that seven accessions of *P. rhodotricha* Maxim. form a well-supported clade sister to *P. trichoglossa* Hook. f.

TANGUT: Sêrtar, Hexixing, Shiquhe River, 4550 m, 5 Sept. 1961, *Q. L. Zhang 330358* (PE). **N HENGDUAN:** Xiaojin, Pinggou, 3500 m, 10 Aug. 1957, *J. J. Zhao 0387* (PE). **S HENGDUAN:** Batang, Yargong, 1904, *M. I. Abbé Soulié 1904* (P02976886). **Daocheng,** Gongga Shan, 4500 m, 29 Aug. 1981, *Qinghai-*

Xizang Exped. 005806 (PE); Daocheng, Sangdui 91 km along the road, 4450 m, 22 Aug. 1981, *Qinghai-Xizang Exped. 005104* (PE); Daocheng, Haizi Shan, 4300 m, 31 July 2001, *F. S. Yang 2039* (PE). **Dêqên,** Baimaxue Shan, 3900 m, 11 Aug. 1937, *T. T. Yü 9577* (PE); Dêqên, Baimaxue Shan, 4270 m, 22 July 1987, *Z. D. Fang 0188* (SABG). **Dêrong,** 65 km to Batang, 4129 m, 26 Sept. 2010, *H. Sun et al. SunH-07ZX-3013* (KUN). **Kangding,** Pusharong, 3600–4000 m, 5 Aug. 2017, *Y. D. Gao et al. THP-KD-2174* (CDBI); Kangding, Gongga Shan, 3471–3577 m, 12 Aug. 2017, *Q. Yu et al. THP-KD-4070* (CDBI); Kangding, Qianxi, 15 Aug. 2017, *Q. Yu et al. THP-KD-5052* (CDBI); Kangding, Liubazimei vallige, 3375 m, 2 July 1979, *T. C. Wei 20882* (CDBI); Kangding, Zheduo Shan, 4000 m, 21 Aug. 1974, *Y. D. He & H. G. Wang* (WUK); Kangding, Kangding to Xinguqiao, 3800 m, 5 Aug. 1982, *K. Y. Lang & L. Q. Li 1040* (PE); Kangding, 15 June, 1898, *R. P. Mussot 292* (P02970883). **Litang,** Yakou Shan to the Yajiang direction, 4400 m, 5 Aug. 1983, *K. Y. Lang & L. Q. Li 2773* (PE). **Muli,** Shao-siang-liang-tze, 3900 m, 17 Aug. 1937, *T. T. Yü 7777* (PE, KUN). **Shangri-la** (Zhongdian), 4000 m, Aug. 1913, *G. Forrest 10789* (PE); Shangri-la (Zhongdian), Habaxue Shan, 4000 m, 16 July 2009, *T. Yoshida K14* (KUN, E); Shangri-la (Zhongdian), Tianbao Shan, 3959 m, 13 Aug. 2011, *T. Zhang et al. 11CS3083* (KUN). **Xiangcheng,** Wuming Shan, Maxionggou, 3850 m, 17 Aug. 1981, *Qinghai-Xizang Exped. 004892* (PE); Xiangcheng, Wuming Shan, 4450 m, 24 July 2001, *F. S. Yang Y0069* (PE); Xiangcheng, Maxionggou, 4315 m, 1 Aug. 2016, *J. Hu et al. SC-a-009-1307* (NAS); Xiangcheng 4200 m, 2 Aug. 1983, *K. Y. Lang & L. Q. Li 2606* (PE). **Yanbian,** Lisuwan, 2600 m, 16 Aug. 1933, *T. T. Yü 1699* (PE). **Yanyuan,** Huolu Mountain, 4000 m, 23 July 1983, *Qinghai-Xizang Exped. 12317* (PE). **Yulong** (Lijiang), 3 Aug. 1939, *R. C. Ching 21183* (PE).

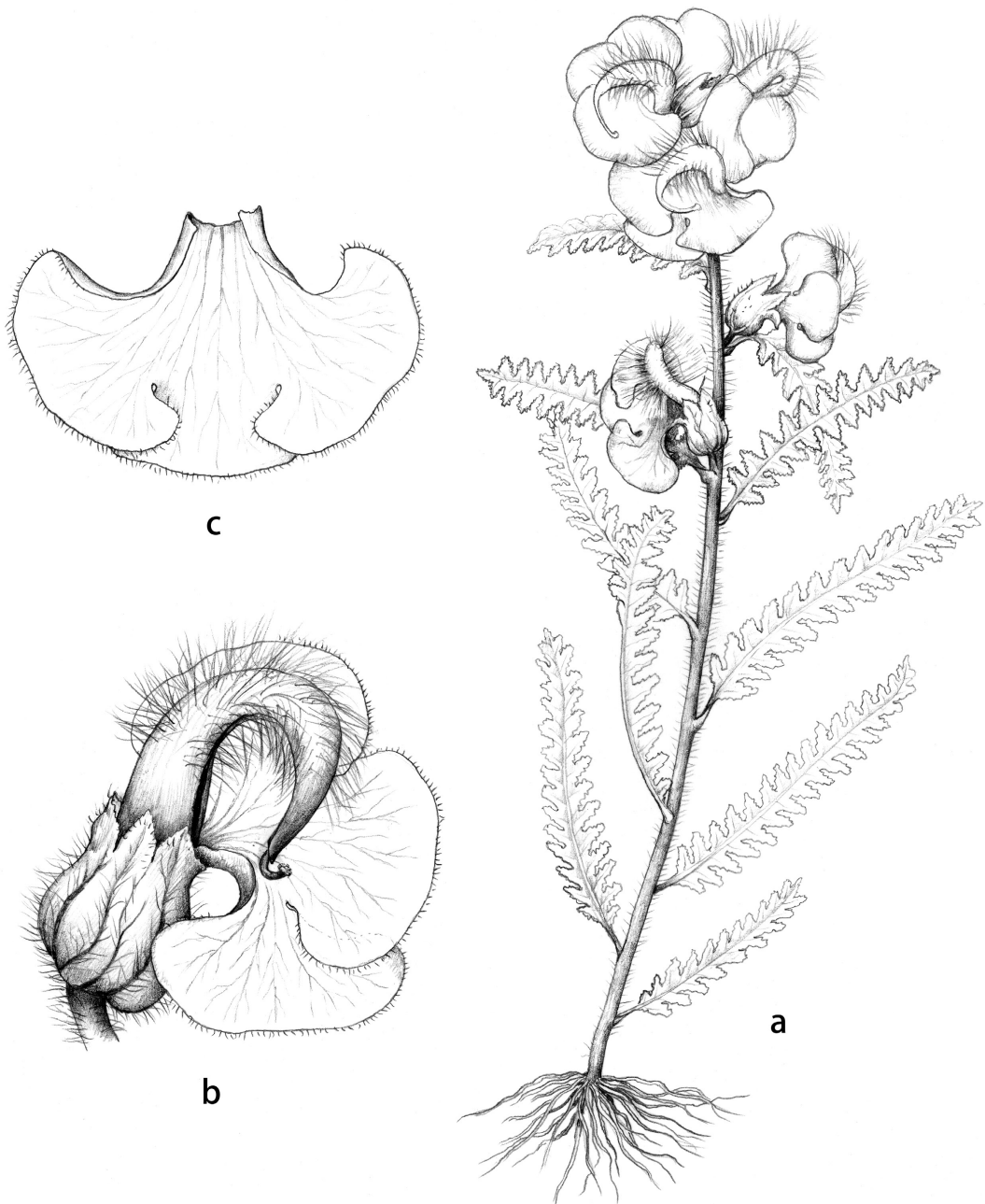
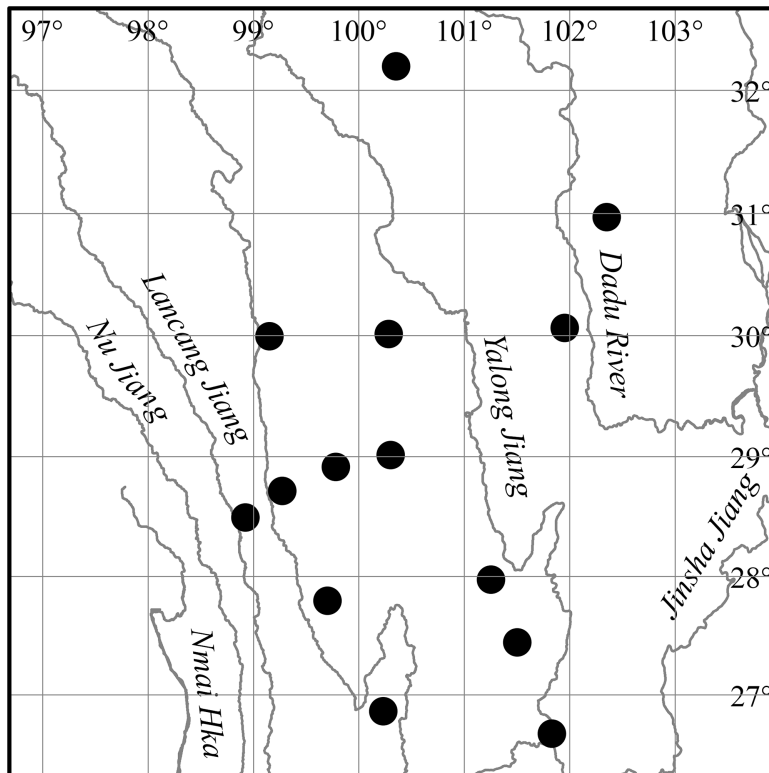


Figure 45(2)–10: *Pedicularis rhodotricha* Maxim. a, habit; b, flower; c, corolla lip. Drawn by A.-L. LI.



Map 45(2)-20: *Pedicularis rhodotricha* Maxim.

Ser. 8. Lasiophrydes

Ser. Lasiophrydes H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 8. 1949.

Herbs low or medium-sized and black when dry. Stems erect, usually unbranched. Leaves cauline or basal, alternate; leaf blade lanceolate-linear, pinnatilobate. Inflorescences capitate to spicate, often few-flowered. Corolla tube less than 2 times as long as calyx; galea bent at middle, margin densely pubescent; beak horizontal, more or less straight, nearly as long as lower lip; lower lip 3-parted nearly to base, lobes stipitate at base.

Two species; both in the Pan-Himalaya.

Notes: Species of the series *Lasiophrydes* and *P. tristis* L. (Ser. *Tristes*) form a moderately supported clade in the phylogenetic tree, indicating a close relationship between the two series of *Pedicularis*.

- 1a. Corolla yellow; corolla galea pubescent abaxially at apex21. *P. lasiophrys*
 1b. Corolla whitish-rose; corolla galea glabrous abaxially.....22. *P. craspedotricha*

21. *Pedicularis lasiophrys* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 24: 68. 1878; Tsoong

in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 57. 1963; Yang, Holmgren & Mill

in Wu & Raven (eds.), Fl. China 18: 109. 1998. \equiv *Pedicularis lasiophrys* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 79. 1949. Type: China, Gansu (Tangut), “pratis mountains et alpinis, in his frequentius (Przewalski)”, 1872, *Pl. a N. M. Przewalski s.n.* [lectotype designated here: LE; isolectotype: PE(00033128)].

Pedicularis lasiophrys var. *sinica* Maxim. Bull. Acad. Imp. Sci. Saint-Petersb. 32: 564. 1888. **syn. nov.** Type: China, Gansu, precise location unknown, 1885, *G. N. Potanin s.n.* [lectotype designated here: LE].

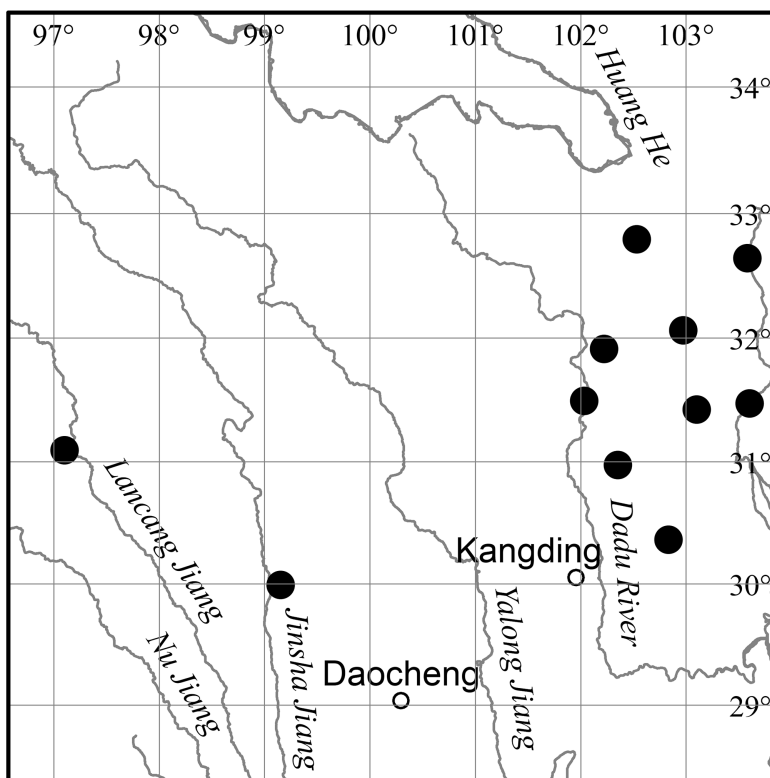
Herbs perennial. Whip-like rhizome 3–5 cm long, with a tuft of fibrous rootlets near the upper end. Stems usually unbranched, with 2 lines of hairs, striate. Leaves mostly basal, sometimes pseudo-rosulate, short-petiolate or sessile to more or less clasping; leaf blade lanceolate-linear,

2–4 cm long, 1 cm wide, abaxially brown-pubescent, adaxially whitish pilosulous when young, crenate-pinnatifid, dentate. Inflorescences capitate to short-racemose; bracts leaflike, densely brown glandular-pubescent. Calyx 6–8 mm long, 10 veins, tomentose, 5-lobed; lobes triangle, entire. Corolla yellow; tube slightly longer than calyx, glabrous or pubescent; galea densely yellow-pubescent except for glabrous beak; lower lip deeply 3-parted to base. Filaments all glabrous. Capsule 8–11 cm long and 5 mm wide.

Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows, *Picea* forests; 2900–5000 m.

Distribution: N Hengduan, S Hengduan; also in other regions of Gansu and Qinghai Provinces, China [Map 45(2)–21].



Map 45(2)-21: *Pedicularis lasiophrys* Maxim.

Notes: Maximowicz did list type of *P. lasiophrys* Maxim. in the protologue but only provided partial information “pratis mountains et alpinis, in his frequentius (Przewalski)”, and a sheet in the herbarium LE was designated as “lectotype” by T. N. Popova (1996, noted on the sheet). When Maximowicz (1888. Bull. Acad. Imp. Sci. Saint-Petersb. 32: 564) described *P. lasiophrys* var. *sinica* Maxim. as new, he provided information “Kansu orientali: cacumine montis Tschagola, Szetschuan boreali: trajectu Gumà-Kikà, nec non circa fontes fl. Atu-Lunwa (Potain, 1885)”. Eighteen individuals of this collection were mounted on one sheet (LE), which were designated as “lectotype” or “syntypes” by T. N. Popova (1996, noted on the sheet). Our phylogenetic study shows that five accessions of *P. lasiophrys* Maxim. form a well-supported clade. This species is characterized by the completely 3-parted lower lip of corolla and densely pubescent galea, by which it is distinct from the next species *P. craspedotricha* Maxim.

TANGUT: Qamdo, Kajila Shan, 4600 m, 13 Aug. 2001, *F. S. Yang Y0174* (PE). **N HENGDUAN:** Barkam, 3 July 1958, *Z. L. Wu 32578* (PE); Barkam, 4000 m, 5 Aug. 1922, *H. Smith 4179* (PE). **Batang,** 4670 m, 29 July 1983, *K. Y. Lang et al. 2503* (PE). **Heishui,** Yakexia, 4200 m, 8 Aug. 2009, *L. Gu & Z. R. Li GaoXF-09ZX-1632* (CDBI). **Hongyuan,** Yakou Shan, 4300 m, 19 Aug. 2000, *F. S. Yang 2099* (PE). **Jinchuan,** 4100 m, 18 June 1958, *X. Li 77790* (PE); **Lixian,** Zhegu Shan, shrubs and meadows, 4000 m, 15 July 1958, *Z. L. Wu 33016* (PE). **Songpan,** 2600 m, 9 July 1922, *H. Smith 2564* (PE); Songpan, alpine meadows, 3400 m, 13 July 1922, *H. Smith 2908* (PE); Songpan, on grassy slope, 4032 m, 8 Aug. 1988, *W. P. Fang 4032* (NAS). **Wenchuan,** 4000 m, 18 Aug. 1982, *K. Y. Lang et al. 1116* (PE). **Xiaojin,** Balong Shan, 4230–4350 m, 29 July 2007, *D. E. Boufford et al. 38576* (PE). **S HENGDUAN:** **Baoxing,** 1954 (no more detailed information), *Z. P. Song 39102* (PE, SZ).

22. *Pedicularis craspedotricha* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 564. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popu-

laris Sin. 68: 53. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 108. 1998. Type: China, Sichuan, “Sze-tschan boreali, trajectu Gumà-Kikà 6 Aug. 1885, *G. N. Potanin s.n.* [holotype: LE; isotype: PE(00031358)].

Pedicularis cinerascens Franch., Bull. Soc. Bot. France 47: 30. 1900; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 58. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 110. 1998. **syn. nov.** Type: China, Sichuan, Kangding, 1893, *J. A. Soulié 312* [lectotype designated here: P(P02995872); isolectotype: P(P02995876)].

Pedicularis xiqingshanensis H. Y. Feng & J. Z. Sun, Acta Bot. Yunnan. 21: 28. 1999. **syn. nov.** Type: China, Gansu, Luqu county, Gahaixiang, 3800 m, 20 July 1996, *J. Sun & G. Zhang 96488* (holotype: LZU).

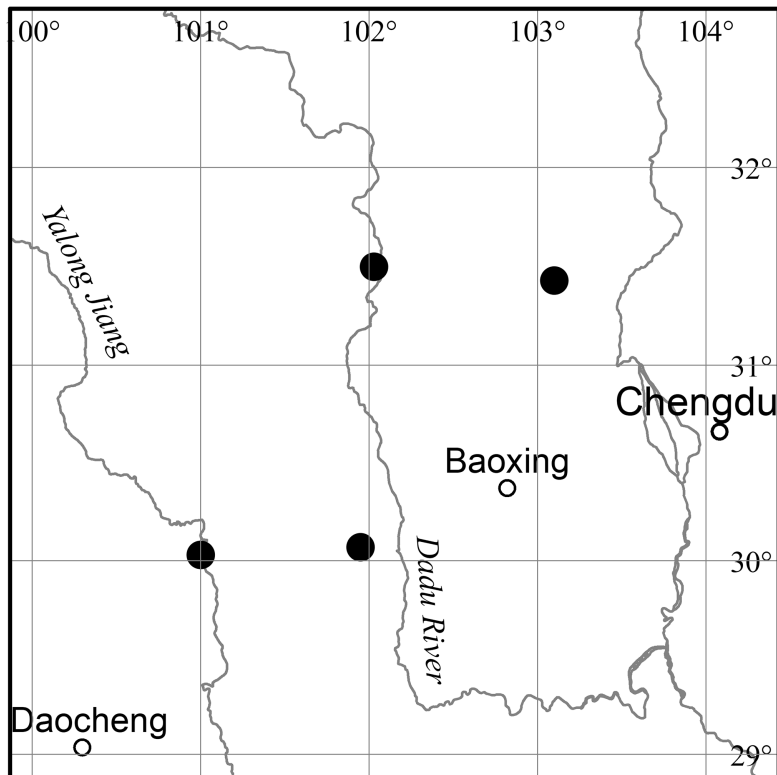
Herbs perennial, 10–28 cm tall. Whip-like rhizome 3–5 cm long, with a tuft of fibrous rootlets near the upper end. Stems grayish brown-pubescent, striate. Leaves short-petiolate to sessile or more or less clasping; leaf blade narrowly lanceolate, 2–4.5 cm long, 0.3–0.7 cm wide; leaves dense and small at base, adaxially pubescent, abaxially glabrous, crenate-pinnatilobate to pinnatipartite; segments double-dentate. Inflorescences capitate to laxly racemose, 7–14 cm long, with more than 20 flowers; bracts ovate-oblong, densely tomentose. Calyx 8–10 mm long, pubescent, 5-lobed. Corolla whitish-rose; tube 10–12 mm long, glabrous; galea glabrous except for long-bearded margin, with purple hairs; lower lip deeply 3-parted nearly to base. Filaments all glabrous. Capsule 10–13 mm long and 5 mm wide.

Phenology: flowering and fruiting from July to August.

Habitats: grassy slopes; 4000–4400 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–22]; also in other regions of Gansu Province, China.

Notes: Maximowicz cited one collection in the protologue of *P. craspedotricha* “Sze-tschan boreali, trajectu Gumà-Kikà”. A sheet of this



Map 45(2)-22: *Pedicularis craspedotricha* Maxim.

collection, with a drawing of a corolla, deposited in the herbarium LE, was labelled as “type”, with an “isotype” reserved in the herbarium PE. *Pedicularis craspedotricha* Maxim. is quite similar to *P. cinerascens* Franch., but the former is taller and has more stem leaves, which should be a result of a special habitat. Hence, *P. cinerascens* Franch. is here treated as a synonym of *P. craspedotricha* Maxim. Franchet cited two collections (*musso* 279 and *Soulié* 312) in the protologue of *P. cinerascens* Franch., and one sheet of the latter is designated here as lectotype.

Feng & Sun described *P. xiqingshanensis* H. Y. Feng & J. Z. Sun as new based on a collection sampled from Luqu, Gansu Province of China. They stated that the new species resembles *P. lasiophrys* Maxim. but differs in

purple and glabrous galea and shorter calyx lobes. However, a statistical analysis of morphological characters reveals that *P. xiqingshanensis* H. Y. Feng & J. Z. Sun is most closely related to *P. craspedotricha* Maxim., and there are no morphological gaps between the two “species”. Hence, *P. xiqingshanensis* H. Y. Feng & J. Z. Sun is here treated as a new synonym of *P. craspedotricha* Maxim.

N HENGDUAN: Jinchuan, Wanli, 4700 m, 21 Aug. 1958, *X. Li* 78156 (PE). **Lixian**, Dabanzhao, Huangtuliang, ca. 3600 m, 7 July 1957, *D. Z. Deng* 1195 (SZ). **Yajiang**, 4240 m, 3 Aug. 1960, *Z. T. Guan* 44-023 (PE). **S HENGDUAN:** Kangding, Zheduo Shan, 4400 m, 30 July 1963, *K. C. Kuan et al.* 1125 (PE); Kangding, alpine meadows, 4500 m, 20 July 1922, *H. Smith* 3813 (PE).

Ser. 9. Kongboenses

Ser. Kongboenses P. C. Tsoong ex H. P. Yang, Acta Phytotax. Sin. 33: 245. 1995.

Herbs usually 30 cm to 100 cm tall and black when dry. Stems erect, stout. Leaves alternate, sessile; leaf blade linear or linear-lanceolate, pinnatilobate. Inflorescences spicate. Corolla tube slightly longer than calyx; galea very narrow, slightly curved, marginally pubescent; beak bent upward, relatively long, slender; lobes of lower lip narrowly lanceolate.

Two species; both endemic to the Pan-Himalaya.

- 1a. Calyx 10–13 mm long; corolla tube 11–15 mm long; beak of galea bent upward and twisted.....
..... 23. *P. kongboensis*
1b. Calyx 8–10 mm long; corolla tube 8–9 mm long; beak of galea bent slightly upward.....
..... 24. *P. retingensis*

23. *Pedicularis kongboensis* P. C. Tsoong, Acta Phytotax. Sin. 3: 304. 1955; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 59. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 110. 1998. Type: China, Tibet, Mainling, 3960 m, 27 July 1938, *F. Ludlow, G. Sherriff & G. Taylor 5956* [holotype: BM(BM000997962); isotypes: E(E000284056), PE(00033095)].

Pedicularis kongboensis var. *obtusata* P. C. Tsoong, Acta Phytotax. Sin. 3: 305. 1955; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 59. 1963. **syn. nov.** Type: China, Tibet, Nyingchi, 2987 m, 13 Aug. 1938, *F. Ludlow, G. Sherriff & G. Taylor 6829* (holotype: BM).

Herbs perennial, pubescent. Whip-like rhizome 5–10 cm long, with a tuft of fibrous rootlets near the upper end, taproot 0.5–1 cm in diameter. Stems 30–110 cm tall, branched or not. Leaves alternate; leaf blade linear or linear-lanceolate, 3–12 cm long, 3–13 mm wide; segments 25–30 pairs, ovate, double-dentate. Inflorescences 10–50 cm long, often interrupted at base, pubescent. Calyx 10–13 mm long, pubescent, membranous, tubes with conspicuous reticulate veins, lobes 5, triangular, more or less entire. Corolla tube 11–15 mm long, glabrous; galea margin densely long-pubescent; beak 7–8 mm long, more or less S-shaped, bent upward; lower lip shorter

than galea, 10–13 mm long, ca. 8 mm wide, ciliate. Filaments 2 pubescent, 2 glabrous. Figure 45(2)–11.

Phenology: flowering from July to August.

Habitats: grasslands at hilltops, open very steep hillsides; 2900–4000 m.

Distribution: endemic; L Yarlung Zangbo [Map 45(2)–23].

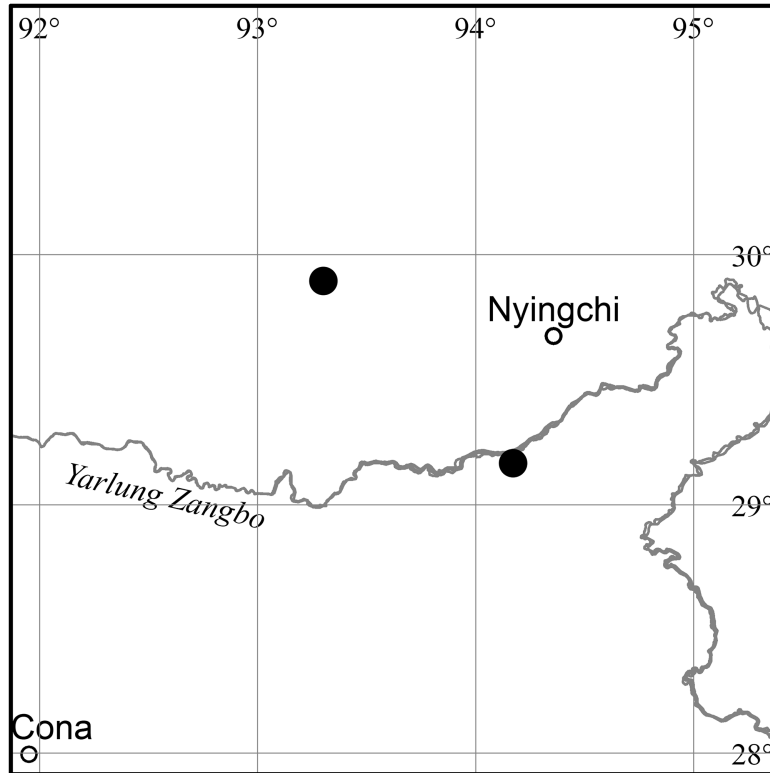
L YARLUNG ZANGBO: Gongbo' gyamda, 3000 m, 13 Aug. 1938, *F. Ludlow, G. Sherriff & G. Taylor 6829* (BM). **Mainling**, Pmam Chu near Je (Pasum habe), 4330 m, 11 July 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 14122* (PE).

24. *Pedicularis retingensis* P. C. Tsoong, Acta Phytotax. Sin. 3: 305. 1955; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 59. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 110. 1998. Type: China, Tibet, Reting, 60 miles N of Lhasa, 4572 m, 20 July 1942, *F. Ludlow & G. Sherriff 11060* [holotype: BM(BM000997961); isotypes: E(E00284051), PE(00033004)].

Herbs perennial. Whip-like rhizome 5–10 cm long, with a tuft of fibrous rootlets near the upper end, taproot 0.5–1 cm in diameter. Stems 30–80 cm tall, unbranched, hirsute. Leaves clasping; leaf blade linear or linear-lanceolate,



Figure 45(2)-11: *Pedicularis kongboensis* P. C. Tsoong. a, habit; b, branch; c, flower. C.-Z. JI modified from J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 58, figure 5: 1-2. 1963].



Map 45(2)-23: *Pedicularis kongboensis* P. C. Tsoong

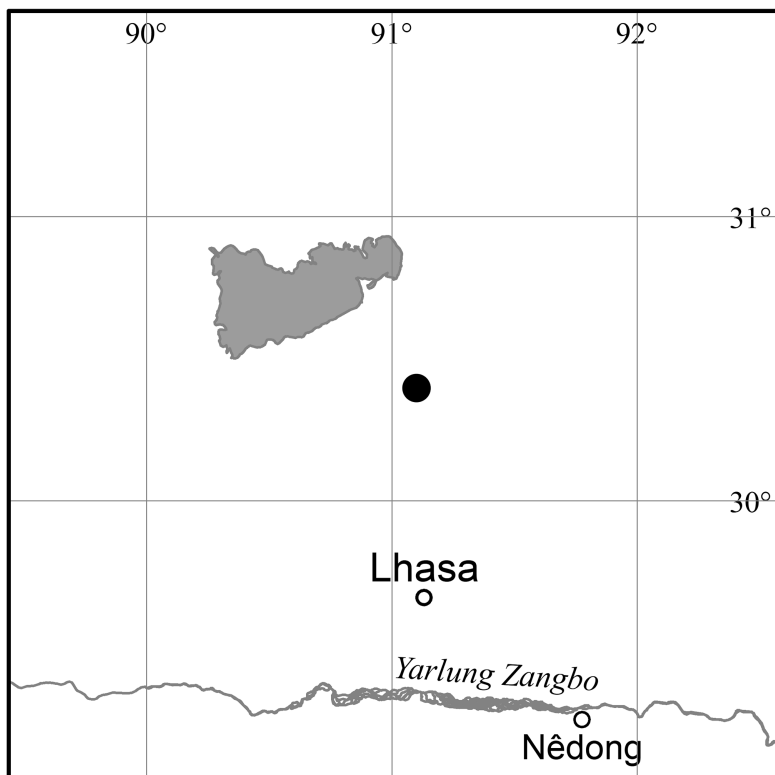
5–8 cm long, 5–8 mm wide, base truncate or cordate, subglabrous; segments 20–30 pairs, triangular-ovate to ovate, margin incised-dentate. Inflorescences 10–30 cm long; bracts leaflike, longer than flowers. Calyx 8–10 mm long, glabrous; lobes 5, triangular or triangular-lanceolate, entire. Corolla tube 8–9 mm long, glabrous; galea margin densely long-pubescent, beak straight or slightly upward; lower lip shorter than galea, 9–10 mm long, 8 mm wide. Filaments 2 pubescent, 2 glabrous.

Phenology: flowering from July to August.

Habitats: dry stony hillsides, amidst boulder screes; ca. 4100 m.

Distribution: endemic; M Yarlung Zangbo [Map 45(2)-24].

M Yarlung Zangbo: **Damxung**, Reting, 60 miles N of Lhasa, 4572 m, 20 July 1942, *F. Ludlow & G. Sherriff* 8835 (BM, E, PE).



Map 45(2)-24: *Pedicularis retingensis* P. C. Tsoong

Ser. 10. Subsurrectae

Ser. Subsurrectae Prain, Ann. Roy. Bot. Gard. Calc. 3: 80. 1890. Type: *Pedicularis vialii* Franch. ex F. B. Forbes & Hemsl.

Herbs tall and not black when dry. Stems branched apically or unbranched. Cauline leaves alternate, long-petiolate; leaf blade ovate-lanceolate, pinnatipartite to pinnatisect; rachis winged; segments remote. Inflorescences long-racemose, a lax. Corolla small; galea inflated-convex, 3–4 times longer than lower lip, beak curved upward.

One species; endemic to the Pan-Himalaya.

Notes: Our molecular phylogenetic results reveal that the series *Subsurrectae* Prain is closely related to the series *Recurvae* H. L. Li., indicating a close relationship between two series of *Pedicularis*.

25. *Pedicularis vialii* Franch. ex F. B. Forbes & Hemsl., J. Linn. Soc. Bot. 26: 219. 1890, “*Pedicularis viali*”; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 60.

1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 111. 1998. Type: China, Yunnan, Eryuan (Yunnan au dessus du col de Yen-tze-hay), 3300 m, 8 Aug.

1888, *J. M. Delavay* 3378 [**lectotype designated here**: K(K000708884); isoelectotypes: K(K000708880), MPU(MPU020863), and P(P03005357)].

Stems usually 40–80 cm tall, ascending, subglabrous. Leaves withering early at base; cauline leaves sparsely; petiole 2–5 cm long, slender, pilose; leaf blade lanceolate-oblong, 8–15 cm long, 3–6 cm wide, pilose, pinnatisect; segments 5–10 pairs, lanceolate-oblong, margin double-dentate, 15–33 mm long, 5–10 mm wide. Inflorescences elongated in fruit, 15–30 cm long, interrupted at base; bracts linear, distal ones shorter than calyx. Calyx 5–6 mm long, glabrous; lobes 5, triangular, entire. Corolla whitish, with rose to purple galea, 9–10 mm long; beak of galea 4–5 mm long, slender, curved upward; lower lip 5–6 mm long, not spreading. Filaments all glabrous. Capsule lanceolate, 9–11 mm long, 5 mm wide. Figure 45(2)–12.

Phenology: flowering and fruiting from May to August.

Habitats: grassy slopes, coniferous forests; 2700–4300 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra, S Hengduan, U Irrawaddy [Map 45(2)–25].

Notes: Type, in woods above Yen-tze-hay, was collected by *J. M. Delavay* on 8 Aug. 1888. One sheet in the herbarium K(K000708884) was noted as “type”, types in the herbaria BM, E, MPU, NY, and P were examined. Our molecular phylogenetic results show that two

individuals of *P. vialii* Franch. ex F. B. Forbes & Hemsl. form a moderately supported clade, while the position of this clade is poorly resolved.

Yarlung Zangbo-Brahmaputra: Shangzayü, Aug. 1935, *C. W. Wang* 65391 (PE). **S HENGDUAN: Dêqên**, 3900 m, 18 Aug. 1940, *K. M. Feng* 6691 (PE, KUN); Dêqên, 3600 m, 10 Aug. 1940, *K. M. Feng* 6496 (PE, KUN); Dêqên, 3800 m, 1 Aug. 1940, *K. M. Feng* 6007 (PE); Dêqên, 3650 m, 10 Aug. 1937, *T. T. Yü* 9508 (PE); Dêqên, Meilixue Shan, *Yunnan University JW531* (SABG). **Gongshan**, 3800 m, 8 Aug. 1938, *T. T. Yü* 19806 (PE); Gongshan, 3600 m, 1 Aug. 1938, *T. T. Yü* 22747 (PE); Gongshan, 3000 m, 25 July 1982, *Qinghai-Xizang Exped.* 8581 (PE). **Jiulong**, Wuxuhai, 3900 m, 7 Aug. 1979, *X. H. Hu* 20585 (CDBI). **Kangding**, Moxi, 3670 m, 12 Aug. 2017, *W. B. Yu & C. C. Zhang THP-KD-5966* (CDBI). **Muli**, 2800 m, 2 Aug. 1937, *T. T. Yü* 7538 (PE, KUN); Muli, 3400 m, 19 Aug. 1983, *Qinghai-Xizang Exped.* 13080 (PE); Muli, Maoniuping, 3400 m, 26 Aug. 1983, *Qinghai-Xizang Exped.* 13418 (PE). **Shangri-la** (Zhongdian), Langdu vallige, 3827 m, 16 Sept. 2011, *Y. J. Guo et al.* 11CS3452 (KUN); Shangri-la (Zhongdian), Langdu vallige, 3534 m, 19 Sept. 2011, *Y. J. Guo et al.* 11CS3229 (KUN); Shangri-la (Zhongdian), 3900 m, 10 Aug. 1981, *Hengduan Shan Exped. (PE)* 2826 (PE); Shangri-la (Zhongdian), 3200 m, 9 Aug. 1937, *T. T. Yü* 12709 (PE). **Weixi**, 3600 m, Aug. 1935, *C. W. Wang* 68556 (PE). **U Irrawaddy:** near the Upper Burma, Sept. 1924, *G. Forrest* 24990 (PE).

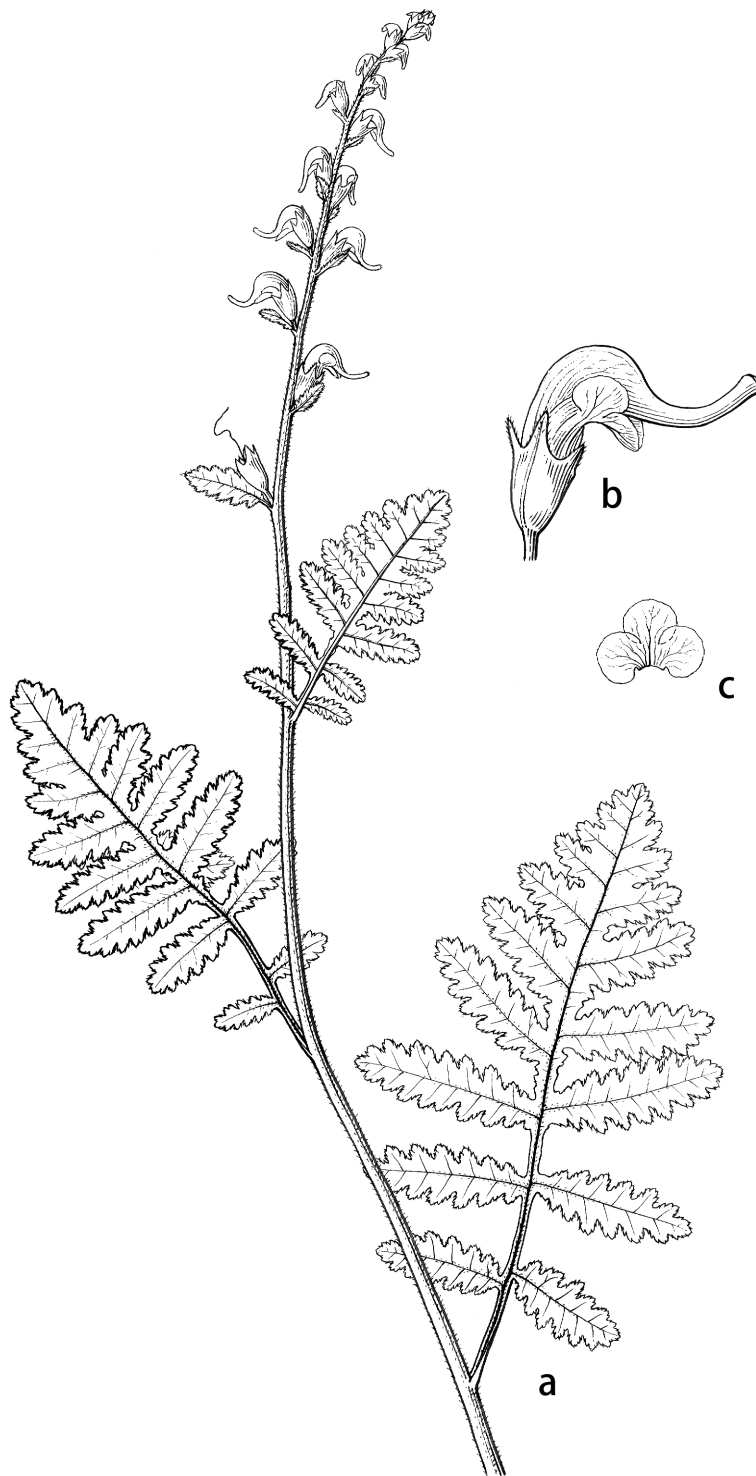
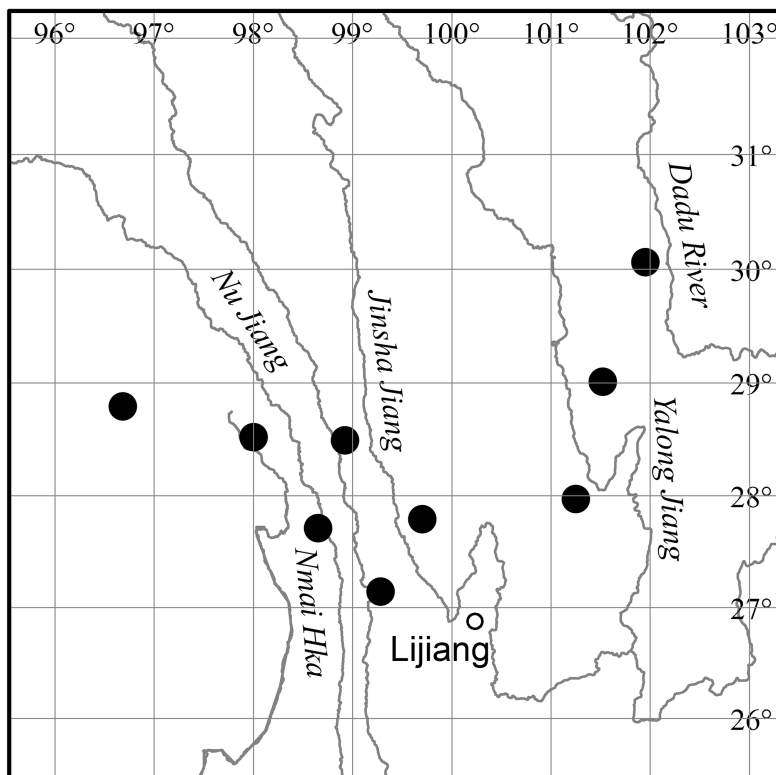


Figure 45(2)-12: *Pedicularis vialii* Franch. ex F. B. Forbes & Hemsl. a, habit; b, flower; c, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 60, figure 6: 1-3. 1963].



Map 45(2)-25: *Pedicularis vialii* Franch. ex F. B. Forbes & Hemsl.

Ser. 11. *Kialenses*

Ser. *Kialenses* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 9. 1949.

Herbs medium-sized, less than 30 cm tall. Stems often many, erect, unbranched. Leaves alternate, mostly basal, long-petiolate; leaf blade linear to lanceolate or lanceolate-ovate, pinnatipartite to pinnatisect. Inflorescences racemose, a lax. Calyx cylindric; lobes 3 or 5, unequal. Corolla tube slightly longer than calyx; galea strongly twisted; beak S-shaped, longer than lower lip, slender, covered with long villus or glabrous; lobes of lower lip short and wide, more or less square.

Two species; both endemic to the Pan-Himalaya.

Notes: Our molecular phylogenetic results indicate that two species of the series *Kialenses* form a well-supported clade, supporting the delimitation of the series.

- 1a. Galea margin bearded; leaf blade pinnatisect; calyx 8–9 mm long, pubescent, 5-lobed26. *P. kialensis*
 1b. Galea margin not bearded; leaf blade pinnatifid; calyx 11–12 mm long, sparsely pubescent or subglabrous, 3-lobed27. *P. ludovicii*

26. *Pedicularis kialensis* Franch., Bull. Soc. Bot. France 47: 22. 1900; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 62.

1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 111. 1998. Type: China, Sichuan, Kangding, 1893, *Soulié 611*

[**lectotype designated here:** P(P04332995);
isolectotypes: P(P04332996, P04332997)].

Herbs perennial, 8–20 cm tall. Roots slender, 6–15 cm long, and more or less fusiform. Stems often many, slightly pubescent. Leaves alternate; petiole of basal leaves 4–6 cm long; leaf blade lanceolate, 14–20 cm long, pinnatisect; segments 8–16 pairs, ovate-lanceolate to lanceolate, incised-dentate. Inflorescences interrupted, pubescent; bracts leaflike; pedicels 2–3 mm long. Calyx cylindric, 7–8 mm long, deeply cleft anteriorly, pubescent, 5-lobed. Corolla red; tube slightly longer than calyx, glabrous; galea purple, margin bearded; beak bent upward apically, 8–10 mm long; lower lip ciliate. Filaments 2 pubescent, 2 glabrous. Capsule triangular-lanceolate, 11–15 mm long. Figure 45(2)–13.

Phenology: flowering from June to July.

Habitats: along banks, in forests; 3000–4900 m.

Distribution: endemic; N Hengduan [Map 45(2)–26].

Notes: Type, “La Chine occidentale su-tchuen, Tongola dans les fêts de Sans (*Soulié 611*)” has been deposited in the herbarium P. Tsoong designated one photo of *Soulié 2897* and a specimen of *Soulié 2857* as “type” (PE00033101), both on the same sheet and neither of them was cited in the protologue. After examinations of specimens in the herbarium P, we find collection *Soulié 2897* and three sheets of *Soulié 611*, and one of the latter is designated here as a lectotype.

N HENGDUAN: **Garzê**, 4150 m, 23 Sept. 1961, *Q. L. Zhang 360261* (PE). **Jinchuan:** 3850 m, 12 Sept. 1958, *The Eighth Forest Exped. 4928* (PE). **Yajiang**, 1960, *Z. T. Guan 440858* (PE); Yajiang, 3950 m, 5 Aug. 1960, *Z. T. Guan 46-0560* (PE).

27. *Pedicularis ludovicii* H. Limpr., Repert. Spec. Nov. Regni Veg. 20: 247. 1924, “*Pedicularis ludovicii*”. ≡ *Pedicularis dielsiana* H. Limpr., Fedde. Rep. Bieh. 12. 483. 1922, nom. illeg., non *Pedicularis dielsiana* Bonati, Bull. Soc. Bot. France 54: 186. 1907. Type: China, Sichuan, Dawu, Lumpu-er Tal, 4400 m, 14 July 1914, *H. Limpricht 1988* [isotype: WU].

Pedicularis streptorhyncha P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 397. 1963; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 62. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 111. 1998. **syn. nov.** Type: China, Sichuan, Tsi-pu La, in *Rhododendron muscosis*, ca. 4000 m, *H. Smith 2040* [holotype: PE(00033013); isotype: PE(00123517)].

Herbs perennial, 15–30 cm tall, black when dry. Rootstock 15–30 cm long, 5 mm in diameter, more or less fleshy. Stems single to several and clustered, slightly pubescent. Basal leaf petiole usually 4–6 cm long; leaf blade linear-lanceolate, 2.5–18 cm long, 0.3–2 cm wide, pinnatilobate; segments 9–28 pairs, triangular-ovate, glabrous except adaxially hispidulous along midvein, margin double-dentate; cauline leaves few or absent. Inflorescences 6–20 cm long, few-flowered; bracts leaflike. Calyx cylindric, 10–11 mm long, sparsely pubescent or subglabrous, deeply cleft anteriorly, 3-lobed; posterior lobe smaller, subulate, entire, others larger and serrate. Corolla tube 13–15 mm long, subglabrous; galea margin glabrous; beak 14–17 mm long; lower lip 15–18 mm long. Filaments 2 pubescent, 2 glabrous. Capsule triangular-lanceolate, 16–20 mm long. Figure 45(2)–14.

Phenology: flowering from June to July.

Habitats: alpine *Quercus* scrubs, mossy *Rhododendron* scrubs; 3900–4000 m.

Distribution: endemic; N Hengduan [Map 45(2)–27].

Notes: Limpricht described *P. dielsiana* H. Limpr. as new based on one collection (*Limpricht 1988*) from Sichuan Province of China, and he might not notice that the epithet “*dielsiana*” had been used by Bonati (1907. Bull. Soc. Bot. France 54: 186) to describe a species with verticillate leaves. Limpricht stated that *P. dielsiana* H. Limpr. is similar to *P. kialensis* Franch. but differs in pinnatilobate (vs. pinnatisect segments of *P. kialensis* Franch.) leaves. In 1924, Limpricht noticed the mistake and used a new epithet “*ludovicii*” for the collection *Limpricht 1988* and treated *P. dielsiana* as a synonym of *P. ludovicii* H. Limpr.

Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 137–138) treated cautiously *P. ludovicii*

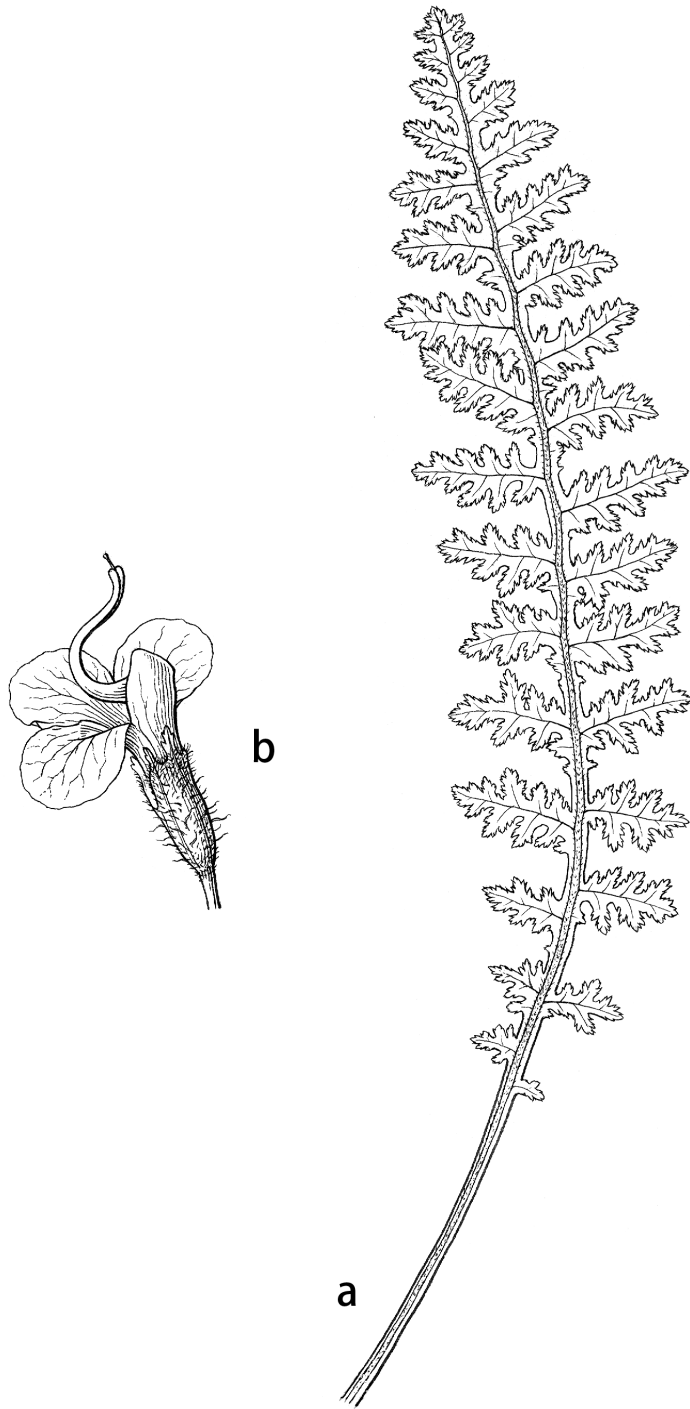
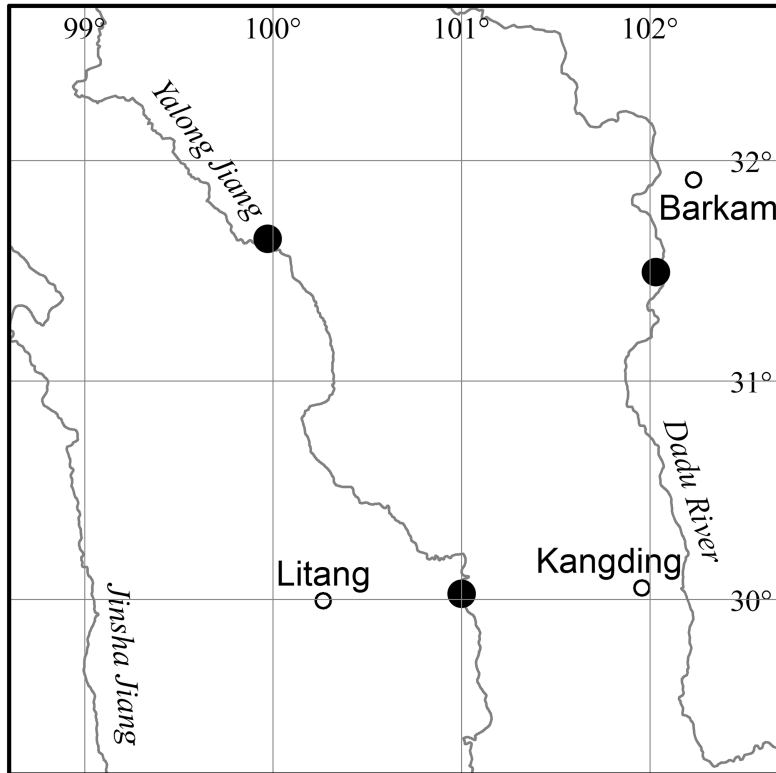


Figure 45(2)-13: **Pedicularis kialensis** Franch. a, leaf; b, flower. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 64, figure 7: 4-5. 1963].



Map 45(2)-26: *Pedicularis kialensis* Franch.

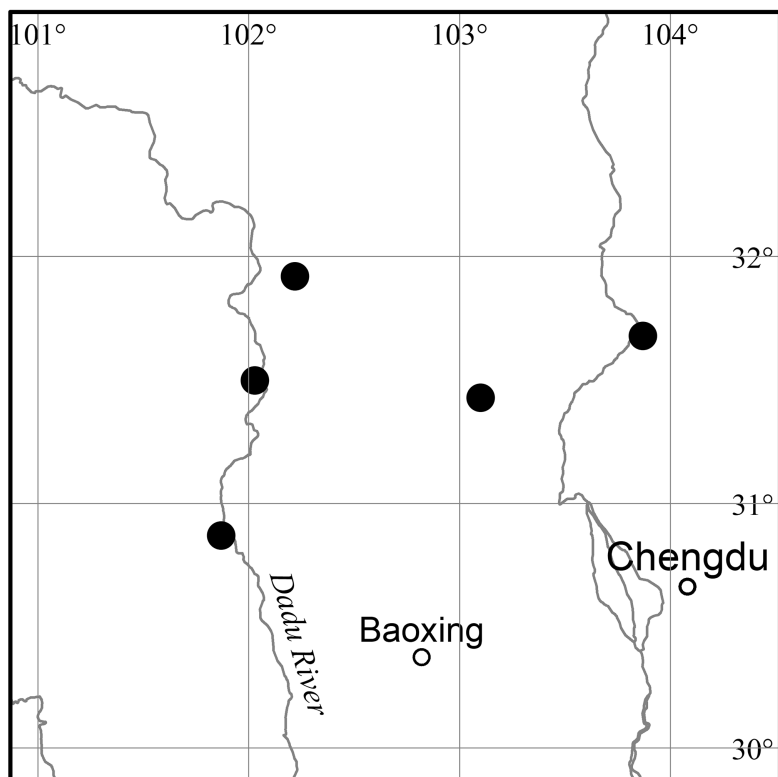
H. Limpr. as a synonym of *P. tibetica* Franch., although he had never seen any specimens or types of the former. Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 138) stated that “The type (*P. ludovicii*), Ost-Tibet: Dawu, Tal von Lumpu, oberhalb des Talschlusses Lartza gegen dem Passgrat Silha tschem la, 4400–4500 m. [Limpricht] (n. 1988) [in 1914], has not been seen. Limpricht’s type was from Dawu, in Sikang, very near to the type locality (Tongolo) of *P. tibetica*. Limpricht’s description did not give any measurements, with the exception of the length of the corolla. In general, it agrees fairly well with *P. tibetica* Franch., and reveals no notable differences. However, Limpricht recognized at the same time *P. tibetica* by citing his collection 1666 from Tatsienlu. Thus the name is only tentatively reduced to the synonymy of the latter. An examination of the type is necessary for the final decision.” Li’s taxonomic treatment was followed by Tsoong (1963. Fl. Reipubl.

Popularis Sin. 68: 253) and Yang *et al.* (1998. Fl. China 18: 169). After an examination of type (in the herbarium WU) of *P. ludovicii* H. Limpr., we agree with Limpricht’s opinion (1922. Repert. Spec. Nov. Regni Veg. 12: 483) that *P. ludovicii* H. Limpr. is quite similar to *P. kialensis* Franch., and Li’s treatment in lack of type examination is not a good decision. Hence, we recover here the species status of *P. ludovicii* H. Limpr. and transfer it from the series *Oxycarpae* Prain to the series *Kialenses* H. L. Li.

Tsoong described *P. streptorhyncha* P. C. Tsoong as new and stated that it is similar to *P. kialensis* Franch. but differs in pinnatilobate (vs. pinnatisect segments of *P. kialensis* Franch.) leaves and bearded margin of galea. After examining type specimens of both species, we find that *P. streptorhyncha* P. C. Tsoong is quite similar to *P. ludovicii* H. Limpr. Tsoong (1963) did not compare *P. streptorhyncha* with *P. ludovicii*



Figure 45(2)-14: *Pedicularis ludovicii* H. Limpr. a, habit; b, flower; c, capsule. Drawn by J.-Y. FENG for *P. streptorhyncha* P. C. Tsong [Fl. Reipubl. Popularis Sin. 68: 64, figure 7: 1-3. 1963].



Map 45(2)-27: *Pedicularis ludovicii* H. Limpr.

because Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 138) had treated *P. ludovicii* H. Limpr. as a synonym of *P. tibetica*, which belongs to another series *Oxycarpae*, and also because none of them had examined type collection of *P. ludovicii* H. Limpr. Hence, we treat *P. streptorhyncha* P. C. Tsoong as a new synonym of *P. ludovicii* H. Limpr., because there are no morphological gaps between these two taxa.

N HENGDUAN: **Danba**, 5 Aug. 1958, *The Eighth Forest Exped.* 5593 (PE). **Jinchuan**, 4200 m, 23 June 1958, *X. Li* 77856 (PE). **Lixian**, Zhegu Shan, 15 July 1958, *Z. L. Wu* 33026 (PE); Lixian, Zhegu Shan, 4000 m, 16 Aug. 2001, *F. S. Yang* 2081 (PE); Lixian, Dabanzhao, Huangtuliang, ca. 3600 m, 7 July 1957, *D. Z. Deng* 1227 (SZ). **Maoxian**, 1952, *Z. He & Z. L. Zhou* 13731 (PE). **Barkam**, 24 June 1958, *Z. L. Wu* 32299 (PE).

Ser. 12. Excelsae

Ser. Excelsae Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 523. 1888.

Herbs up to 160 cm tall, not black when dry. Stems branched. Leaves alternate; leaf blade more or less ovate, usually more than 3.5 cm wide, 3-pinnatifid to pinnatisect. Inflorescences long-racemose. Calyx deeply cleft anteriorly. Corolla 10–15 mm long; galea with a widened anther case, margin long-bearded; beak semicircular, sinistrorse, slender.

One species; endemic to the Pan-Himalaya.

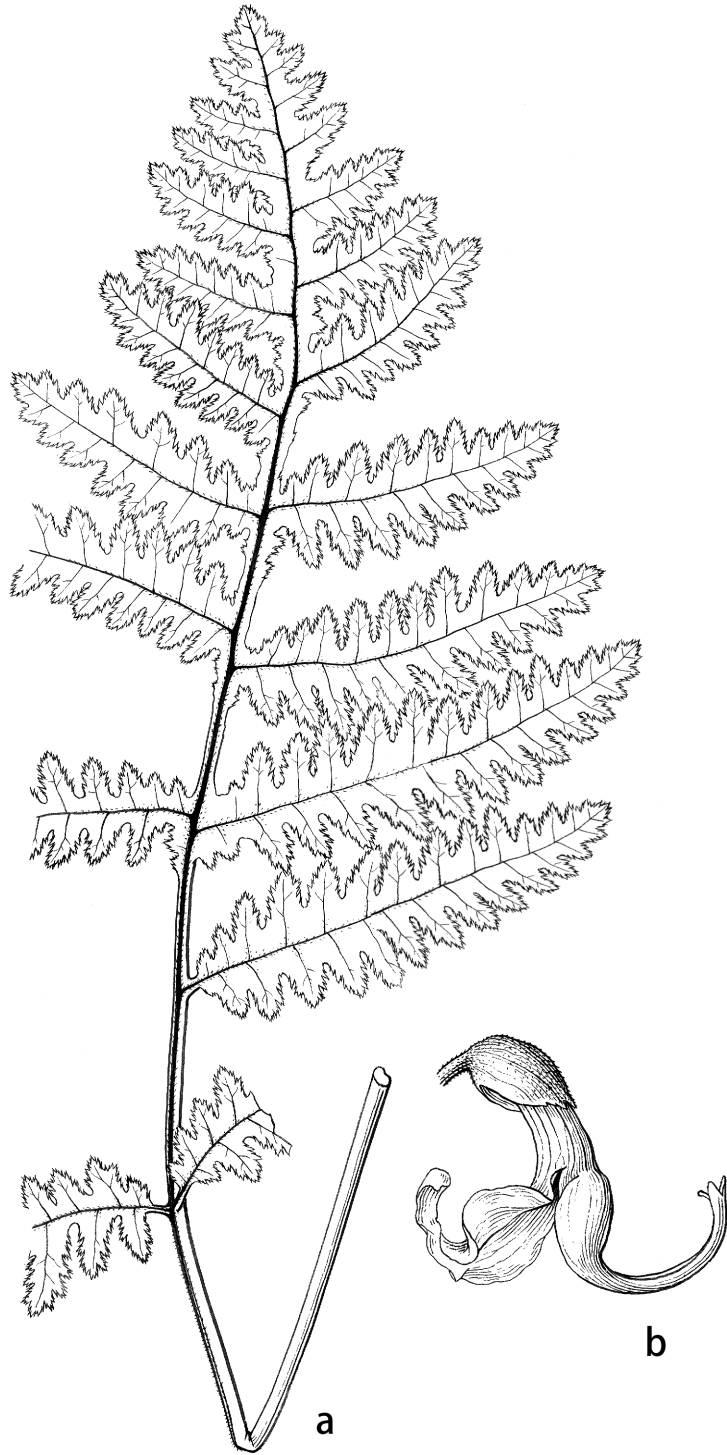


Figure 45(2)-15: *Pedicularis excelsa* Hook. f. a, leaf; b, flower. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 60, figure 6: 4-5. 1963].

28. *Pedicularis excelsa* Hook. f., Fl. Brit. India 4: 311. 1884; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 61. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 111. 1998. Type: India, Sikkim, Yeumtong, 3650 m, Sept. 1849, *Hooker f. & Thomson Pedicularis 27* [lectotype designated here: K(000739056; isolectotype: BM(BM000629882)].

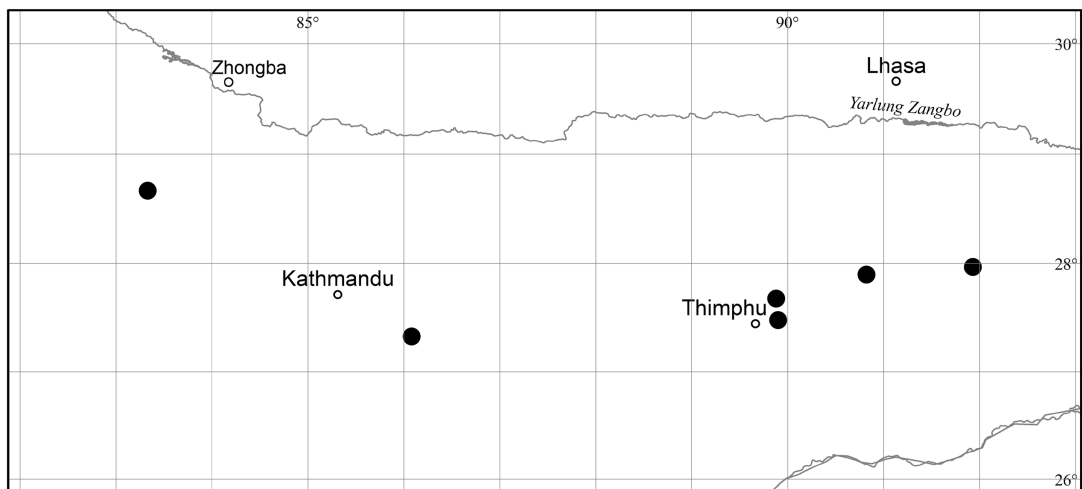
Herbs perennial, 80–160 cm tall. Rootstock more or less lignified, 3–4 cm in diameter, branched. Stems hollow, striate. Leaves withering early at base; petiole 2–6 cm long; leaf blade ovate, 8–16 cm long, 5–10 cm wide, 3-pinnatifid to pinnatisect; segments ovate-lanceolate, margin incised-dentate, apex acute. Inflorescences 6–20 cm long; bracts leaflike, 8–9 mm long, shorter than flowers. Calyx 4–5 mm long; lobes 5, obtuse triangular, less than 1 mm long, margin entire. Corolla tube slightly exceeding calyx; beak of galea 9–10 mm long; lower lip 16–18 mm long, ciliate. Filaments all glabrous. Capsule ovoid-oblong, ca. 4 times as long as calyx, apex obtuse. Figure 45(2)–15.

Phenology: flowering and fruiting from July to August.

Habitats: deep wet humus in the shade of broad-leaved forests, swamps, dense *Rhododendron* and *Abies* forests; 3200–3600 m.

Distribution: endemic; C Nepal, Sikkim, Bhutan, Yarlung Zangbo-Brahmaputra [Map 45(2)–28].

CNEPAL: Dhawalagiri, Myagdi, Gurjakhani, 3350 m, 28 Aug. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams 3921* (BM). **Janakpur**, Ramechhap, Neju, 2767 m, 2 Aug. 1985, *H. Ohba, T. Kikuchi, M. Wakabayashi et al. 8561062* (KATH). **Sikkim:** Lachen, Yeumtong, 3650 m, Sept. 1849, *Hooker f. & Thomson Pedicularis 27* (BM). **BHUTAN:** Bumthang, in a swamp, 3700 m, 30 July 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 16971* (PE). **Thimphu**, 3400 m, between Barshong and Dotena, on wet rocks at stream edge in open Fir-Juniper forest, Aug. 1989, *J. R. I. Wood 7108* (E). **Upper Pho Chu**, 4040 m, *Abies* dense forest on S-facing slope, 1 Sept. 2000, *G. Miede & S. Miede 00-342-09* (TI). **YARLUNG ZANGBO-Brahmaputra:** Cona, Leiqugongri-Rangcun, 3200 m, 9 Sept. 1975, *Qinghai-Xizang Suppl. Exped. 751849* (PE); Cona, Leiqugongri-Rangcun, 3200 m, 9 Sept. 1975, *Qinghai-Xizang Suppl. Exped. 751848* (HNWP).



Map 45(2)–28: *Pedicularis excelsa* Hook. f.

Ser. 13. Lachnoglossae

Ser. Lachnoglossae Prain, Ann. Roy. Bot. Gard. Calc. 3: 81. 1890.

Herbs black when dry. Stems erect, unbranched. Leaves mostly basal; leaf blade pinnatisect with lanceolate segments; cauline leaves few, alternate, pinnatisect, segments linear. Inflorescences elongated, more or less lax at base. Corolla tube less than 2 times as long as calyx; galea pubescent abaxially and at margin; beak well developed, straight, nearly as long as lower lip, slender, with a tuft of hairs at apex.

One species; in the Pan-Himalaya and adjacent regions.

29. *Pedicularis lachnoglossa* Hook. f., Fl. Brit. India 4: 311. 1885; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 67. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 113. 1998. Type: India, Sikkim, Lachen Valley, 4267 m, 15 July 1849, *Pedicularis No. 32 Hooker f. s.n.* [lectotype designated by Mill (2001: 91): K(K000739061); isolectotypes: BM(BM000885888), K(K000739060), P(P02985283, P02985287)].

Pedicularis lachnoglossa var. *macrantha* Bonati, Notes Bot. Gard. Edinb. 8: 41. 1913a; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 113. 1998. ≡ *Pedicularis macrantha* (Bonati) H. Lévl., Cat. Pl. Yun-Nan. 263. 1917. nom illeg., non *Pedicularis macrantha* Spreng., Syst. Veg., ed. 16 [Sprengel] 4(2. Cur. Post.): 233. 1827. Type: China, Yunnan, Yulong, 3353 m, June 1910, *G. Forrest 5821* [lectotype designated by Garg & Singn (2020: 86): E(E00284019); isolectotype: BM(BM001010997)].

Herbs perennial, 20–50 cm tall. Rootstock slightly lignified, 1–2 cm in diameter, few branched. Stems usually 2–5, sometimes up to 8, brown-pubescent, base with petiolar remnants from preceding years. Leaves clustered at base; petiole 3–8 cm long; leaf blade lanceolate-linear, 8–16 cm long, 1–2.6 cm wide, pinnatisect; segments 20–40 pairs, lanceolate, pinnatipartite or double-dentate. Inflorescences racemose, 8–20 cm long, usually interrupted; bracts linear, equal to, or shorter than, flower. Calyx cylindrical-oblong, 9–10 mm long, cleft more deeply anteriorly; lobes 5, more or less dentate or entire. Corolla purple-rose, 14–16 mm long; galea densely red to brown-pubescent abaxially and at margin;

beak 3–4 mm long; lower lip with densely red-brown ciliation. Filaments all glabrous. Capsule long-ovoid, 11–14 mm long, 6 mm wide.

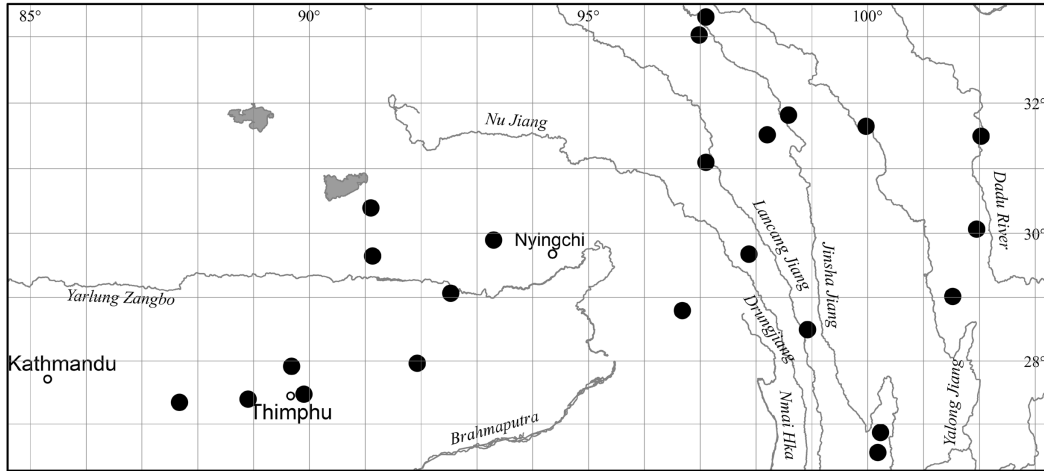
Phenology: flowering from June to July.

Habitats: alpine meadows, *Abies* forests, among small shrubs on hillsides; 2500–5400 m.

Distribution: E Nepal, Bhutan, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S Hengduan [Map 45(2)–29]; also in other regions of Qinghai Province, China.

Notes: Our molecular phylogenetic results show that six accessions of *P. lachnoglossa* Hook. f. form a well-supported clade.

E NEPAL: **Mechi**, Taplejung, Nup, 3800–4000 m, 20 July 1978, *H. Tabata, K. R. Rajbhandari & Y. Shimizu 11732* (TI). **BHUTAN:** **Gasa**, Forb-rich pasture encroached by *Rhododendron lepidotum* on E-facing slope, 4330 m, 16 Aug. 2000, *G. Miede & S. Miede 00-289-30* (TI). **Thimphu**, mountain SE of Pome La, 3500 m, 15 July 1991, *J. R. I. Wood 7384* (E). **M YARLUNG ZANGBO:** **Damxung**, 60 km N of Lhasa, 4260 m, 16 July. 1944, *F. Ludlow & G. Sherriff 11013* (E). **Lhasa**, 4660 m, 31 Aug. 1943, *F. Ludlow & G. Sherriff 9909* (PE). **Yadong**, Pali town, 4300 m, 18 Sept. 1974, *Qinghai-Xizang Exped. 74-2645* (HNWP, PE). **LYARLUNG ZANGBO:** **Gongbo'gyamda**, 3810 m, 20 July 1947, *F. Ludlow, G. Sherriff & J. H. Hicks 14582* (E). **Gyaca**, 4210 m, 25 July 1975, *Qinghai-Xizang Suppl. Exped. 750710* (HNWP, PE). **YARLUNG ZANGBO-Brahmaputra:** **Cona**, near the China/Bhutan border, 3810 m, 30 June 1949,



Map 45(2)-29: *Pedicularis lachnoglossa* Hook. f.

F. Ludlow, G. Sherriff & J. H. Hicks 20434 (E). **Zayü**, 3500 m, Sept. 1935, *C. W. Wang 66255* (PE, KUN). **TANGUT: Chindu**, valley NE of Xiwu, on the road between Madoi and Yushu, 3850 m, 14 Aug. 1996, *T. N. Ho et al. 1791* (E). **Dêgê**, Keluodong, on the slope, 3650 m, 21 June 1974, *Sichuan Exped. 7052* (PE). **Garzê**, 3950 m, 1961, *Q. L. Zhang 250261* (PE); Garzê, 3400 m, 27 June 1961, *T. C. Ying et al. 9139* (PE). **Jomda**, 3800 m, 18 Aug. 1976, *Qinghai-Xizang Exped. 12497* (PE). **Qamdo**, 4000 m, 10 Aug. 1976, *Qinghai-Xizang Exped. 12756* (PE). **Yushu**, Xiao Surmang, 3630 m, 25 Aug. 1996, *T. N. Ho et*

al. 2391 (E). **N HENGDUAN: Jinchuan**, Kasa, 4000 m, 28 June 1958, *X. Li 77935* (PE). **Zogang**, 3800 m, 19 Aug. 2001, *F. S. Yang Y0190* (PE). **SHENGDUAN: Dêqên**, Jiansheju, 2700 m, Sept. 1935, *C. W. Wang 70103* (PE). **Heqing**, 3400 m, 3 Sept. 1929, *R. C. Ching 24290* (PE). **Jianchuan**, July 1929, *R. C. Ching 23090* (PE, KUN). **Jiulong**, 4400 m, 16 June 1960, *Z. T. Guan 25-0236* (PE). **Kangding**, 3020 m, 20 June 1953, *X. L. Jiang & J. H. Xiong 36060* (PE); Kangding, Shangchenzhi, ca. 3800 m, 3 July 1974, *Y. Z. Zhang 4769* (CDBI). **Yulong** (Lijiang), 2800 m, 13 Aug. 1937, *T. T. Yü 15437* (PE).

Ser. 14. *Recurvae*

Ser. *Recurvae* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 9. 1949.

Herbs perennial, not black when dry. Stems erect or ascending, unbranched. Leaves alternate, long-petiolate at base; leaf blade lanceolate-oblong. Inflorescences racemose or spicate. Calyx lobes entire, triangular, ciliate. Corolla red to purple-red; tube barely exceeding the calyx; galea strongly bent or falcate, densely villous at base and at margin; beak well developed, bent upward; lower lip narrow.

One species; in the Pan-Himalaya and adjacent regions.

30. *Pedicularis recurva* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 563. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popu-

laris Sin. 68: 68. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 113. 1998. Type: China, Sichuan (no detailed

information), collected in 1885, *G. N. Potanin* [**lectotype designated here:** LE).

Pedicularis angustilabris H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 82. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 70. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 114. 1998. **syn. nov.** Type: China, Yunnan, Shangri-la (Zhongdian), Habaxue Shan, 3650 m, July 1923, *J. F. Rock 9653* [holotype: PH(00019421)].

Pedicularis kangtingensis P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 398. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 114. 1998. **syn. nov.** Type: China, Sichuan, Kangding, Yulingkong, ca. 3600 m, 22 July 1934, *H. Smith 10664* [holotype: PE(00033105)].

Pedicularis recurva var. *polyantha* Bonati, Notes Bot. Gard. Edinb. 5: 88. 1911; Limpricht, Repert. Sp. Nov. 20: 230. 1924; Handel-Mazzetti, Symb. Sin. 7: 857. 1936; Li, Proc. Acad. Nat. Sci. Philad. 101: 82. 1949. Type: China, Yunnan, Yulong, at the base of cliffs on the eastern flank of the Lichiang range, 3353–3658 m, Aug. 1906, *G. Forrest 2667* [holotype: E(E00284016); isotype: KUN(0472950)].

Herbs perennial, 30–80 cm tall. Roots clustered, fibrous, 1–1.5 cm in diameter, branched, more or less fusiform. Stems single or sometimes several together, 30–80 cm tall, glabrous and purple tinted at base. Basal leaves withering early; cauline leaves alternate; petiole to 5–12 cm long, distal ones shorter; leaf blade oblong-lanceolate, 5–13 cm long, 3–5.5 cm wide, glabrous, pinnatisect; segments 9–18 pairs, ovate to lanceolate, lobulate or double-dentate. Inflorescences 5–27 cm; bracts linear-lanceolate, ciliate, becoming narrowly ovate upward, margin white villous. Calyx 3–5 mm long, slightly cleft anteriorly; lobes 5, triangular, more or less equal, densely ciliate, entire. Corolla red to purple-red; tube

4–6 mm long, exceeding calyx; galea strongly bent, apex with several dark purple spots; lobes of lower lip unequal in size, apex more or less acute. Capsule ovoid, 7–10 mm long, 7 mm wide. Figure 45(2)–16.

Phenology: flowering from June to August.

Habitats: alpine meadows and open hillside; 3000–4100 m.

Distribution: S Hengduan [Map 45(2)–30]; also in other regions of Gansu Province, China.

Notes: In Li's monograph (1949. Proc. Acad. Nat. Sci. Philad. 101: 80–83), two geographically separated species were recognized: *P. recurva* Maxim. in NW Yunnan and *P. angustilabris* H. L. Li in N Sichuan and S Gansu of China. Tsoong described *P. kangtingensis* P. C. Tsoong as new, which was collected from Kangding, Sichuan Province of China. Tsoong recognized that *P. kangtingensis* represents a transition stage between the former two species. A statistical analysis of morphological characters reveals that these three species should be merged into one species, and molecular phylogenetic results indicate that three individuals of *P. recurva* Maxim. form a well-supported clade, in which an individual of *P. kangtingensis* P. C. Tsoong is nested.

S HENGDUAN: **Baoxing**, 3250 m, 15 July 1933, *T. T. Yü 2320* (PE). **Kangding**, 1934 (no more detailed information), *Z. S. Liu 872* (PE); Kangding, Sandaoqiao, 3600 m, 27 July 1951, *Z. He 10560* (PE); Kangding, Yulingkong, ca. 3600 m, 22 July 1934, *H. Smith 10664* (PE). **Shangri-la** (Zhongdian), Habaxue Shan, 3650 m, July 1923, *J. F. Rock 9653* (PH). **Yulong** (Lijiang), at the base of cliffs on the eastern flank of the Lichiang range, *G. Forrest 2667* (KUN); Yulong (Lijiang), 3750–4100 m, 20 July 1914, *H. R. E. von Handel-Mazzetti 4266* (WU); Yulong (Lijiang), 25 July 1939, *R. C. Ching 30453* (PE).

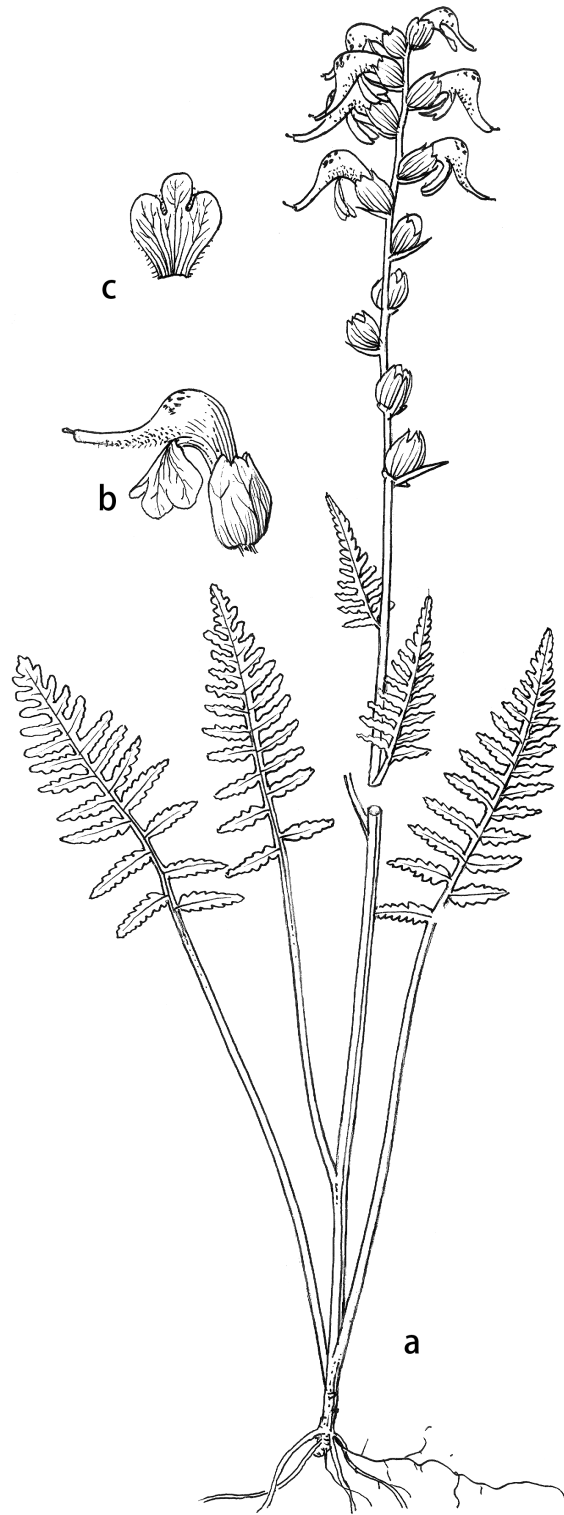
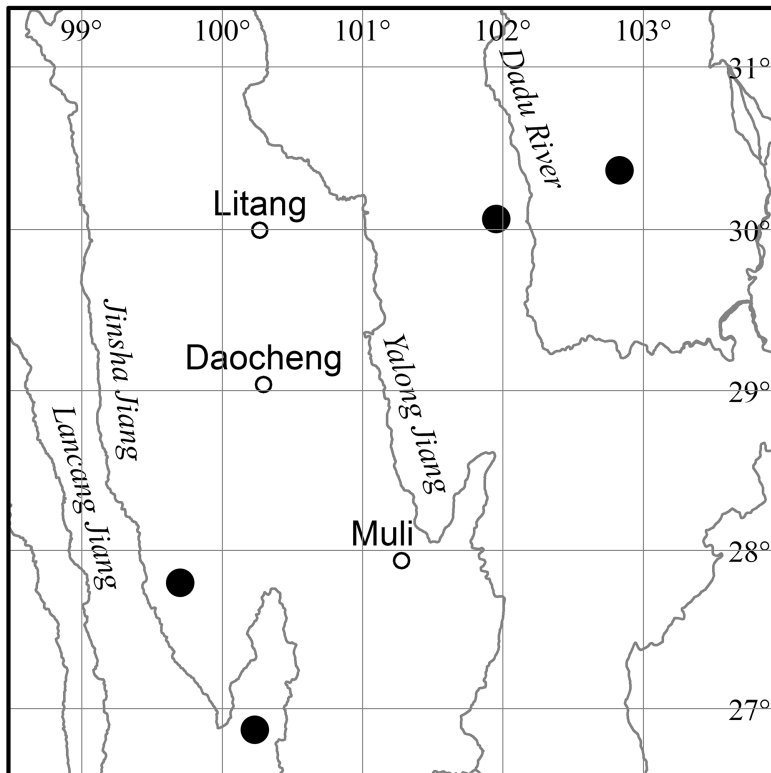


Figure 45(2)-16: *Pedicularis recurva* Maxim. a, habit; b, flower; c, corolla lip. C.-Z. JI modified from J.-Y. FENG for *P. kangtingensis* P. C. Tsoong [*Fl. Reipubl. Popularis Sin.* 68: 68, figure 9: 6-8. 1963].



Map 45(2)-30: *Pedicularis recurva* Maxim.

Ser. 15. Hirtellae

Ser. Hirtellae Prain, Ann. Roy. Bot. Gard. Calc. 3: 89. 1890.

Herbs reddish or reddish-brown hirtellous, and black when dry. Stems single, unbranched. Basal leaves persistent; cauline leaves alternate, short-petiolate; leaf blade less than 12 cm long, pinnatifid. Inflorescences spicate. Corolla tube straight, erect; galea pubescent abaxially, 2-toothed at apex; lower lip not spreading.

One species; endemic to the Pan-Himalaya.

31. *Pedicularis hirtella* Franch. ex F. B. Forbes & Hemsl., J. Linn. Soc. Bot. 26: 209. 1890; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 71. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 114. 1998. Type: China, Yunnan, Heqing, Sept. 1887, *J. M. Delavay 2729* [**lectotype designated here:** K(K000708898); isolectotype: K(K000708899)].

Herbs biennial, 20–50 cm tall, brown-hirtellous, sometimes glandular-pubescent. Whip-like rhizome 2–5 cm long, with a tuft of fibrous

rootlets near the upper, taproot 3–6 mm in diameter. Stems erect, rigid, unbranched, with 1 or 2 lines of glandular hairs. Basal leaves large; petiole 4–10 mm long; leaf blade ovate-oblong to lanceolate-oblong, 2–5 cm long, 2–3 cm wide, adaxially long-pubescent, abaxially densely long-pubescent along veins; segments 9–15 pairs, ovate to ovate-lanceolate, dentate; cauline leaves smaller than basal leaves, more or less sessile. Inflorescences spicate, 7–14 cm long, often interrupted at base; bracts leaflike. Calyx cylindrical, 8–10 mm long, glandular-pubescent; lobes 5, linear-oblong, more



Figure 45(2)-17: *Pedicularis hirtella* Franch. ex F. B. Forbes & Hemsl. a, habit; b, leaf segments; c, flower; d, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 66, figure 8: 1-4. 1963].

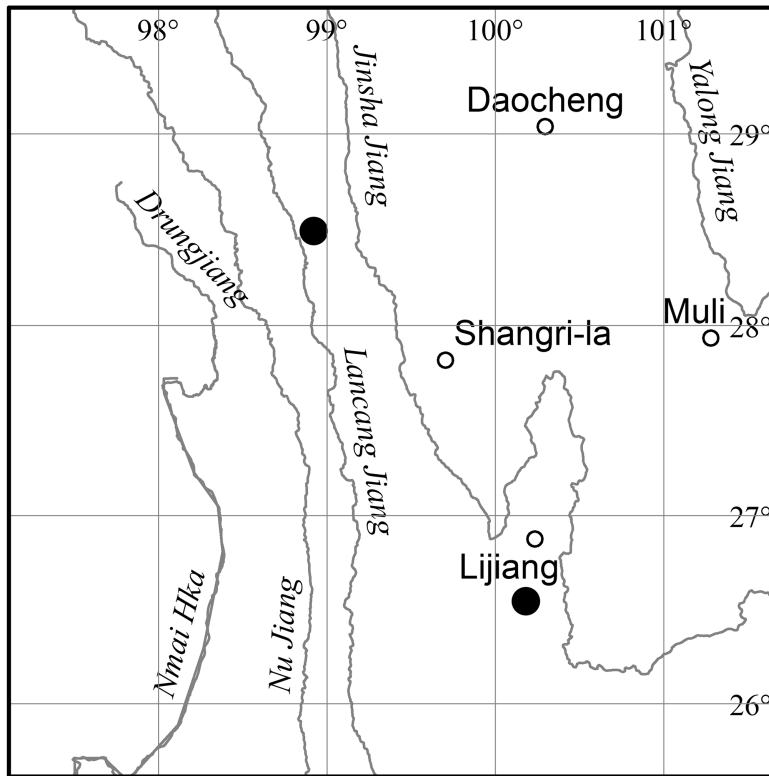
or less equal. Corolla white to rose, 2.4–3 cm long, glandular-pubescent; tube ca. 2 times as long as calyx; galea 10–11 mm long, falcate, distinctly subulate-dentate at apex; lower lip shorter than galea, lobes rounded, more or less equal, ciliate. Filaments all glabrous. Figure 45(2)–17.

Phenology: flowering and fruiting from July to September.

Habitats: open stony pastures; 2800–3700 m.

Distribution: endemic; S Hengduan [Map 45(2)–31].

S HENGDUAN: **Dêqên**, Merong-Salween Divide, open stony pasture on the margins of pine forests, Aug. 1914, *G. Forrest 13390* (PE). **Heqing**, Baiyanshaxi, 2800 m, 7 Sept. 1929, *R. C. Ching 24402* (PE, KUN); Heqing (montis Hee-chan-men, prope collum), Sept. 1887, *J. M. Delavay 2729* (K, US).



Map 45(2)–31: *Pedicularis hirtella* Franch. ex F. B. Forbes & Hemsl.

Ser. 16. Vagantes

Ser. Vagantes Prain, Ann. Roy. Bot. Gard. Calc. 3: 81. 1890.

Stems numerous, prostrate, repent to climbing, slender, sometimes plants stemless. Basal leaves long-petiolate, fernlike, up to 20 cm long; leaf blade pinnatisect to pinnatipartite; cauline leaves often pseudo-opposite. Flowers axillary, often in clusters, at the base of stem. Corolla tube less than 2 times as long as calyx; galea beaked.

Two species: both in the Pan-Himalaya (one endemic).

- 1a. Stems barely 1 cm tall, or stemless; leaf blade 10–14 cm long; corolla 35–40 mm long 32. *P. daochengensis*
 1b. Stems prostrate, repent to climbing; leaf blade 15–30 cm long; corolla 25–30 mm long 33. *P. vagans*

32. *Pedicularis daochengensis* H. P. Yang, Bull. Bot. Res. Harbin 10: 29. 1990; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 119. 1998. Type: China, Sichuan, Daocheng, 3900–4200 m, 31 Aug. 1981, *Qinghai-Xizang Exped. 5874* [holotype: PE(00135514)].

Herbs perennial, ca. 15 cm tall, black when dry. Stems usually 3–5 together, scarcely 1 cm tall, or plants stemless. Leaves nearly all basal, numerous; petiole 5–7 cm long, sparsely villous; leaf blade oblong to lanceolate-oblong, 10–18 cm long, abaxially white-tomentose along veins, adaxially subglabrous, pinnatisect; segments 12–15 pairs, oblong, margin double-dentate. Flowers nearly all basal; pedicels 2–3 cm long, slender. Calyx cylindrical, 18–20 mm long, cleft anteriorly

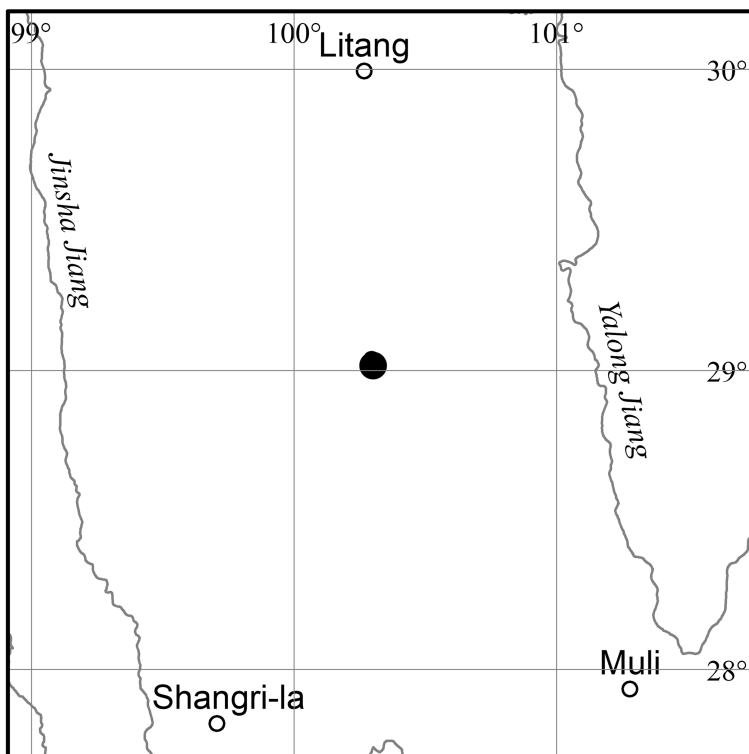
to 1/3 of tube; lobes 5, distinctly unequal. Corolla pink, 35–40 mm long; tube 20–22 mm long, slightly expanded apically; galea slightly falcate; beak 2–3 mm long, slender; lower lip ca. 18 mm long, 20–25 mm wide, ciliate. Filaments all glabrous. Capsule completely enclosed by calyx, obliquely narrowly ovoid, 16–20 mm long, short-mucronate.

Phenology: flowering from July to August.

Habitats: *Abies fabri* forests, slopes; 3900–4200 m.

Distribution: endemic; S Hengduan [Map 45(2)–32].

Notes: When Yang (1900. Acta Phytotax. Sin. 28(2):136–144) described *P. daochengensis*



Map 45(2)–32: *Pedicularis daochengensis* H. P. Yang

H. P. Yang as new, she stated that it differs from typical individuals of *P. vagans* Hemsl. ex F. B. Forbes & Hemsl. in having shorter stem, smaller leaf, and larger corolla. This species was described based on one individual, so it is difficult to evaluate whether it is a good species.

S HENGDUAN: Daocheng, 3900–4200 m, 31 Aug. 1981, *Qinghai-Xizang Exped.* 5874 (PE).

33. *Pedicularis vagans* Hemsl., in F. B. Forbes & Hemsley, *J. Linn. Soc. Bot.* 26: 218. 1890; Li, *Proc. Acad. Nat. Sci. Philad.* 101: 157. 1949; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 87. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 119. 1998. Type: China, Sichuan, Emei, 1887, *E. Faber 183* [lectotype designated here: K(K000708856); isolectotypes: K].

Herbs perennial, black when dry. Stems numerous, more than 40 cm long, prostrate, repent to climbing, glabrous. Basal leaves fernlike; petiole up to 25 cm long; leaf blade oblong-lanceolate, 15–30 cm long, 5–10 cm wide, pinnatisect to pin-

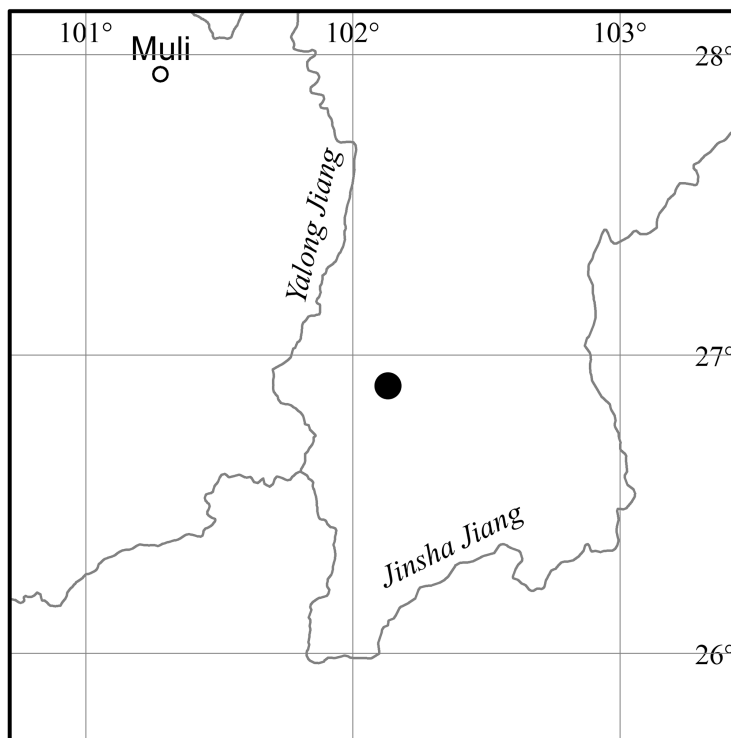
natipartite; segments 10–17 pairs, linear-lanceolate to oblong, incised-dentate. Stem leaves alternate to sub-opposite, more or less ovate or orbicular, abaxially subglabrous, adaxially sparsely-bristly; segments 2–5 pairs. Flowers often in dense clusters, axillary; bracts leaflike. Pedicel short. Calyx tubular, 8–12 mm long, glabrous, cleft more deeply anteriorly; lobes 5, unequal, serrate. Corolla pink, 24–30 mm long; tube erect, longer than calyx; galea falcate; beak conical, 3–4 mm long; lower lip 13–17 mm long, spreading. Filaments subglabrous.

Phenology: flowering and fruiting from July to October.

Habitats: forest understories, shaded wet paths, thickets; 900–2200 m.

Distribution: S Hengduan [Map 45(2)–33]; also in Emei, Sichuan Province, China.

S HENGDUAN: Miyi, Baipo Shan, 2900–3100 m, 10 July 1983, *Qinghai-Xizang Exped.* 11923 (PE).



Map 45(2)–33: *Pedicularis vagans* Hemsl.

Ser. 17. Axillares

Ser. Axillares Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 523. 1888.

Stems slender, often repents. Leaves more or less opposite or alternate, pinnatisect. Flowers several, axillary, scattered, usually long-pedicellate. Corolla tube from shorter than calyx to more than 2 times as long; beak straight.

Notes: Our molecular phylogenetic results reveal that species of the series *Axillares* Maxim. do not form a monophyletic clade. *Pedicularis axillaris* Franch. ex Maxim., *P. longipes* Maxim., and species of other series form a clade sister, but *P. membranacea* H. L. Li of this series is nested in other clades. The series *Axillares* should be further redefined.

Seven species; five in the Pan-Himalaya (2 endemics).

- 1a. Pedicels usually 2–7 cm long; segments of basal leaves 5–7 mm wide.
 - 2a. Stems often several together, more than 60 cm tall; segments of leaf blade ovate to ovate-oblong, pinnatifid or incised double-dentate..... 34. *P. membranacea*
 - 2b. Stems barely 10 cm tall, more or less stemless; segments of leaf blade lanceolate, pinnatifid, apex acute..... 35. *P. longipes*
- 1b. Pedicels usually less than 2.5 cm long; segments of basal leaves 2–3 mm wide.
 - 3a. Petiole 1–1.5 cm long; filaments all villous 36. *P. aquilina*
 - 3b. Petiole 2–3 cm long; filaments all glabrous.
 - 4a. Leaf pseudo-opposite; segments pinnatipartite..... 37. *P. axillaris*
 - 4b. Leaf alternate; segments pinnatipartite to pinnatifid 38. *P. laxiflora*

34. *Pedicularis membranacea* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 168. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 94. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 121. 1998. Type: China, Sichuan, Kangding (near Ta Kwan, Ta Hsiang Ling), 2400 m, 7 Aug. 1937, *C. Y. Chiao 1657* [holotype: A(00097271)].

Herbs perennial, not black when dry. Rhizome more or less lignified, lanceolate scales on nodes. Stems often several together, more than 60 cm tall, repent, covered with densely gray-brown pubescence at base. Leaves alternate or more or less opposite at branches; petiole 2–8 cm long; blade ovate-elliptic to lanceolate-oblong, 2–10 cm long, 4–5 cm wide, membranous, adaxially slightly hirtellous, abaxially glabrous, pinnatisect; segments 4–8 pairs, ovate to ovate-oblong, pinnatifid or incised double-dentate. Flowers axillary, pedicels 8–15 mm long. Calyx 5–8 mm long, slightly cleft anteriorly; lobes 5, equal or unequal in size. Corolla purple, 12–15 mm long; tube erect, nearly

1.5 times as long as calyx; galea bent at a right angle apically; beak straight, 3–4 mm long, slender; lower lip 10–12 mm long, middle lobe acute at apex. Filaments all glabrous. Capsule enclosed by calyx, compressed, ovoid, 6–8 mm long, 5 mm wide, oblique, mucronate. Figure 45(2)–18.

Phenology: flowering and fruiting from June to August.

Habitats: forests, rocky slopes; 2200–2400 m.

Distribution: S Hengduan [Map 45(2)–34]; also in other regions of Sichuan Province, China.

Notes: Li described *P. membranacea* H. L. Li as new based on one collection with only immature flowers.

S HENGDUAN: **Baoxing**, 1936, *G. N. Qu 2958* (PE). **Tianquan**, 2000 m, 9 June 1953, *X. L. Jiang & J. H. Xiong 34358* (PE); Tianquan, Erlang Shan, 2200 m, 14 June 1953, *X. L. Jiang & J. H. Xiong 34423* (PE); Tianquan, Erlang Shan, 2200 m, 28 June 1953, *W. P. Fang & W. G. Hu*

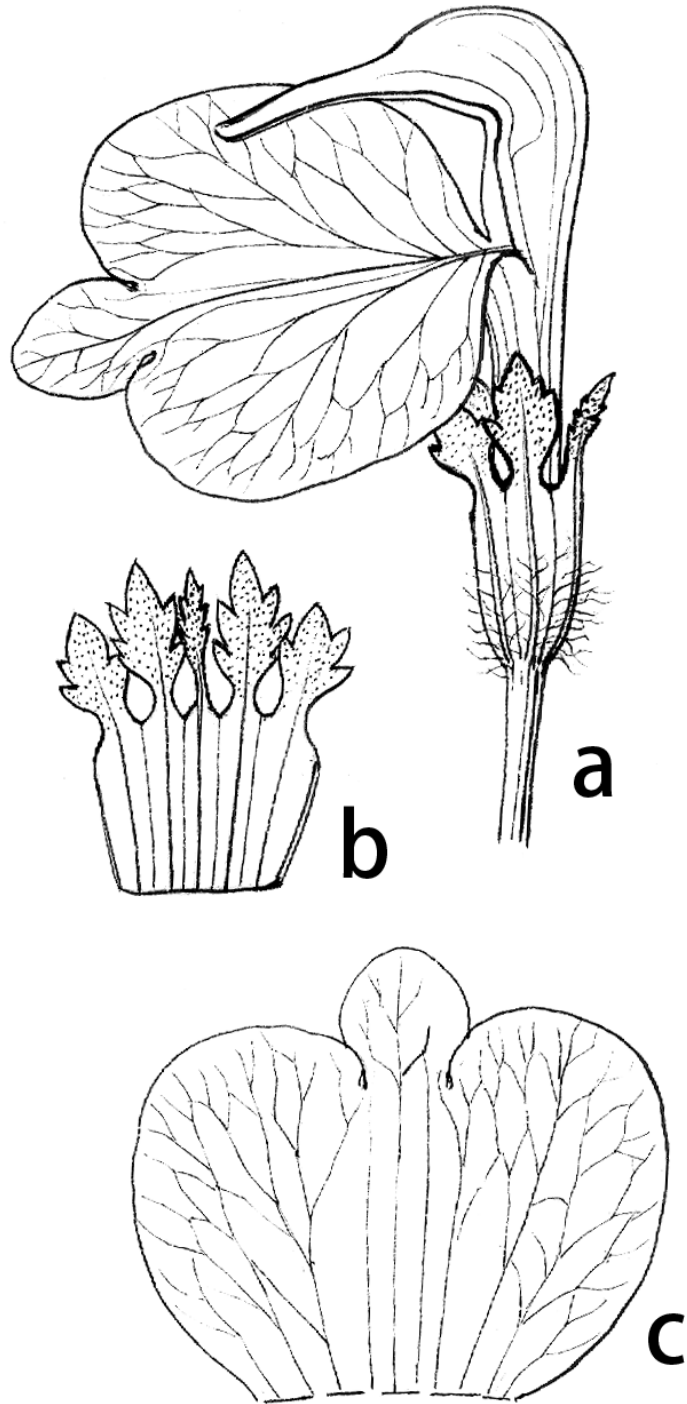
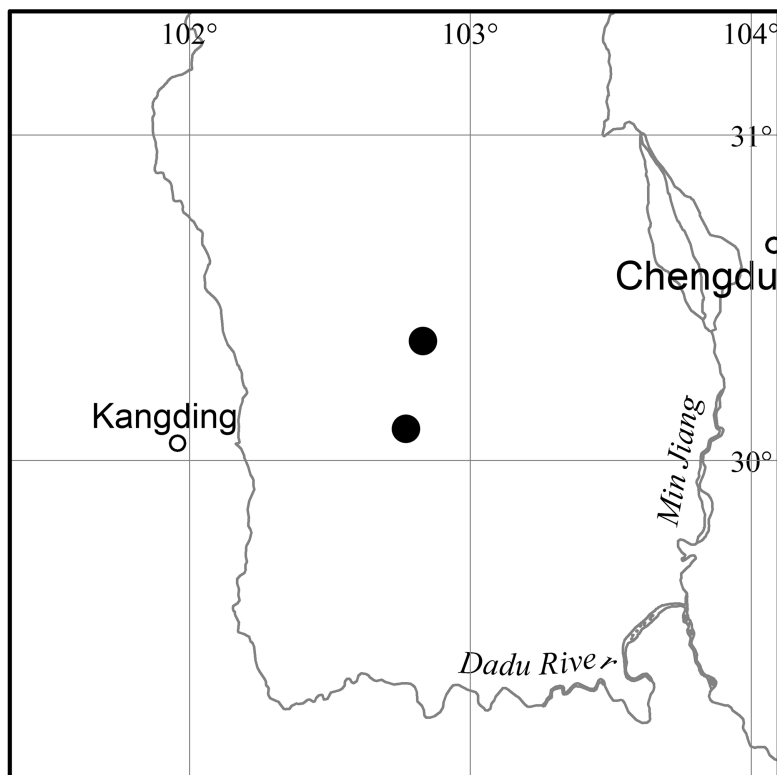


Figure 45(2)-18: *Pedicularis membranacea* H. L. Li. a, flower; b, calyx; c, corolla lip. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 90, figure 14: 9-11. 1963].



Map 45(2)-34: *Pedicularis membranacea* H. L. Li

34669 (PE); Tianquan, Erlang Shan, 2600 m, 23 June 1953, *X. L. Jiang & J. H. Xiong* 34588 (PE); Tianquan, Erlang Shan, Guniuping, 27 June 1951, *W. G. Hu et al.* 10183 (PE); Tianquan, Erlang Shan, Mucaipeng, 3 July 1951, *W. G. Hu & Z. He* 10239 (PE).

35. *Pedicularis longipes* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 554. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 89. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 120. 1998. Type: China, Sichuan (no more detailed information), collected in 1885, *G. N. Potanin s.n.* [lectotype designated here: LE].

Herbs perennial, barely 10 cm tall, more or less stemless, delicate, and not black when dry. Whip-like rhizome black, smooth, 5–8 cm long. Stems 3–4 cm high, leafy, occasionally branched. Leaves alternate; petiole 3–6 cm long; leaf blade oblong to oblong-lanceolate, 4–7 cm long, 2.5 cm wide, pinnatisect; segments 4–9 pairs, oblong-lanceolate, pinnatisect,

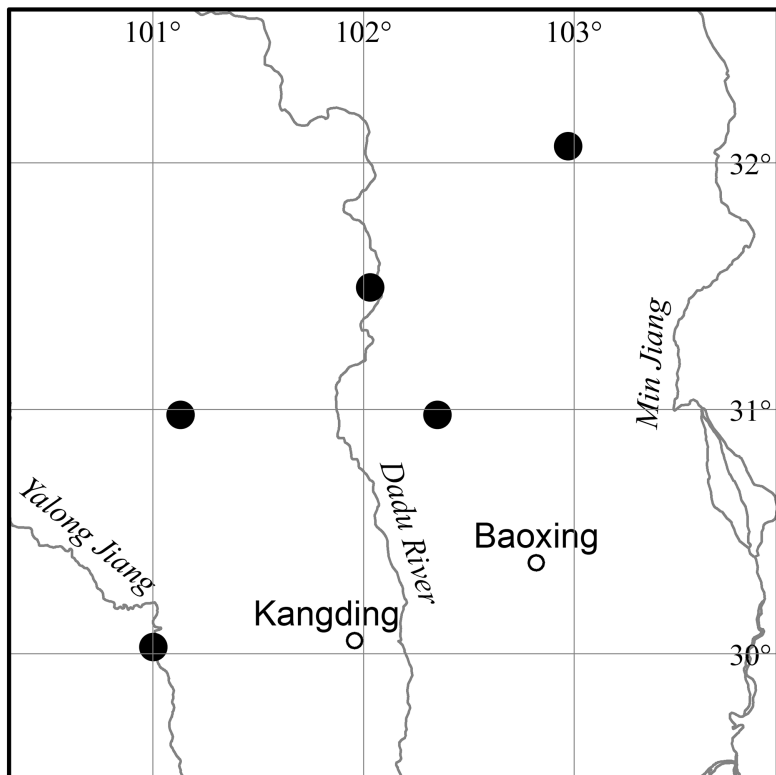
incised-dentate. Flowers few; pedicels curved, 1.5–6 cm long, slender. Calyx turbinate-campanulate, 5–7 mm long, slightly cleft anteriorly; lobes 5, lanceolate-linear, more or less entire to obscurely dentate. Corolla rose, 14–16 mm long; tube more than 2 times as long as calyx; galea 8–9 mm long, more or less bent at a right angle; beak straight, slender; lower lip 10–11 mm long, 13–15 mm wide, middle lobe rounded, smaller than lateral lobes, ciliate. Filaments all glabrous.

Phenology: flowering and fruiting from July to August.

Habitats: moist *Abies* forests; 3400–4100 m.

Distribution: endemic; N Hengduan [Map 45(2)-35].

Notes: Maximowicz listed one collection (*Potanin, 1885*) in the protologue of *P. longipes* Maxim., and one sheet deposited in the herbarium LE was labelled as “holotype”.



Map 45(2)-35: *Pedicularis longipes* Maxim.

N HENGDUAN: **Dawu**, Haizi Shan, 4100 m, 31 Aug. 1934, *H. Smith 11719* (PE). **Heishui**, 3470 m, 23 July 1955, *The Central Third Team for Forest Investigation 0121* (PE). **Jinchuan**, Anning, 2770 m, 13 June 1983, *Hengduan Shan Veg. Exped. 4113* (PE). **Xiaojin**, 3570 m, 26 June 1957, *J. Zhou 83* (PE). **Yajiang**, Mawogou, 3700 m, 1 Aug. 1959, *S. Jiang & C. L. Jing 02642* (PE); Sichuan (no detailed information), 1885, *G. N. Potanin s.n.* (K).

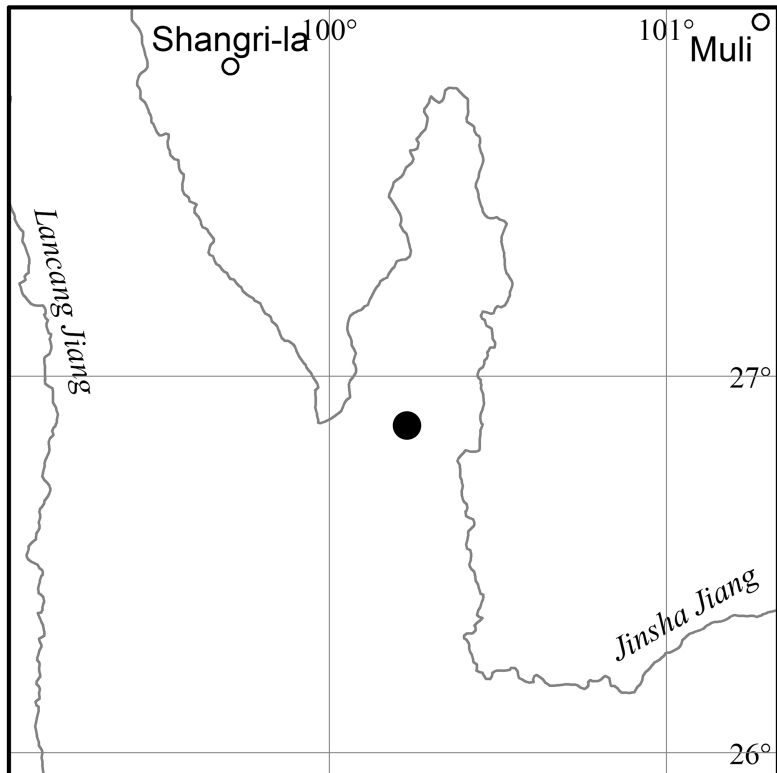
36. *Pedicularis aquilina* Bonati, *Bull. Soc. Bot. France* 55: 245. 1908; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 95. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 121. 1998. Type: China, Yunnan, (*F. Doucloux*) *Sans 4629* [lectotype designated here: P(P02994259); isolectotype: P(P02994260)].

Herbs perennial. Stems numerous, 20–30 cm tall, procumbent, slightly branched or

unbranched, subglabrous, leafy; cauline leaves alternate; petiole 8–10 mm long, glabrous; leaf blade ovate-elliptic, 1–3 cm long, slightly hispid, pinnatisect; segments 6–8 pairs, lanceolate, pinnatifid, apex acute. Flowers remotely arranged; bracts leaflike, nearly as long as flowers; pedicels more or less curved, slender, 1–1.5 cm long. Calyx more or less spathe-like, cleft to the middle of tube anteriorly; tube 4–5 mm long, membranous; lobes 5, equal in size, apex flabellate, 3–6 mm long. Corolla purple, 16–21 mm long; tube shorter than calyx; galea erect, strongly curved apically, longer than tube, with a pair of teeth at throat; beak horizontal, 5–6 mm long, slender; lower lip ca. as long as galea, 7–8 mm long, 13–15 mm wide, middle lobe rounded. Filaments all villous.

Phenology: flowering and fruiting from July to August.

Habitats: moist conifer forests; 3000–3500 m.



Map 45(2)–36: *Pedicularis aquilina* Bonati

Distribution: endemic; S Hengduan [Map 45(2)–36].

Notes: Bonati did provide some information on type collection, but he did not list the record number in the protologue of *P. aquilina* Bonati. After examining herbarium specimens, we find that two sheets of (*F. Doucloux*) *Sans* 4629 deposited in the herbarium P match well the description, one of them is designated here as lectotype and the other as isolectotype.

S HENGDUAN: NW Yunnan, precise location unknown, (*F. Doucloux*) *Sans* 4629 (P).

37. *Pedicularis axillaris* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 555. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 89. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 120. 1998. Type: China, Yunnan, Dali, Cangshan (Monte Tsang-schan), 19 June 1884, *J. M. Delavay s.n.* [holotype: LE; isotype: LE].

Pedicularis heterophylla Bonati, Bull. Soc. Bot. France 55: 244. 1908. Type: China, Sichuan, Kangding (Yargong), collected in 1903, *R. P. Soulié* 3348, not seen.

Pedicularis lacerata Bonati, Notes Roy. Bot. Gard. Edinb. 13: 110. 1921. Type: China, Yunnan, Dêqên, Atuntsi, 3960m, Aug. 1913, *F. Kingdon-Ward* 935 [holotype: E(E00284033)].

Herbs perennial, weak, often procumbent, and black when dry. Whip-like rhizome black, smooth, 10–14 cm long, several pairs of scales on nodes, roots more or less fusiform. Stems 2 or more together, usually branched at base; branches very slender, repent or ascending, sparsely pubescent. Leaves mostly pseudo-opposite; petiole 1.5–2.5 cm long; leaf blade elliptic-lanceolate, 4–8 cm long, 1.5–3 cm wide, pinnatisect; segments 5–12 pairs, pinnatipartite to pinnatifid, incised-dentate. Flowers axillary; pedicels erect at anthesis, later elongated to 2.5 cm long,

becoming curved. Calyx tubular, 5–6 mm long, slightly cleft anteriorly; lobes 5, incised-dentate. Corolla purple or greenish-white, 15–20 mm; tube erect, ca. 2 times as long as calyx, glabrous; galea bent at a right angle; beak bent slightly downward, slender; lower lip 7–8 mm long, ciliate. Filaments all glabrous. Capsule compressed, ovoid, 6–8 mm long, 6.5 mm wide, apex acuminate. Figure 45(2)–19.

Phenology: flowering and fruiting from June to August.

Habitats: moist and open pastures, shaded damp places in forests and thickets, open rock crevices; 2700–4000 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–37]; also in other regions of Yunnan Province, China.

Notes: Two collections of *P. axillaris* Franch. ex Maxim. deposited in the herbarium LE were examined, one of them was designated as “holotype” and the other as “isotype”.

- 1a. Petiole 2–2.5 cm long; corolla purple
37a. subsp. *axillaris*
 1b. Petiole 3–5 cm long; corolla greenish-white.....37b. subsp. *balfouriana*

37a. *Pedicularis axillaris* subsp. *axillaris*

Stems up to 20 cm long; petiole short, up to 2.5 cm long. Corolla purple.

Phenology: flowering and fruiting from May to August.

Habitats: moist and open pastures, shaded damp places in forests and thickets, open rock crevices; 3000–4000 m.

Distribution: S Hengduan [Map 45(2)–38]; also in other regions of Yunnan Province, China.

S HENGDUAN: **Cawarong**, 2800 m, Aug. 1935, *C. W. Wang* 65320 (PE). **Dali**, 3400 m, 27 July 1933, *H. T. Tsai* 53865 (PE). **Daocheng**, 3800 m, 21 Aug. 1937, *T. T. Yü* 12819 (PE). **Dêqên**, 3650 m, 7 July 1940, *K. M. Feng* 5188 (PE). **Dêrong**, 3400 m, 5 Aug. 1981,

Qinghai-Xizang Exped. 003296 (PE). **Lanping**, 3200 m, 17 Aug. 1933, *H. T. Tsai* 53786 (PE). **Muli**, Longshaliangzi, ca. 3800 m, 26 Aug. 1978, *Q. S. Zhao, J. S. Liu & G. Hu.* 8095 (SZ); Muli, 2800 m, 2 Aug. 1937, *T. T. Yü* 7583 (PE, KUN). **Ninglang**, 3200 m, 20 June 1960, *South-to-North Water Divers. Proj. Exped.* 6046 (PE, KUN). **Shangri-la** (Zhongdian), 3000 m, 5 July 1937, *T. T. Yü* 11903 (PE); Shangri-la (Zhongdian), Xiaoxue Shan, 3600 m, 5 July 2001, *F. S. Yang* Y0024 (PE). **Weixi**, 3200 m, June 1935, *C. W. Wang* 64073 (PE). **Yangbi**, 3000 m, 7 June 1963, *Jingshajiang Exped.* 4358 (PE). **Yulong** (Lijiang), 4000 m, 29 Aug. 1922, *J. F. Rock* 4515 (PE).

37b. *Pedicularis axillaris* subsp. *balfouriana* (Bonati) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 90. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 120. 1998. ≡ *Pedicularis balfouriana* Bonati, Notes Roy. Bot. Gard. Edinb. 5: 82. 1911. ≡ *Pedicularis axillaris* var. *balfouriana* (Bonati) H. L. Li., Proc. Acad. Nat. Sci. Philad. 101: 167. 1949. Type: China, Yunnan, Dali, 2740–3050 m, June 1906, *G. Forrest* 4489 [holotype: E(E00284032)].

Stems usually 7–10 cm long; petiole 3–5 cm long. Corolla greenish-white.

Phenology: flowering from June to July.

Habitats: open, stony pasture land; 2700–3050 m.

Distribution: endemic; S Hengduan [Map 45(2)–37].

S HENGDUAN: **Dali**, open, stony pastureland on the eastern flank of the Tali range, 2740–3050 m, June 1906, *G. Forrest* 4489 (E00284032).

38. *Pedicularis laxiflora* Franch., Bull. Soc. Bot. France 47: 27. 1900; Li, Proc. Acad. Nat. Sci. Philad. 101: 167. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 91. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 120. 1998. Type: China, Chongqing, Chengkou, *R. P. Farges* s.n. [lectotype designated here: P(P02985210);

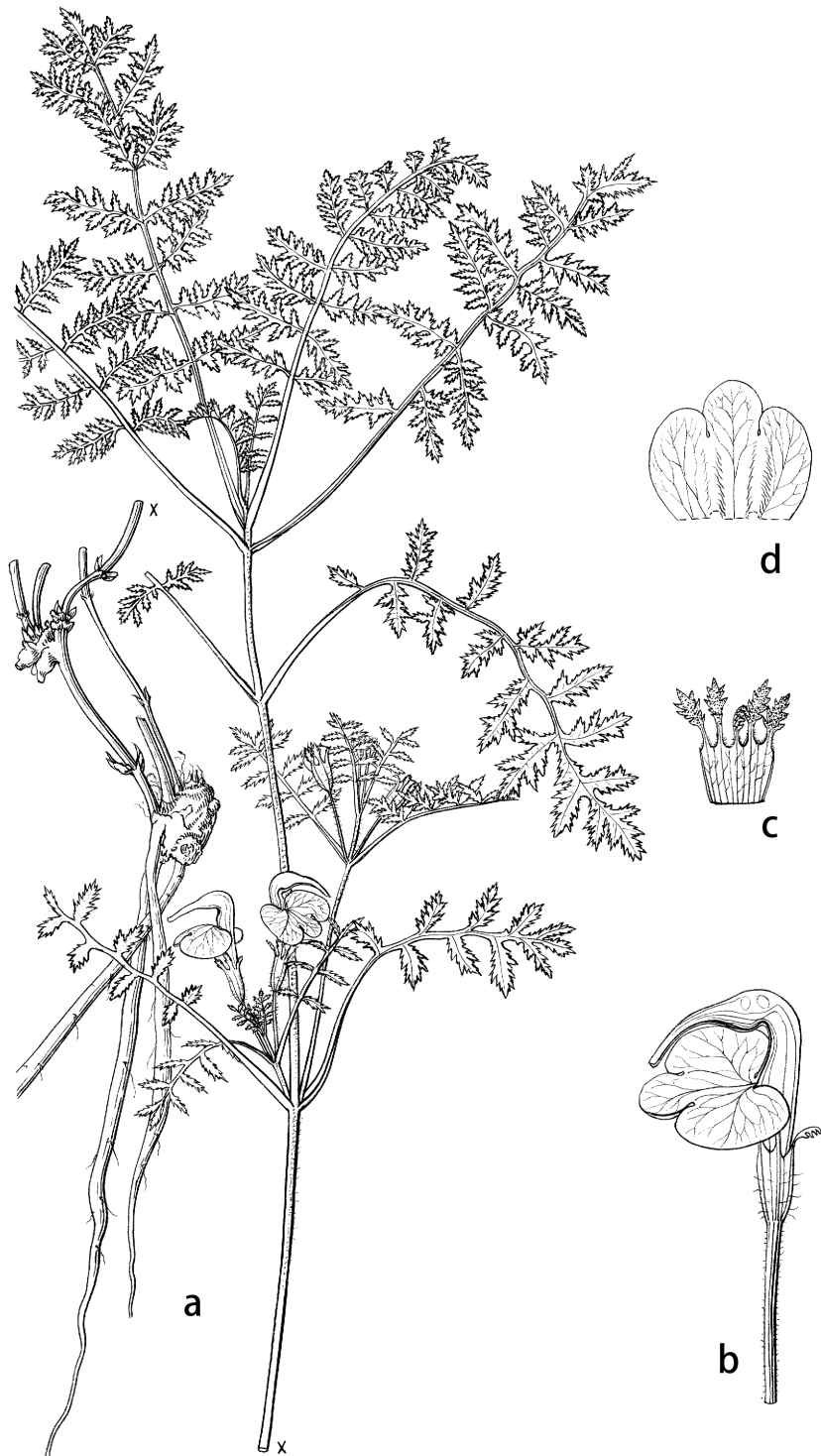
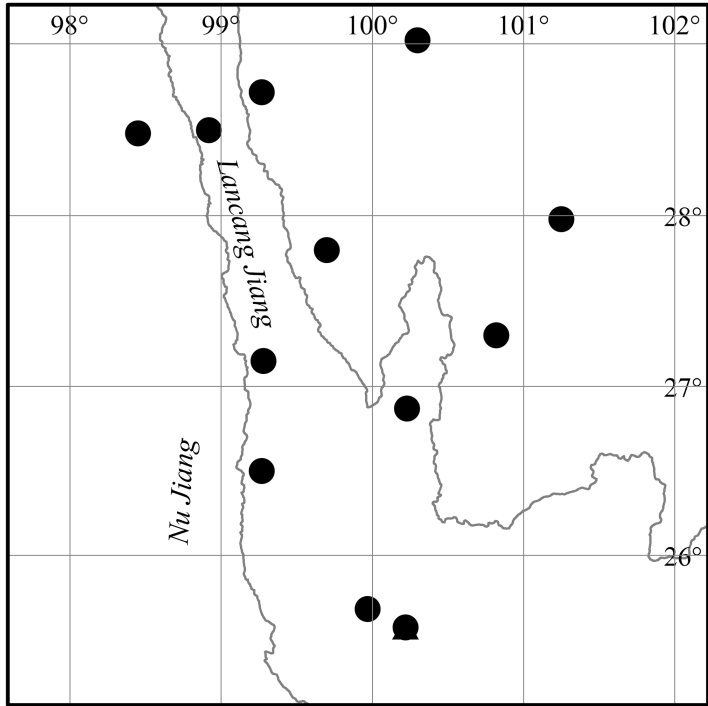
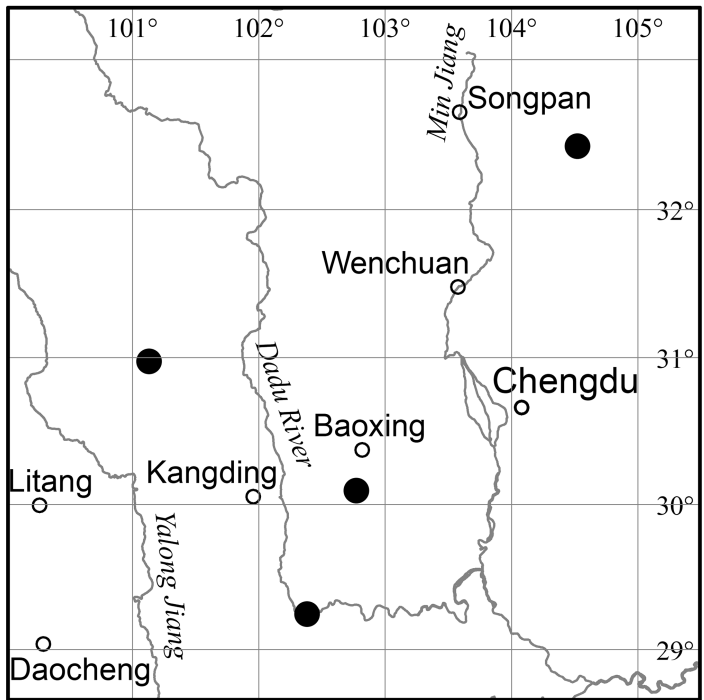


Figure 45(2)–19: *Pedicularis axillaris* Franch. ex Maxim. a, habit; b, flower; c, calyx; d, corolla lip. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 90, figure 14: 1-4. 1963].



Map 45(2)-37: *Pedicularis axillaris* Franch. ex Maxim.
 ● subsp. *axillaris* ▲ subsp. *balfouriana*



Map 45(2)-38: *Pedicularis laxiflora* Franch.

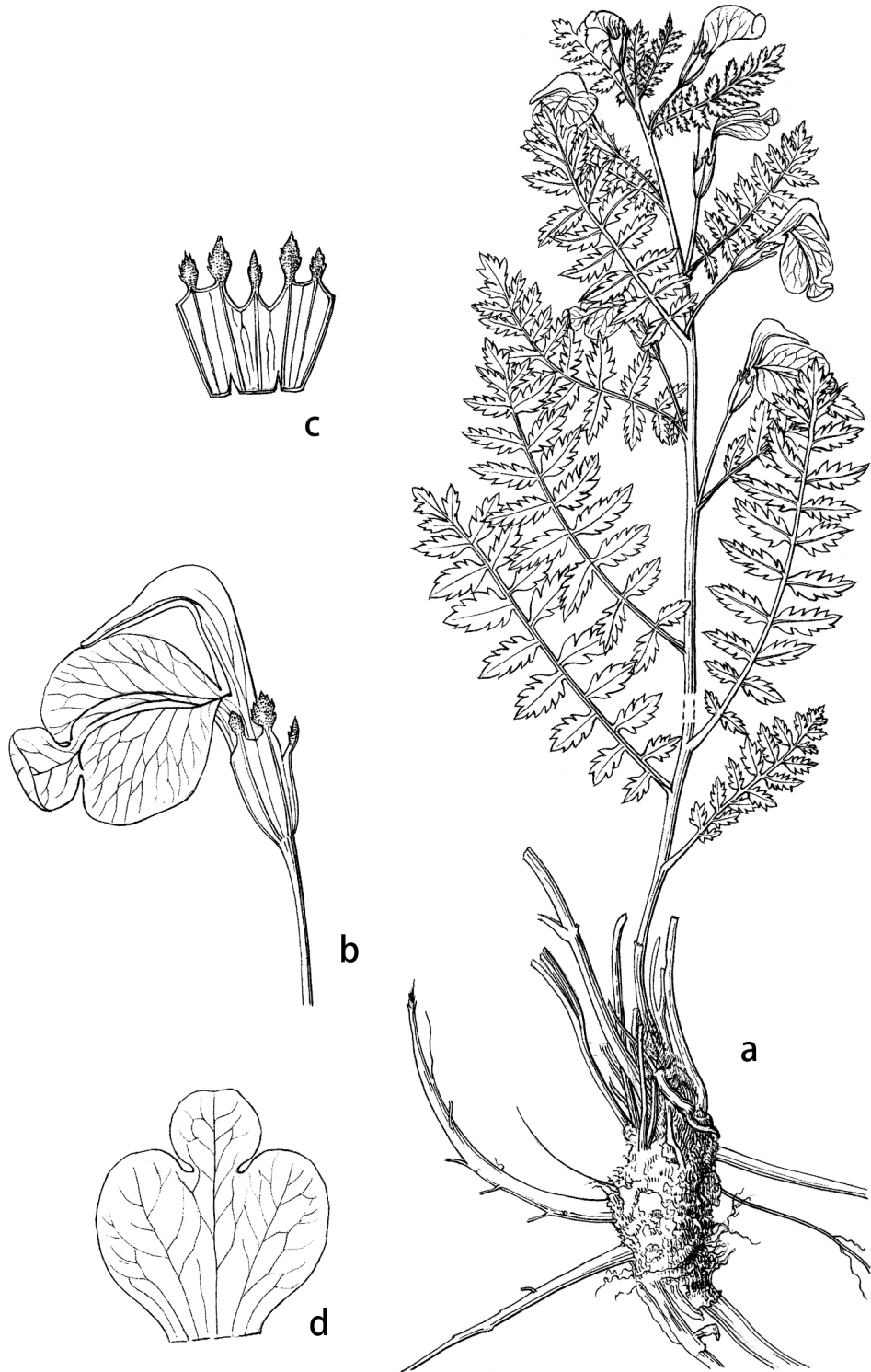


Figure 45(2)–20: *Pedicularis laxiflora* Franch. a, habit; b, flower; c, calyx; d, corolla lip. Drawn by C.-R. LIU [Fl. Reipubl. Popularis Sin. 68: 91, figure 15: 5-8. 1963].

isolectotypes: P(P02985206, P02985208, P02985209, P02985211, P02985212), LE].

Herbs perennial and not black when dry. Stems few, more or less flexuously ascending, unbranched, or sometimes with long and repent branches. Leaves mostly alternate, glabrous; petiole up to 2.8 cm long; leaf blade oblong-lanceolate to oblong, 4–10 cm long, 2–3.5 cm wide, abaxially subglabrous, adaxially slightly pubescent along midvein, pinnatisect; segments 6–12 pairs, often pinnatipartite, ovate-oblong to ovate-lanceolate, incised-dentate. Pedicel 1–1.5 cm long. Calyx tube 4–5 mm long, slightly cleft anteriorly; lobes 5, unequal in size, serrate. Corolla pink; tube 8–11 mm long; galea strongly curved, scarcely 5 mm long; beak bent slightly downward, 3–4 mm long, slender; lower lip 11–14 mm

long, nearly 2 times as long as galea, middle lobe broadly ovate, apex hoodlike. Filaments 2 pubescent, 2 glabrous. Capsule ovoid, compressed, mucronate. Figure 45(2)–20.

Phenology: flowering and fruiting from June to August.

Habitats: moist places; 2500–3300 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–38]; also in other parts of Sichuan, China.

N Hengduan: Dawu, Songlinkou, 3800 m, 18 Sept. 1934, *H. Smith 12097* (PE). **Pingwu,** Zhenghekou, 1947–2500 m, 15 July 2014, *W. G. Liu & P. Liu 2260* (PE). **S Hengduan:** **Shimian,** no precise location, 1955, *C. C. Hsien 42250* (PE). **Tianquan,** Erlang Shan, 2200 m, 28 June 1953, *H. L. Tsiang 34669* (IBK).

Ser. 18. Infirmæ

Ser. Infirmæ H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 148. 1949.

Roots fascicled, slender. Stems soft, fleshy, more or less erect, flexuous, or procumbent. Leaves alternate or subopposite. Basal leaves few, long-petiolate; cauline leaves alternate or pseudo-opposite; leaf blade smaller than basal, with distinct reticulate veins abaxially, pinnatipartite to pinnatisect. Calyx tube with distinct reticulate veins apically. Flowers several, axillary, widely spaced. Corolla tube less than 2 times as long as calyx; galea beaked.

One species; endemic to the Pan-Himalaya.

39. Pedicularis infirma H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 161. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 96. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 121. 1998. Type: China, NW Yunnan, Taron-Taru Divide, Mount Larulaka, mountain slope, 3000 m, 3 Sept. 1938, *T. T. Yü 20060* [holotype: A(00097231); isotype: E(E00284035)].

Herbs perennial, 7–12 cm tall. Roots fleshy. Stems numerous, weak, flexuously ascending, or more or less procumbent, pubescent. Leaves alternate or more or less opposite; petiole of basal leaves 4–7 cm long, glabrous; leaf blade ovate-oblong, 3–13 cm long, ca. 2.5 cm wide, pinnatisect; segments 6 or 7 pairs, ovate to oblong, pinnatipartite to pinnatisect, membranous, glabrous,

dentate; cauline leaves similar to basal leaves, but smaller and short-petiolate. Inflorescences racemose, 8–9 cm long, interrupted at base; bracts leaflike, proximal ones longer than flowers, distal ones ca. as long as flowers; pedicels erect, 1.1–1.3 cm long, pubescent. Calyx 10–12 mm long, villous, slightly cleft anteriorly; lobes 5, unequal in size, leaflike. Corolla purple, 18–20 mm long; tube erect, longer than calyx, slightly pubescent; galea falcate; beak straight, conical, 3–4 mm long; lower lip slightly longer than galea, ciliate. Filaments all villous. Capsule enclosed by accrescent calyx, compressed, ovoid, 8–10 mm long, 7–8 mm wide, apex acute. Figure 45(2)–21.

Phenology: flowering and fruiting from July to September.

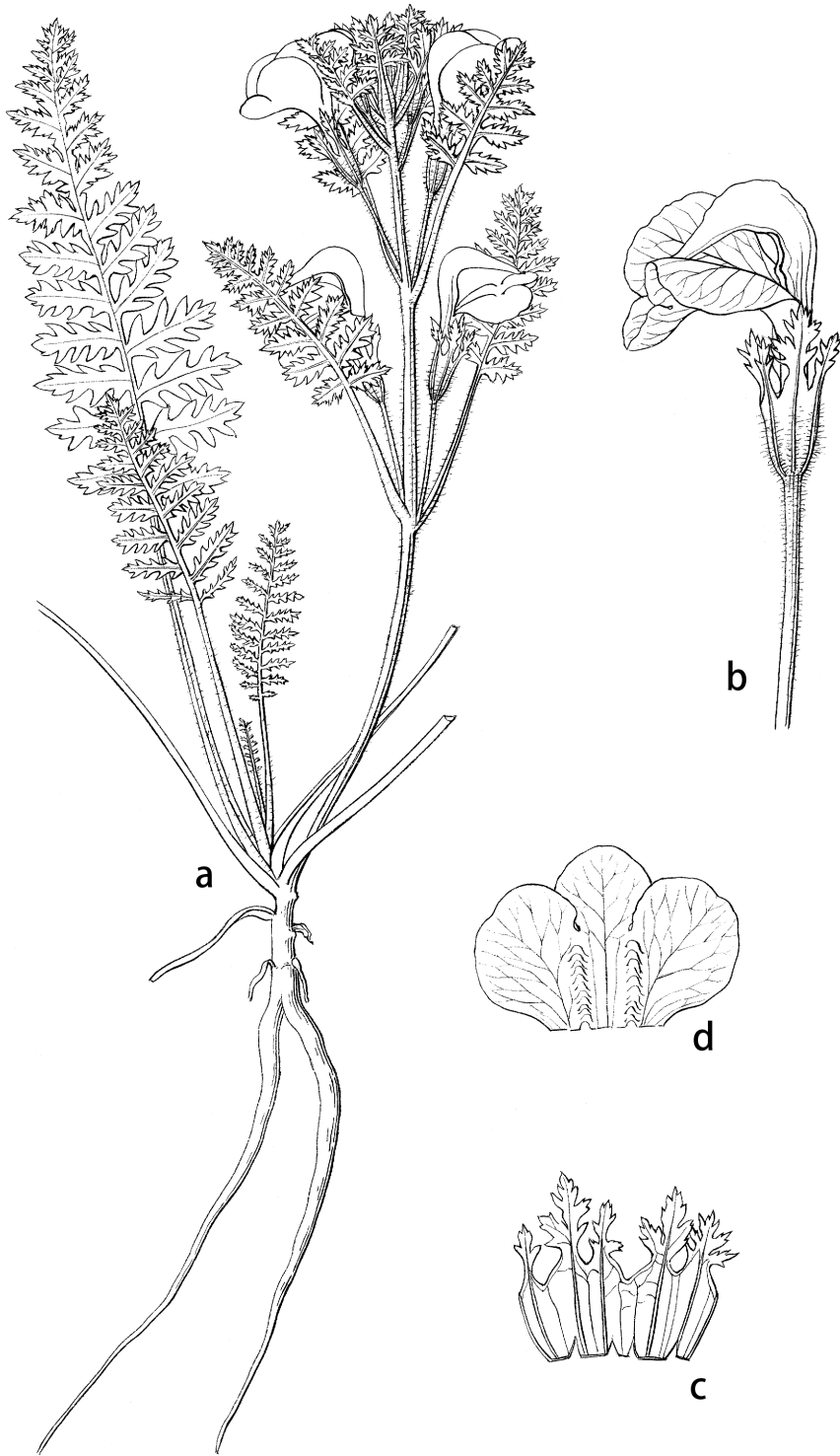


Figure 45(2)-21: *Pedicularis infirma* H. L. Li. a, habit; b, flower; c, calyx; d, corolla lip. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 96, figure 16: 1-4. 1963].

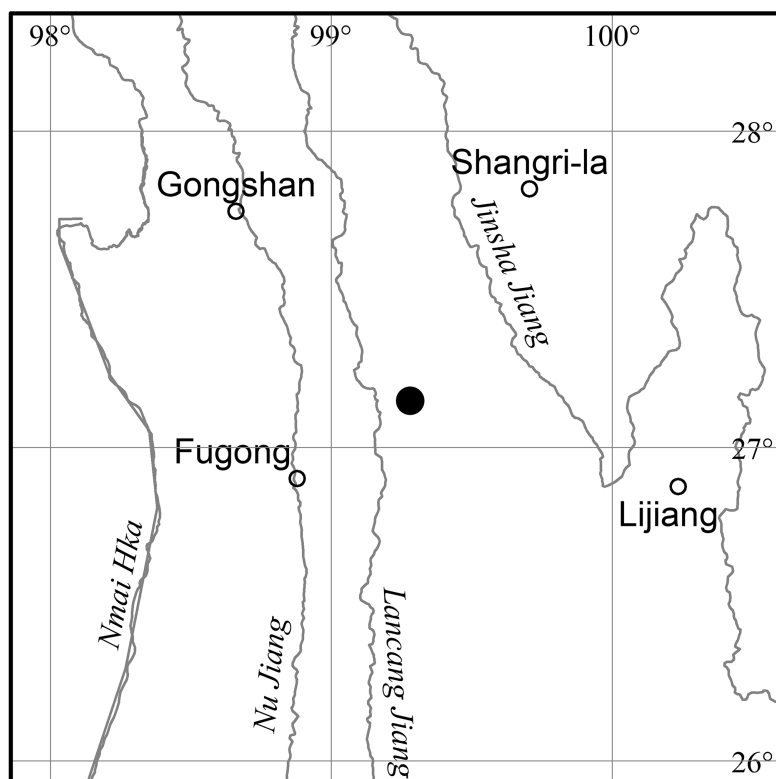
Habitats: open and sandy places; ca. 3000 m.

Distribution: endemic; S Hengduan [Map 45(2)–39].

Notes: Li stated that *P. infirma* H. L. Li resembles *P. flexuosa* Hook. f., but the latter is dis-

tributed in India and has opposite leaves and a long and slender beak.

S Hengduan: Weixi, Taron-Taru Divide, Mount Larulaka, mountain slope open and sandy place, 3000 m, 3 Sept. 1938, *T. T. Yü 20060* (PE).



Map 45(2)–39: *Pedicularis infirma* H. L. Li

Ser. 19. Batangenses

Ser. Batangenses H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 148. 1949.

Plants usually diffuse. Stems slender, more or less woody, many-branched at base; branches long, decumbent. Leaves often pseudo-opposite; leaf blade oblong-lanceolate, pinnatisect; segments linear. Flowers axillary, pedicellate. Calyx lobes usually 5, longer than calyx tube. Corolla tube more

than 2 times as long as calyx, slender; galea much dilated apically with 2 teeth at margin, usually abruptly constricted into a beak; beak straight, slender.

One species; endemic to the Pan-Himalaya.

40. *Pedicularis batangensis* Bureau & Franch., *J. Bot. (Morot)* 5: 106. 1891; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 98. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 122. 1998. Type: China, Sichuan, Batang to Litang, 1890, *Prince Henri d'Orléans s.n.* [lecto-type designated by Yu *et al.* (2015: 145): P(P02994285)].

Herbs perennial, 10–20 cm tall, often procumbent, and black when dry. Rhizome fleshy, branched, more or less fusiform, with small inflamed nodules on small branches. Stems many, clustered, and sometimes repent, only ascending apically; branches pseudo-opposite, 5–30 cm long, with 2 lines of hairs. Leaves more or less opposite (pseudo-opposite), more or less leathery; petiole 1–2 cm long, pubescent; leaf blade oblong to ovate-oblong, 2–3 cm long, 1–2 cm wide, pubescent; segments linear to linear-lanceolate, dentate or lobed. Flowers scattered; pedicels 0.8–1.2 cm long, pubescent. Calyx 8–10 mm long; tube obconical; lobes 5, lanceolate, posterior one more or less entire, lateral lobes larger, leaflike. Corolla pink to rose, or yellow, erect, 17–35 mm long, densely pubescent; galea bent at a right angle, abruptly constricted into a beak apically; beak 4–7 mm long, slender, straight; lower lip 14–18 mm wide, ciliate. Filaments all glabrous. Capsule ovoid, slightly compressed, apiculate. Figure 45(2)–22.

Phenology: flowering from June to August.

Habitats: open rocky slopes; 2500–3100 m.

Distribution: endemic; Tangut, N Hengduan, S Hengduan [Map 45(2)–40].

Notes: Flower color of *P. batangensis* Bureau & Franch. varies from pink, rose, to yellow, and there should be worthy of varietal rank in this species. Our molecular phylogenetic results show that six individuals of this species form a well-supported clade.

TANGUT: Garzê, 3400 m, 11 Aug. 1960, *T. C. Ying 4632* (PE). **N HENGDUAN:** Dawu, 3000 m, 22 July 1959, *S. Jiang & C. L. Jin 02321* (PE). Heishui, 2400 m, 16 July 1957, *X. Li 73618* (PE). Luhuo, Yimu, 3116 m, 26 Sept. 2019, *D. F. Xie & R. Y. Chen 02030745, 02030746, 02030747, 02030748* (SZ); Luhuo, Xinduzhen, 9 July 2020, *X. L. Guo & X. R. Xu 02038177* (SZ); Luhuo, Xinduzhen, 9 July 2020, *X. L. Guo & T. Ren 02038178, 02038179, 02038180, 02038181* (SZ). **Maoxian**, 29 June 1928, *W. P. Fang 1510* (PE). **Xinlong**, Zituoxi, 4437 m, 18 July 2019, *D. F. Xie & R. Y. Chen 02034089, 02034090, 02034091* (SZ). **Yajiang**, 3400 m, 31 July 1960, *Z. T. Guan 42-0227* (PE). **S HENGDUAN:** Kangding, 3000 m, 8 Aug. 1959, *S. Jiang & C. L. Jin 02765* (PE); Kangding, 2600 m, 19 July 1934, *H. Smith 10779* (PE); Kangding, Paoma Shan, 2600 m, 28 July 2001, *F. S. Yang Y0084* (PE); Kangding, Shacheng, 2800–3000 m, 4 Aug. 2017, *Y. D. Gao et al. THP-KD-2044* (CDBI); Kangding, Gabajuli, 3300–3447 m, 12 July 2017, *Q. Yu & X. X. Zhou HP-KD-4157* (CDBI).

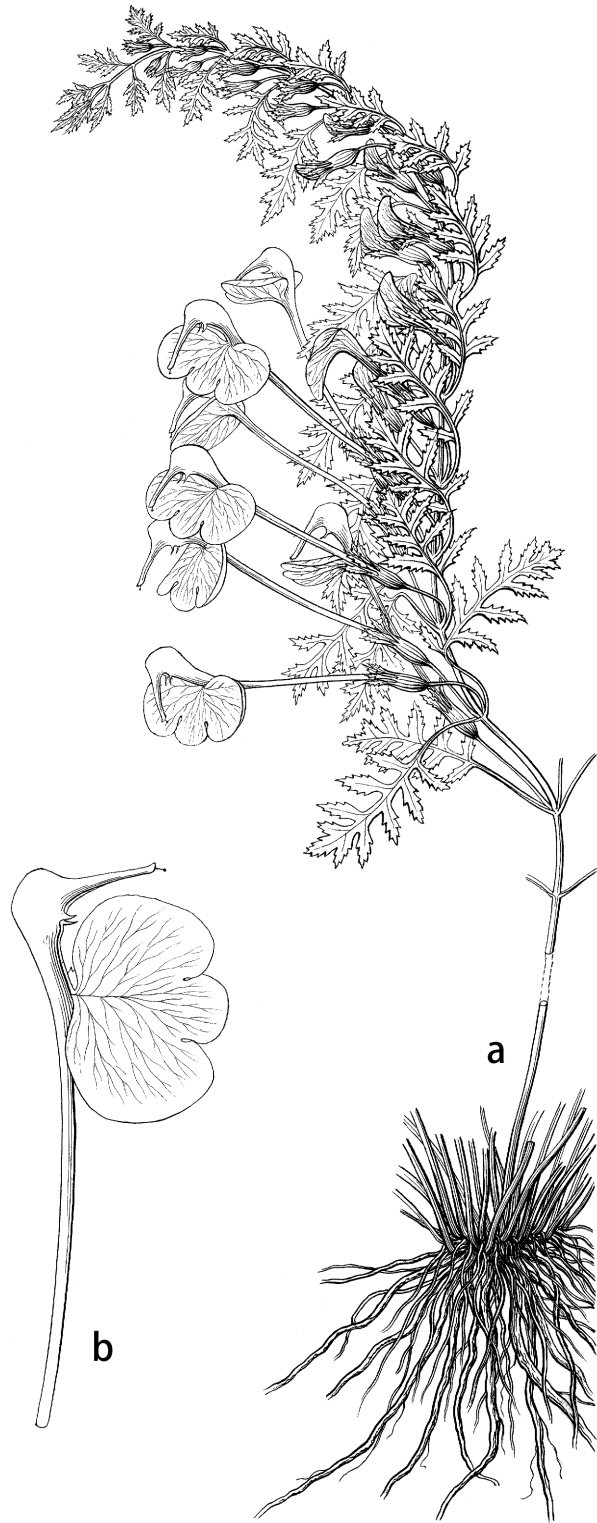
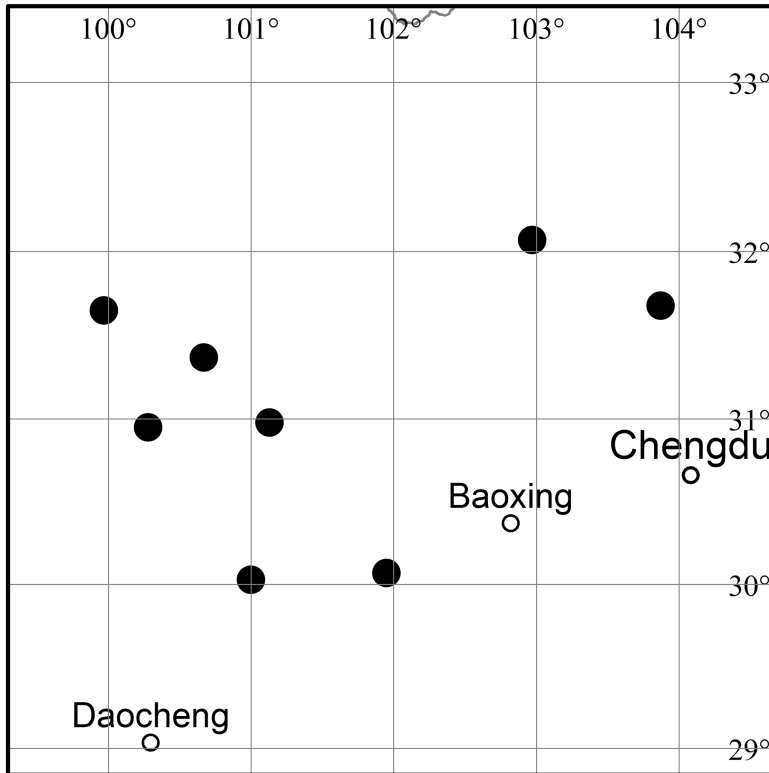


Figure 45(2)-22: *Pedicularis batangensis* Bureau & Franch. a, habit; b, corolla. Drawn by R.-H. ZHANG [Fl. Reipubl. Popularis Sin. 68: 98, figure 17: 1-2. 1963].



Map 45(2)-40: *Pedicularis batangensis* Bureau & Franch.

Ser. 20. Muscicolae

Ser. Muscicolae Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 523. 1888.

Stems many, slender, procumbent and repent, usually branched. Leaf blades elliptic to lanceolate, pinnatifid to pinnatisect. Flowers axillary. Corolla long tubular; tube at least 2 times as long as calyx; galea twisted or not; beak straight or S-shaped, slender.

Seven species; all in the Pan-Himalaya (3 endemics).

Notes: Our molecular phylogenetic results indicate that species of the series *Omiianae* H. L. Li are nested within the clade of the series *Muscicolae* Maxim., revealing that these two series should be merged. *Pedicularis quxiangensis* H. P. Yang was removed from the series *Muscicolae* to the series *Longiflorae* because it is treated as a new synonym of *P. siphonantha* D. Don (See notes in the series *Longiflorae*).

- 1a. Beak of galea bent upward; calyx tube 18–20 mm long.....41. *P. omiiana*
- 1b. Beak of galea not bent upward, usually straight or twisted; calyx tube 7–11 mm long.
 - 2a. Calyx slightly cleft anteriorly.
 - 3a. Leaves 2.5–3.5 cm long; lamina segments 4–6 pairs.....42. *P. gracilituba*
 - 3b. Leaves 5–10 cm long; lamina segments 4–12 pairs.
 - 4a. Calyx lobes unequal in size; corolla tube glabrous; corolla lip 12–14 mm wide; beak of galea shorter, not S-shaped.....43. *P. macrosiphon*
 - 4b. Calyx lobes more or less equal in size; corolla tube pubescent; corolla lip 20–22 mm wide; beak of galea 8–10 mm long, S-shaped.....44. *P. muscicola*

2b. Calyx deeply cleft anteriorly.

5a. Beak of galea curved, semicircle 45. *P. pseudomuscicola*

5b. Beak of galea not curved.

6a. Calyx 5-lobed; corolla tube usually 45–55 mm long..... 46. *P. geosiphon*

6b. Calyx 2–4-lobed; corolla tube 50–95 mm long 47. *P. sorbifolia*

41. *Pedicularis omiiana* Bonati, Bull. Soc. Bot. France 54: 184, 375. 1907; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 97. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 122. 1998. ≡ *Pedicularis omiiana* var. *typica* Bonati, Bull. Soc. Bot. France, 54: 185, 376. 1907. Type: China, Sichuan, Emei, June 1904, *E. H. Wilson 5079* [holotype: P(P02981451); isotype: K(K000708843)].

Pedicularis omiiana subsp. *diffusa* (Bonati) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 97. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 122. 1998. **syn. nov.** ≡ *Pedicularis omiiana* var. *diffusa* Bonati, Bull. Soc. Bot. France 54: 185. 1907. Type: China, Western China (no detailed information), July 1903, *E. H. Wilson 4235* [holotype: P(P02981450); isotypes: K(K000708844), BM (BM001010994), HBG(HBG512076)].

Herbs perennial and black when dry. Rhizome more or less woody, branched lateral roots more or less fusiform. Stems usually several together, erect, ascending to decumbent or procumbent, densely pubescent. Basal leaves numerous; petiole 6–9 cm long, slightly puberulent to villous; leaf blade ovate-oblong to oblong-lanceolate, 6–11 cm long, 2–3 cm wide, pinnatisect; segments 11–15 pairs, ovate to ovate-oblong, margin double-dentate; cauline leaves alternate or often more or less opposite, similar to basal leaves but smaller. Flowers axillary; pedicels 8–11 mm long, pubescent. Calyx narrowly campanulate, 7–8 mm long, subglabrous or slightly villous; lobes 5, more or less equal in size, entire to serrate. Corolla purple; tube erect, slender, 30–45 mm long, slightly pubescent; galea erect, obtusely curved; beak cylindric, bent upward, 5–7 mm long; lower lip deeply lobed, lobes rounded, margin glabrous. Filaments all glabrous. Capsule obliquely long-ovoid, 10–13 mm long, apiculate. Figure 45(2)–23.

Phenology: flowering from June to July.

Habitats: damp places in forests, thickets; 2300–3200 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–41]; also in Emei, Sichuan Province, China.

N HENGDUAN: Wenchuan, 2500 m, 28 May 1930, *F. T. Wang 21013* (PE). **S HENGDUAN: Baoping**, Lengpugo, 2500 m, 12 June 1933, *T. T. Yü 1979* (PE). **Tianquan**, precise location unknown, 1936, *G. L. Qu 2890* (PE, WUK).

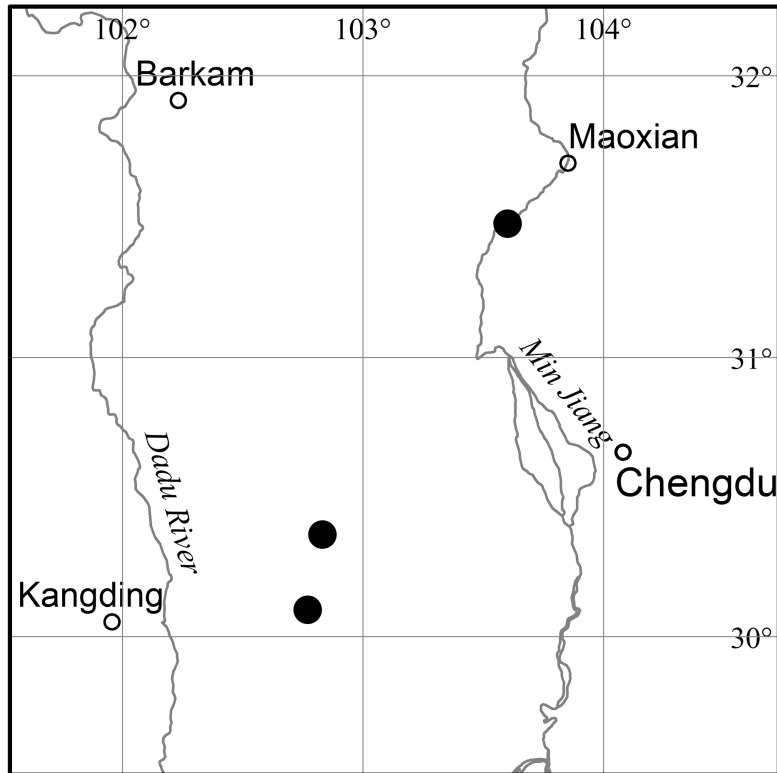
42. *Pedicularis gracilituba* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 173. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 101: 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 124. 1998. ≡ *Pedicularis gracilituba* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 173. 1949. Type: China, Sichuan, Muli, Kulu Mountains, 4000 m, June 1929, *J. F. Rock 18066* [holotype: PH(00019478)].

Pedicularis gracilituba subsp. *setosa* (H. L. Li) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 101; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 124. 1998. **syn. nov.** ≡ *Pedicularis gracilituba* var. *setosa* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 174. 1949; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 124. 1998. Type: China, NW Yunnan (no detailed information), collected in 1930, *T. T. Yü 12060* [holotype: A(00097227)].

Herbs perennial, 4–6 cm tall, rarely up to 15 cm, glabrous or pubescent, and black when dry. Rhizome covered by ovate scales near the upper end, lower part more or less fleshy, branched, 3–5 mm in diameter. Stems densely clustered or few, slender, soft, leafy. Leaves alternate, basal and stem ones similar; petiole 1–4 cm long, often longer than leaf blade, slender, subglabrous to conspicuously pubescent; leaf blade lanceolate-oblong, membranous, glabrous or adaxially sparsely to densely hispidulous, 2.5–3.5 cm long,



Figure 45(2)-23: **Pedicularis omiiana** Bonati. a, habit; b, corolla. Drawn by R.-H. ZHANG [*Fl. Reipubl. Popularis Sin.* 68: 98, figure 17: 3-4. 1963].



Map 45(2)-41: *Pedicularis omiiana* Bonati

0.7–2 cm wide, pinnatisect; segments 4–6 pairs, ovate to ovate-oblong, deeply incised-dentate. Flowers widely spaced; pedicels slender, 0.5–1 cm long. Calyx 7–10 mm long, slightly cleft anteriorly, pubescent; lobes 5, more or less equal in size. Corolla purple, 60–70 mm long; tube 50–60 mm long, slender, pubescent; galea bent at a right angle apically; beak falcate, inconspicuous; lower lip 8–10 mm long, 13 mm wide. Filaments all glabrous.

Phenology: flowering from June to July.

Habitats: alpine meadows, forests; 3300–4000 m.

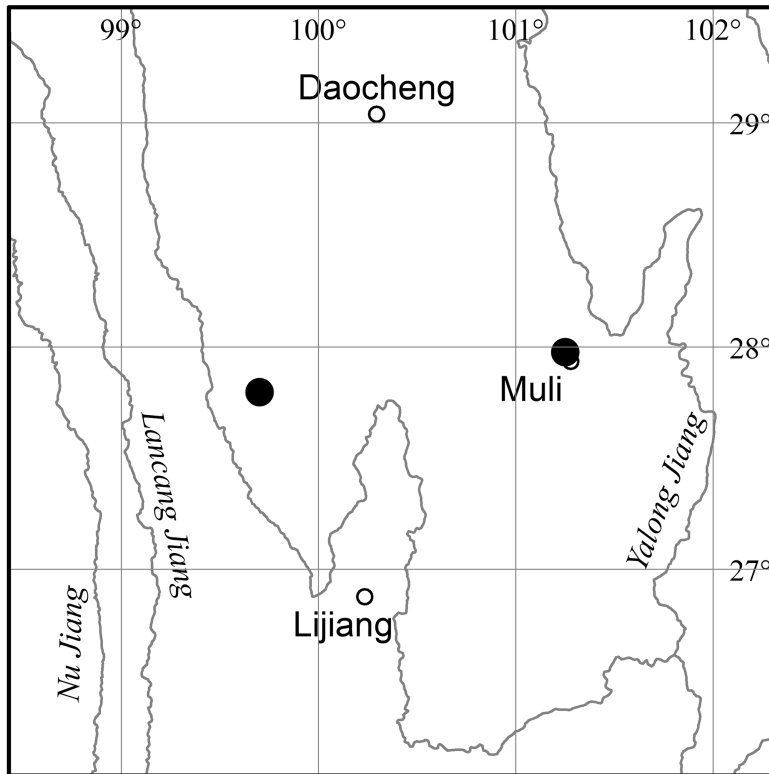
Distribution: endemic; S Hengduan [Map 45(2)–42].

Notes: *Pedicularis gracilituba* H. L. Li is similar to *P. macrosiphon* Franch. but differs in having glabrous habit, shorter stems, and smaller leaves. *P. gracilituba* H. L. Li, *P. macrosiphon* Franch., and *P. geosiphon* H. Smith & P. C.

Tsoong are clustered in a clade, where phylogenetic relationships among them are not resolved.

S HENGDUAN: Muli, Kulu Mount., 4000 m, June 1929, *J. F. Rock 18066* (KUN, US); Muli, mountains between Litang and Yalung rivers, between Muli Gomba and Baurong and Wa-Erh-Dje, *J. F. Rock 16616* (PH, US); Muli, Kulu, 3600 m, 12 July 1937, *T. T. Yü 7176* (PE). **Shangri-la** (Zhongdian), Bitahai, 3500 m, 24 June 1981, *Qinghai-Xizang Exped. 1455* (PE); Shangri-la (Zhongdian), Xiaozhongdian, 3210 m, 17 June 1981, *Qinghai-Xizang Exped. 1181* (HITBC, KUN, PE).

43. *Pedicularis macrosiphon* Franch., *Nouv. Arch. Mus. Hist. Nat., Sér. 2*, 10: 66. 1888; Maximowicz, *Bull. Acad. Saint-Pétersb.* 32: 535. 1888; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 102. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 124. 1998. Type: China, Sichuan, Baoxing (Moupine), June



Map 45(2)-42: *Pedicularis gracilituba* H. L. Li

1869, *A. David s.n.* [**lectotype designated here:** P(P02981456); isolectotypes: P(P02981452, P02981453)].

Pedicularis chengxianensis Z. G. Ma & Z. Z. Ma, Bull. Bot. Res. Harbin 13: 63. 1993; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 123. 1998. **syn. nov.** Type: China, Gansu, Chengxian, Jishan, 1600–1650 m, 29 May 1989, *Z. G. Ma 895036* (holotype: LZU; isotype: LZU).

Pedicularis lucifuga Bonati, Notes Roy. Bot. Gard. Edinb. 13: 112. 1921. Type: China, NW Yunan, Nujiang “Ka-gwr-pw, Mekong-Salween Divide, shady pasture on the margins of pine forests”, 3050 m, July 1917, *G. Forrest 14200* [holotype: E(E00284031); isotype: K(K000708847)].

Pedicularis tribuloides Bonati, Notes Roy. Bot. Gard. Edinb. 13: 111. 1921. \equiv *Pedicularis macrosiphon* var. *tribuloides* (Bonati) H. L. Li,

Proc. Acad. Nat. Sci. Philad. 101: 173. 1949. Type: China, NW Yunnan, Weixi, Salween Valley, margins of thickets, 3050 m, June 1917, *G. Forrest 16207* [holotype: E(E00284030)].

Herbs perennial, usually densely tufted, and black when dry. Rhizome 1–3 cm long, fleshy, leading to several fusiform and branched roots. Stems slender, flexuous, ascending or repent, usually 10–40 cm long. Proximal leaves usually more or less opposite, distal ones alternate; petiole 1–6 cm long, pubescent; leaf blade ovate-lanceolate to linear-oblong, 4–10 cm long, adaxially sparsely pubescent, abaxially villous along midvein, pinnatisect; segments 7–12 pairs, ovate to oblong, spinescent double-dentate. Flowers widely spaced; pedicels 0.5–1 cm long. Calyx 8–10 mm long, slightly cleft anteriorly, villous along veins; lobes 5, unequal, more or less dentate to entire. Corolla pale-purple to rose, 50–80 mm long; tube erect, 30–60 mm long, glabrous; galea bent at a right angle apically; beak straight, 3–5 mm long; lower lip longer than

galea, 13–16 mm long, 14–16 mm wide. Filaments all glabrous. Capsule completely enclosed by calyx, oblong to obovoid, compressed, 10–12 mm long, apex acute.

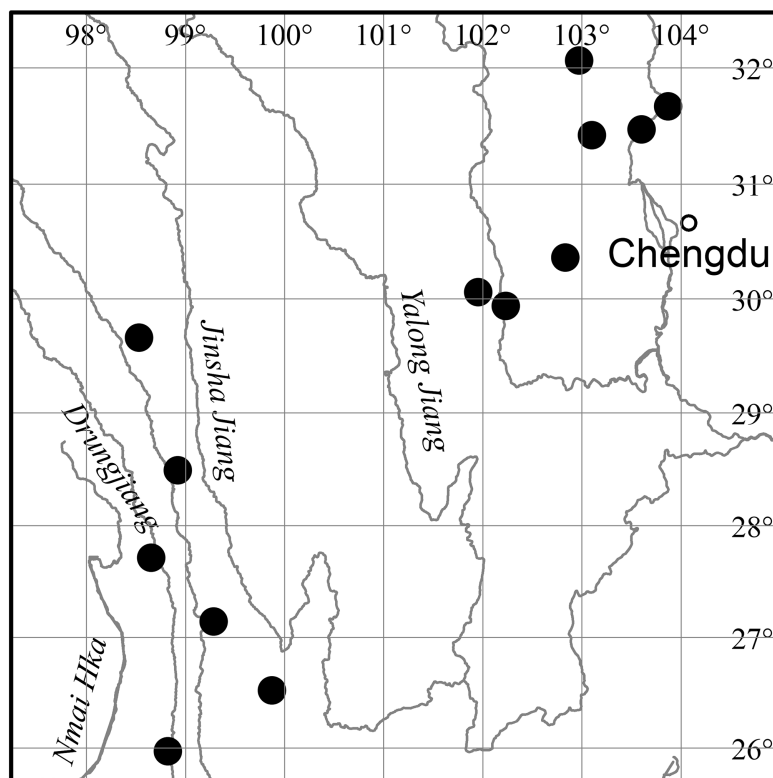
Phenology: flowering and fruiting from May to August.

Habitats: moist shaded forests, ravines; 1200–3800 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–43]; also in other regions of Sichuan and Gansu Provinces, China.

Notes: *Pedicularis chengxianensis* Z. G. Ma & Z. Z. Ma was described as new based on a collection from S Gansu, China. Examinations of type and specimens reveal that all morphological characters are congruent with those of *P. macrosiphon* Franch. Hence, *P. chengxianensis* is here treated as a new synonym of *P. macrosiphon* Franch.

N HENGDUAN: Heishui, 3100 m, 7 May 1959, *Heishui group 1071* (PE). Lixian, Longxi, 14 May 1952, *Z. He 12431* (IBSC). **Maoxian**, Jingzhou Pass, ca. 2200 m, 10 June 1987, *J. T. Wang & J. G. Jin C-0115* (WCSBG). **Markam**, 2600 m, 19 May 1957, *X. Li 70712* (PE); Markam, Mozigou, 2800 m, 26 May 1951, *X. Li 71172* (IBSC); Markam, Zhuokeji, 2800 m, 21 May 1957, *X. Li 71107* (IBSC). **Wenchuan**, 1800 m, 22 May 1930, *F. T. Wang 20919* (PE). **S HENGDUAN:** **Baoxing**, 1600 m, 14 May 1982, *D. Y. Hong & Z. H. Zhong PB82070* (PE); Baoxing, Dengchipu, 1750 m, 18 May 1954, *Z. P. Song 38245* (WUK). **Dêqên**, 3400 m, Aug. 1935, *C. W. Wang 69161* (PE); Dêqên, Atuntsi, 3500 m, July 1935, *C. W. Wang 64720* (WUK); Dêqên, Cizhong, 2400 m, 11 June 1937, *T. T. Yü 19015* (IBSC); Dêqên, Puyanila, 3250 m, 30 Aug. 1937, *T. T. Yü 9989* (IBSC); Dêqên, Qiannalongna, 3100 m, 28 Aug. 1937, *T. T. Yü 9855* (IBSC).



Map 45(2)–43: *Pedicularis macrosiphon* Franch.

Gongshan, 2500 m, 5 Aug. 1937, *T. T. Yü 19651* (PE). **Jianchuan**, Kasaluojiagou, 2600 m, 21 May 1958, *X. Li 77449* (IBSC). **Kangding**, 2600–3000 m, 29 May 2015, *F. S. Yang 2015052902* (PE). **Luding**, near the city, 2000 m, 2 May 1980, *Z. G. Liu & Q. Q. Wang 21957* (CDBI); Luding, Moxi, 2200 m, 8 Sept. 1980, *G. R. Xu 23091* (IBSC). **Lushui**, Lamasi, 3100 m, 7 May 1959, *Heishui Group 1071* (KUN). **Weixi**, Kang-pu, 3000 m, 1935, *C. W. Wang 64399* (WUK); Weixi, 3200 m, July 1935, *C. W. Wang 68049* (PE).

44. *Pedicularis muscicola* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 24: 54. 1878; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 104. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 124. 1998. Type: China, Inn. Mongolia, Alashan, “*Silvis, muscosis rarius* (Przewalski)”, 1873, *Pl. a. N. M. Przewalski s.n.* [lectotype designated by Ivanica (1970: 185): LE].

Pedicularis ruoergaiensis H. P. Yang, Acta Phytotax. Sin. 27: 222. 1989; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 125. 1998. **syn. nov.** Type: China, Sichuan, Ruoergai, 2730–2800 m, 21 June 1983, *K. Y. Lang et al. 1919* [holotype: PE(00032990)].

Herbs perennial, pubescent, and black when dry. Rhizome branched, covered with scales near the upper end. Stems cespitose, usually densely tufted, central stems erect, outer stems usually flexuous, ascending, or procumbent, 10–25 cm tall. Leaves alternate; petiole 0.5–1.5 cm long, sparsely villous; leaf blade elliptic to lanceolate, 3–5 cm long, adaxially sparsely pubescent, abaxially subglabrous, densely ciliolate along midvein, pinnatisect; segments 4–9 pairs, ovate to lanceolate, spinescent, double-dentate. Pedicels up to 1.5 cm long, densely white-villous to subglabrous. Calyx cylindrical, 10–12 mm long, slightly cleft anteriorly, villous along veins; lobes 5, more or less equal in size. Corolla rose; tube 40–75 mm long, pubescent; galea twisted; beak S-shaped, 8–11 mm long, slender; lower lip 18–20 mm long, 20–22 mm wide, marginally pubescent. Filaments all glabrous. Capsule enclosed by calyx, compressed, ovoid, ca. 1 cm long, and 7 mm wide. Figure 45(2)–24. **Chromosomes:** 2n = 16.

Phenology: flowering and fruiting from May to August.

Habitats: shaded damp places in *Picea* forests, under shrubs, near water in valleys; 1700–2700 m.

Distribution: N Hengduan [Map 45(2)–44]; also in other regions of Gansu, Qinghai, Shanxi, Shaanxi, and Hebei Provinces, China.

Notes: *Pedicularis ruoergaiensis* H. P. Yang was described as new based on one collection from Ruoergai, Sichuan Province of China. Yang stated that it assembles *P. muscicola* Maxim. but differs in deeper calyx cleft, more or less equal to calyx lobes, and pubescence on the margin of lower orolla. Examinations of herbarium specimens confirm that variations of *P. ruoergaiensis* fall into the range of *P. muscicola* Maxim., and here the former is treated as a new synonym of the latter.

N HENGDUAN: Jiuzhaigou, 4100 m, 29 June 2015, *F. S. Yang & Y. C. Liu Pedicularis 20150629* (PE). **Songpan**, 3100 m, Sept. 1937, *K. J. Fu 1260* (WUK).

45. *Pedicularis pseudomuscicola* Bonati, Bull. Soc. Bot. France 54: 371. 1907; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 104. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 125. 1998. Type: China, Sichuan, Kangding, *R. P. Soulié 977* [lectotype designated here: P(P02977074); isolectotypes: P(P02977075), MPU(MPU020884)].

Herbs perennial and diffuse. Rhizome branched, yellow, fleshy. Stems cespitose, spreading or procumbent, more or less black, 5–10 cm long, glabrous, shiny. Leaves alternate; petiole of basal leaves 2–7 cm long; leaf blade linear-oblong, 3–3.5 cm long, glabrous, adaxially shiny, pinnatisect; segments 10–20 pairs, ovate-oblong, margin lobed, spinescent-dentate; cauline leaves similar to basal ones but smaller. Pedicels 5–8 mm long, slender, and curved. Calyx cylindrical; tube ca. as long as pedicel, shallowly cleft anteriorly; lobes 5, more or less equal. Corolla purple, 35–50 mm long; tube slender, 30–45 mm long, white-pubescent; galea twisted at base; beak semicircular, 6–10 mm long, slender; lower lip 10–12 mm long, 15–20 mm wide, glabrous. Filaments all glabrous. Figure 45(2)–24.

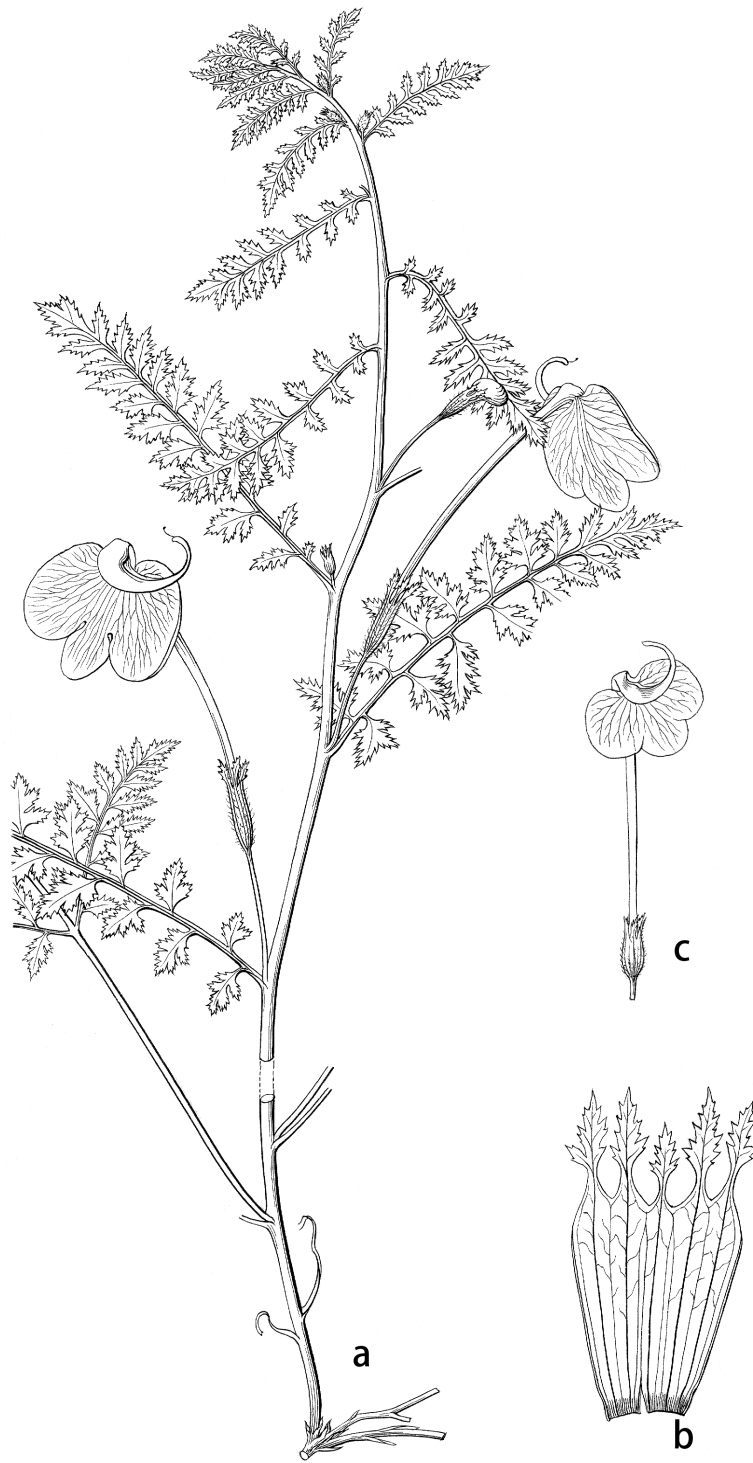
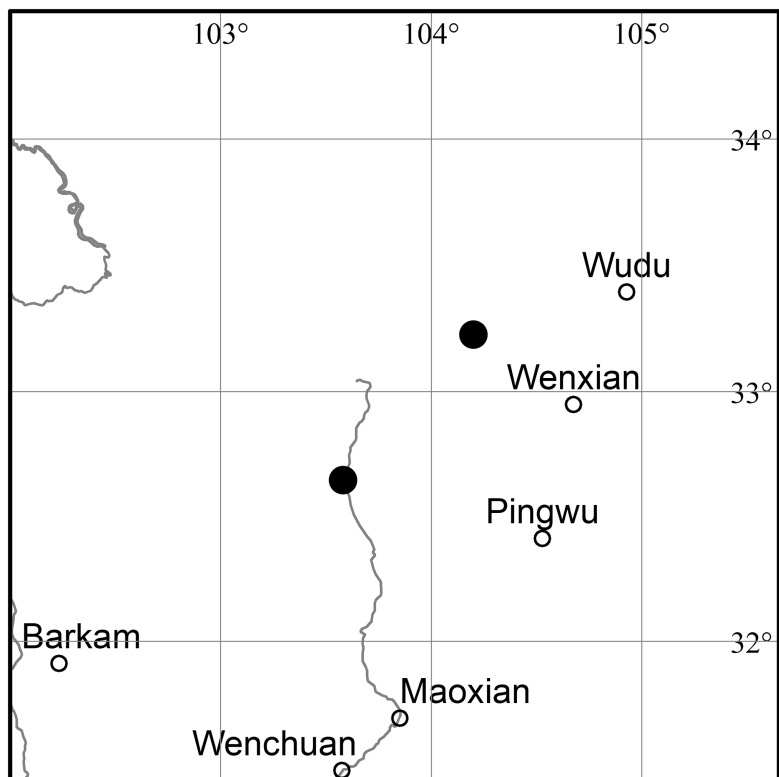


Figure 45(2)-24: **Pedicularis muscicola** Maxim. a-b: a, habit; b, calyx. Drawn by R.-H. ZHANG [*Fl. Reipubl. Popularis Sin.* 68: 102, figure 18: 3-4. 1963]. **Pedicularis pseudomuscicola** Bonati. c, flower. Drawn by R.-H. ZHANG [*Fl. Reipubl. Popularis Sin.* 68: 102, figure 18: 5. 1963].



Map 45(2)-44: *Pedicularis muscicola* Maxim.

Phenology: flowering and fruiting from May to July.

Habitats: shaded damp places in *Pinus* forests, under shrubs; 2400–3200 m.

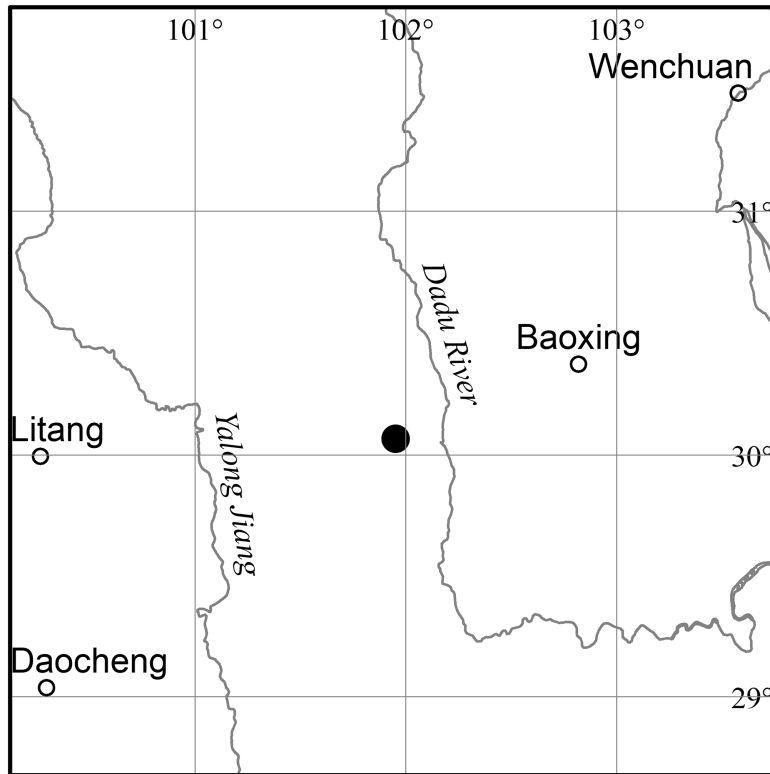
Distribution: endemic; S Hengduan [Map 45(2)–45].

Notes: When Bonati described *P. pseudo-muscicola* Bonati as new, he did not cite any specimen. From the introductory remarks to his paper, Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 175) stated that collection *R. P. Soulié 977* should be types of this species, which have been deposited in the herbaria MPU, P, PH, and UC.

S HENGDUAN: Kangding, Paoma Shan, 2400–3200 m, 29 May 2015, *F. S. Yang 2015052901* (PE); Kangding, Paoma Shan, 2600 m, 26 June 1977, *B. Z. Guo & W. Y. Wang 204731* (HNWP).

46. *Pedicularis geosiphon* Harry Sm. & P. C. Tsoong, Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 400. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 124. 1998. \equiv *Pedicularis pseudogracilituba* P. C. Tsoong, 1950. nom. inval. (noted and named a new species on one sheet of specimen). **syn. nov.** Type: China, Sichuan, Kangding, “Dongrergo, in silva muscosa coniferarum”, ca. 3900 m, 23 Aug. 1922, *H. Smith 2834*. [holotype: PE(00031293); isotype: BM].

Herbs perennial, sparsely pubescent, and not black when dry. Rootstock filiform, black, 5–15 cm long, with membranous scales on nodes. Stems very short, often less than 2 cm long, widely spaced, black, glabrous, with 5 or 6 leaves. Leaves alternate; petiole 2–4 cm long, subglabrous; leaf blade linear-oblong, more than



Map 45(2)-45: *Pedicularis pseudomuscicola* Bonati

4 cm long, 1.5 cm wide, adaxially sparsely pubescent, abaxially glabrous, pinnatisect; segments 3 to 6 pairs, oblique-ovate, incised-dentate. Inflorescences 1–3-flowered; pedicels 0.5–1.5 cm long, glabrous. Calyx cylindric; tube 6–7 mm long, cleft anteriorly to the middle of tube, sparsely villous; lobes 5, unequal in size, posterior lobe linear, lateral lobes inflated near apex, dentate. Corolla tube 45–65 mm long, pubescent; galea more or less bent at a right angle apically, with one marginal tooth on each side near apex; beak straight, 3–4 mm long; lower lip ca. 2 cm long, 2 cm wide, longer than galea. Filaments all glabrous.

Phenology: flowering from June to July.

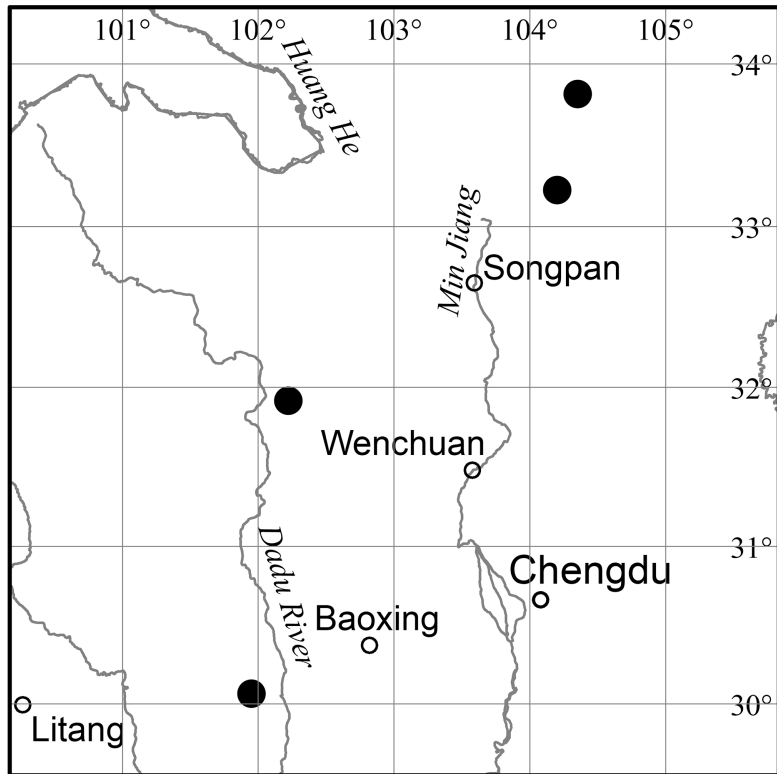
Habitats: mossy places in old-growth coniferous forests; 3500–3900 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–46]; also in other regions of Sichuan and Gansu Provinces, China.

Notes: *H. Smith 2834* was repeatedly named, *i.e.*, *P. geosiphon* H. Smith & P. C. Tsoong and *P. pseudogracilituba* P. C. Tsoong. *Pedicularis geosiphon* H. Smith & P. C. Tsoong was officially published, while the name *P. pseudogracilituba* appears only on sheets of *H. Smith 2834* (MO, PE, TI).

N HENGDUAN: Barkam, Zhegu Shan, ca. 4000 m, 1 June 1988, *Q. M. Hu & F. D. Fu 8960* (WCSBG0008071–WCSBG008079). **Jiu-zhaigou**, 2300–2700 m, 8 June 1983, *K. Y. Lang et al. 1689* [PE(00155901, 00118698)]. **Zhugqu**, Shatan forest farm, under *Abies* forest, 2650 m, 3 July 1964, *B. Z. Guo 5325* (WUK). **S HENGDUAN:** Kangding, “Dongrergo, in silva muscosa coniferarum”, ca. 3900 m, 23 Aug. 1922, *H. Smith 2834* [PE(00031293, 00118699), MO(716113), S(S-G-4634), TI].

47. *Pedicularis sorbifolia* P. C. Tsoong, in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 400.



Map 45(2)–46: *Pedicularis geosiphon* Harry Sm. & P. C. Tsoong

1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 123. 1998. Type: China, Sichuan, “Karlöng, in silva abietina primava, muscosa”, 3300 m, 4 Aug. 1922, *H. Smith 3024* [holotype: BM; isotype: PE(00123516)].

Herbs perennial, slightly pubescent. Stems curved, less than 20 cm long, slender. Basal leaves large, alternate or opposite; petiole 2–4.5 cm long; leaf blade lanceolate-obovate, 5–12 cm long, 1.2–2 cm wide, pinnatisect; segments 6–13 pairs, ovate to oblong, 1–1.8 cm long, 4–8 mm wide, incised double-dentate, apex acute; cauline leaves similar to basal ones but smaller. Pedicels 3–8 mm long. Calyx scarcely 10 mm long, cleft anteriorly to the middle of the tube, 2–4-lobed. Corolla tube 50–70 mm long, sometimes up to 95 mm long, pubescent; galea more or less bent at a right angle apically; beak straight, 3–4 mm long; lower lip longer than galea, 9–12 mm long, 9–10 mm wide,

middle lobe smaller than lateral lobes, narrowly ovate, projected. Filaments all glabrous.

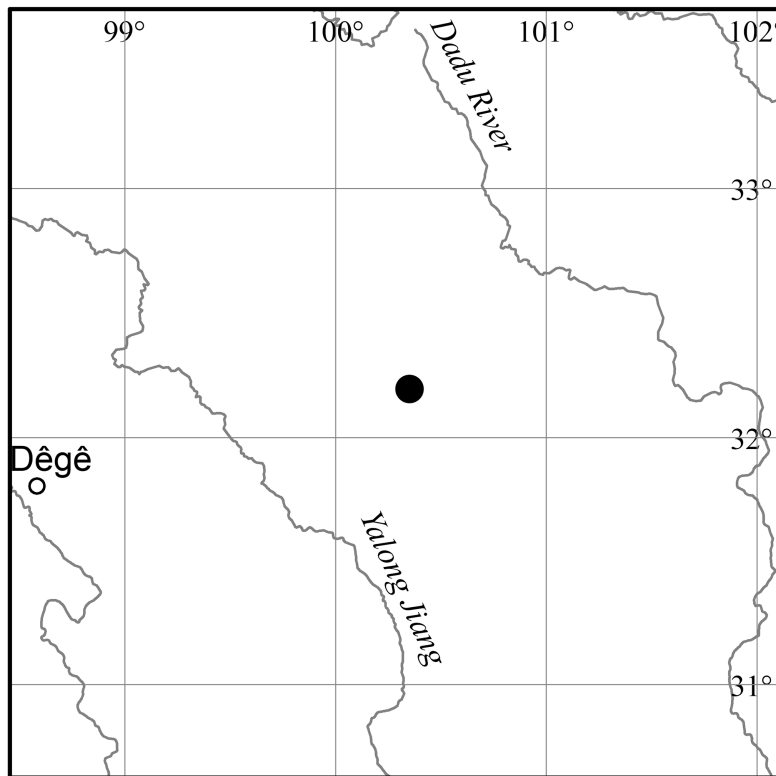
Phenology: flowering from July to August.

Habitats: mossy places in old-growth *Abies* forests; ca. 3300 m.

Distribution: endemic; Tangut [Map 45(2)–47].

Notes: When Tsoong described *P. sorbifolia* P. C. Tsoong as new, he listed one collection (*H. Smith 3024*, 4 Aug. 1922) but did not provide more detailed information. Based on identification time (1950), we believe that the holotype should be deposited in the herbarium BM. Only one collection is available.

TANGUT: Sêrtar, “Karlöng, in silva abietina primava, muscosa”, 3300 m, 4 Aug. 1922, *H. Smith 3024* (PE).



Map 45(2)–47: *Pedicularis sorbifolia* P. C. Tsoong

Ser. 21. Phaceliifoliae

Ser. Phaceliifoliae Bonati, Bull. Soc. Bot. France 57, Mém. 18: 14. 1910.

Stems single to several together, short-branched apically or unbranched. Cauline leaves alternate or more or less opposite; leaf blade often ovate-elliptic, up to 15 cm long and 14 cm wide. Inflorescences more or less compact, capitate. Corolla red or white; tube straight, ca. 2 times as long as calyx; galea twisted laterally; beak more or less curved downward.

Notes: Our molecular phylogenetic results show that the series *Phaceliifoliae* Bonati is closely related to the series *Rhinanthoides* Prain.

Two species; both in the Pan-Himalaya and adjacent regions.

- 1a. Corolla tube scarcely longer than calyx; beak curved downward, parallel to proximal part of galea; leaf blade leathery48. *P. phaceliifolia*
 1b. Corolla tube ca. 2 × as long as calyx; beak more or less straight, curved only apically, pointed forward, perpendicular to basal part of galea; leaf blade membranous49. *P. fargesii*

48. *Pedicularis phaceliifolia* Franch., Bull. Soc. Bot. France 47: 27. 1900, “*Pedicularis phaceliæfolia*”; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 106. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 125. 1998. Type: China, Yunnan, Yanjing, Chengfeng Shan, “dans les lieux frais des montagnes, a Tchen-fong-chan”, June 1894, *J. M. Delavay 4905* [**lectotype designated here:** P(P02977409)].

Herbs annual or biennial, 25–60 cm tall, glabrous. Rhizome branched, fleshed. Stems more or less flexuous ascending. Basal leaf petiole usually 5–10 cm long, sometimes up to 20 cm long; leaf blade ovate-oblong to oblong-lanceolate, 10–15 cm long, 7–13 cm wide, pinnatisect to pinnatipartite; segments 7–10 pairs, ovate to oblong, leathery, pinnatifid, dentate; cauline leaves pseudo-opposite, only alternate apically, smaller than basal leaves. Inflorescences more or less capitate; bracts leaflike, upper ones shorter than flowers. Calyx 5–7 mm long, slightly cleft anteriorly; lobes 5, unequal, posterior lobe narrow-ovate, lateral lobes inflated near apex, denate, sparsely ciliate. Corolla white; tube scarcely longer than calyx; galea semicircular apically; beak parallel to basal part of galea, curved downward, 1–3 mm long; lower lip ca. as long as galea. Filaments all villous. Capsule obliquely lanceolate, 15–17 mm long, apex acute. Figure 45(2)–25.

Phenology: flowering and fruiting from June to August.

Habitats: grassy slopes, shaded places, *Abies* forests, under shrubs; 1500–3400 m.

Distribution: S Hengduan [Map 45(2)–48]; mainly in other regions of S Sichuan, China.

Notes: Franchet listed two collections [Yunnan, dans les lieux frais des forêts des montagnes, à Tchen-fong-chan (*Delavay 2124, 4905*)] when he described *P. phaceliifolia* Franch. as new. Two collections deposited in the herbarium P match the records of Franchet, and the collection should be *Delavay 5124* (not 2124) and 4905. One sheet of *Delavay 4905* is

designated here as a lectotype. Other specimens in the herbarium P were examined.

S HENGDUAN: **Baoxing**, Leimugou, under bushes, June 1933, *T. T. Yü 1897* (PE).

49. *Pedicularis fargesii* Franch., Bull. Soc. Bot. France 47: 26. 1900; Li, Proc. Acad. Nat. Sci. Philad. 101: 156. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 107. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 126. 1998. Type: China, Chongqing, Chengkou, 1400 m, *R. P. Farges 1201* [**lectotype designated here:** P(P02985404); isolectotypes: K(K000708877), P(P02985401, P02985402, P02985403, P02985405), LE].

Herbs annual or biennial, 20–40 cm tall, subglabrous, not black when dry. Petiole of basal leaves 4–7 cm long; leaf blade ovate-oblong to elliptic-oblong, 5–6 cm long, 2.5–3.5 cm wide, membranous, pinnatisect to pinnatipartite; segments 5–8 pairs, ovate-oblong, incised-double dentate, abaxially sparsely white-pubescent along veins, adaxially glabrous. Stem leaves often only 2 or absent, pseudo-opposite. Inflorescences capitate, 5- or 6-flowered; bracts leaflike. Calyx 8–11 mm long, slightly cleft anteriorly; lobes 5, more or less equal in size, serrate. Corolla white, 16–20 mm long; tube slender, ca. 2 times as long as calyx; galea crescent-shaped apically; beak pointed forward, perpendicular to basal part of galea, straight, curved only apically; lower lip slightly shorter than galea, ciliate. Filaments villous. Figure 45(2)–25.

Phenology: flowering and fruiting from June to September.

Habitats: moist shaded banks in valleys; 2800–3300 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–49]; also in other parts of Sichuan, China.

N HENGDUAN: **Pingwu**, Wangbachu, Baihegou, 2500 m, *H. L. Tsiang 10723* (IBSC). **S HENGDUAN:** **Tianquan**, Erlang Shan, July 1958, *H. L. Tsiang 10792* (IBSC); Tianquan, Erlang Shan, 15 July 1958, *H. L. Tsiang 10859* (IBSC).

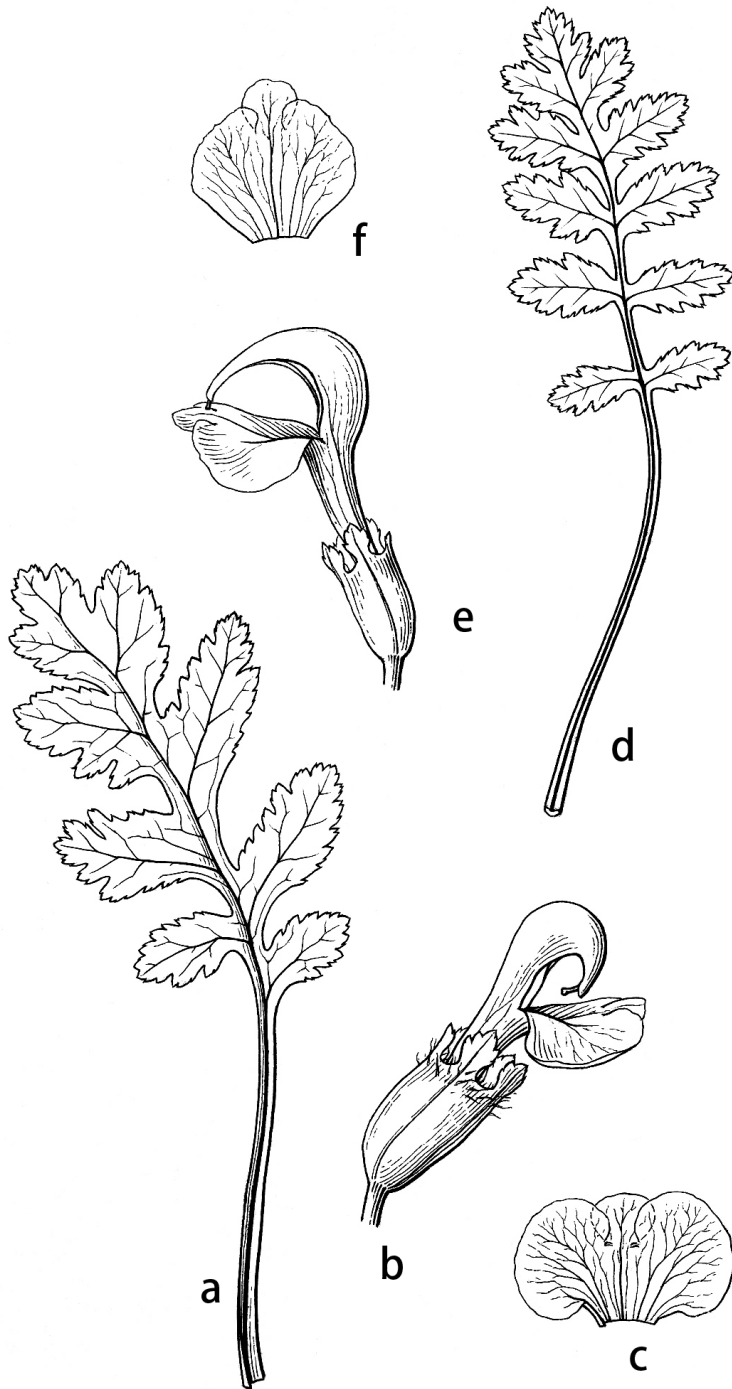
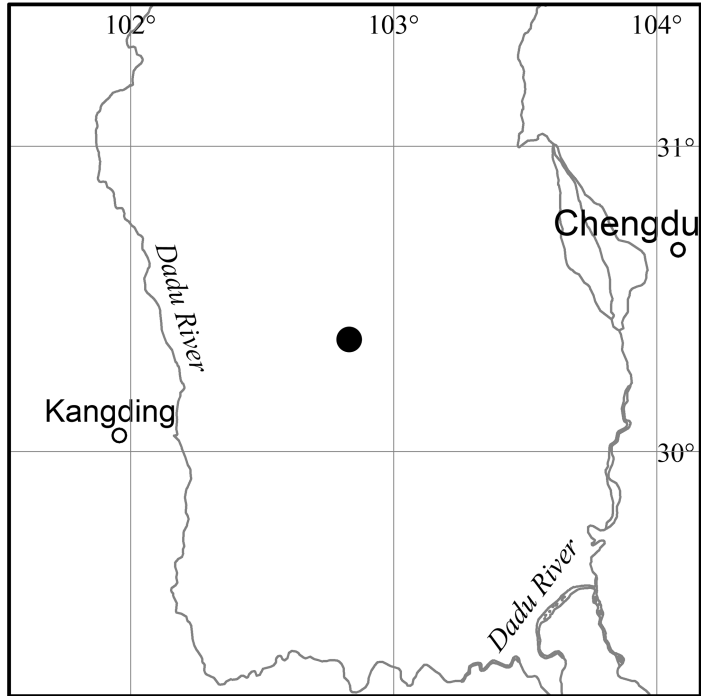
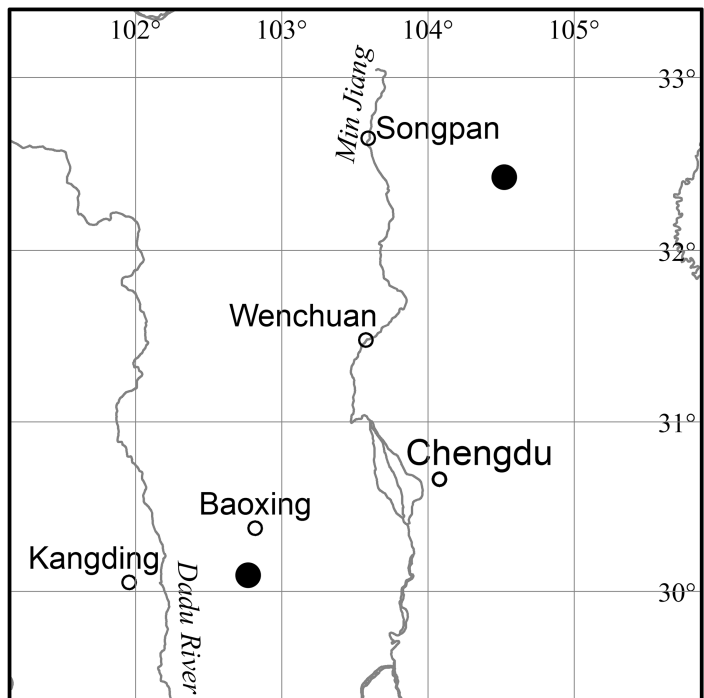


Figure 45(2)–25: **Pedicularis phaceliifolia** Franch. a-c: a, leaf; b, flower; c, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 106, figure 19: 2-4. 1963]. **Pedicularis fargesii** Franch. d-f: d, leaf; e, flower; f, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 107, figure 19: 5-7. 1963].



Map 45(2)-48: *Pedicularis phaceliifolia* Franch.



Map 45(2)-49: *Pedicularis fargesii* Franch.

Ser. 22. Carnosae

Ser. Carnosae Prain, Ann. Roy. Bot. Gard. Calc. 3: 77. 1890. Type: *Pedicularis bifida* (Buch.-Ham. ex D. Don) Pennell.

Plants more or less woody. Stems many-branched apically or unbranched. Leaves alternate; leaf blade ovate to linear-oblong, shallowly to deeply crenate. Inflorescences spicate, racemose, or axillary, usually short and compact; bracts sessile. Calyx 2-lobed or sometimes 4- or 5-lobed. Corolla tube less than 2 times as long as calyx; galea recurved apically; beak short, indistinct.

Nine species; four distributed in the Pan-Himalaya and adjacent regions.

Notes: The series *Carnosae* Prain includes about 9 species, with most of them distributed at lower latitudes near the southeast Pan-Himalaya. Our molecular phylogenetic results show that *P. veronicifolia* Franch., *P. bifida* (Buch.-Ham. ex D. Don) Pennell, *P. crenata* Maxim. and two species (*P. nigra* Vaniot and *P. henryi* Maxim.) outside the Pan-Himalaya form a well-supported clade.

1a. Leaves 2–10 cm long, 0.8–2.5 cm wide; calyx deeply cleft anteriorly..... 50. *P. veronicifolia*

1b. Leaves 2.5–5 cm long, 1–1.7 cm wide; calyx scarcely cleft anteriorly.

2a. Filaments glabrous; beak of galea 4–5 mm long51. *P. bifida*

2b. Filaments pubescent (or glabrous in *P. shanensis*); beak of galea less than 3 mm long.

3a. Corolla lip wider than long or nearly equal; beak of galea 2–3 mm long.....52. *P. crenata*

3b. Corolla lip longer than wide; galea beakless or barely 1 mm long..... 53. *P. crenularis*

50. *Pedicularis veronicifolia* Franch., Bull. Soc. Bot. France 47: 30. 1900; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 125. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 132. 1998. Type: China, Yunnan, “Sur Ia montagne de Pee-ngui-tze”, 4 Sept. 1882, *J. M. Delavay 330* [lectotype designated here: P(P00520830); isolectotype: P(P2968524)].

Herbs perennial, 15–50 cm tall. Rootstock fleshy, several to caespitose, more or less fusiform. Stems erect, many-branched or unbranched, finely pubescent or glabrescent. Leaves petiolate; leaf blade obovate to rhomboid-lanceolate, 2–10 cm long, 0.8–2.5 cm wide, hispid on both surfaces, long-attenuate at base, pinnatifid or double crenate, apex rounded to attenuate. Inflorescences racemose, more than 10 cm long, interrupted at base; bracts broadly ovate to oblong-ovate, entire at base, double-dentate upper. Calyx 10–13 mm, densely hispidulous, long, pubescent along veins, deeply cleft anteriorly; lobes 2(or 3), narrow, distinctly serrulate. Corolla pale-rose, 24–30 mm long; tube 13–15 mm long, glabrous; galea falcate, 10–14 mm long; beak to 2–3 mm, truncate; lower lip 10–12 mm long. Filaments all villous.

Capsule obliquely lanceolate-ovoid, 10–13 mm long, apex acute.

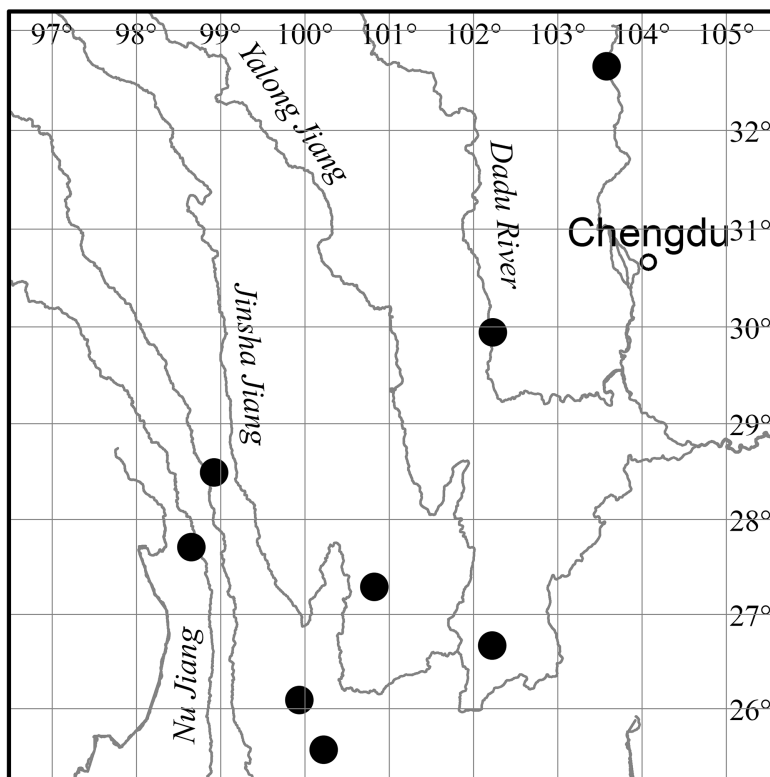
Phenology: flowering and fruiting from July to October.

Habitats: grassy slopes, forests; 1000–4000 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–50]; also in SE Yunnan, China.

Notes: In the protologue of *P. veronicifolia*, Franchet listed three collections, “Yunnan, sur la montagne de Pee-ngui-tze (*J. M. Delavay 330*); mont Yo-lin-chan (id.) mont Pee-tsa-long-chan (*J. M. Delavay 6644*); Yunnan, sen (*Bodinier et Ducloux 438*)”. Here, one sheet of *J. M. Delavay 330* in the herbarium (P00520830) is designated as lectotype.

N HENGDUAN: Songpan, Liheqiao, 2000 m, 22 Oct. 1937, *T. P. Wang 7928* (PE, WUK). **S HENGDUAN:** Dali, Cangshan, 4000 m, Aug. 1941, *H. C. Wang 1262* (PE). **Dêqên,** Cizhong, 3800 m, 5 July 1940, *K. M. Feng 5136* (PE). **Eryuan,** 2600 m, 21 Sept. 1929, *R. C. Ching 24762* (PE). **Gongshan,** Lapu, 3600 m, 23 Sept. 1938, *T. T. Yü 22717* (PE). **Huili,** 2000 m, 2 Oct. 1932, *T. T. Yü 1615* (PE).



Map 45(2)-50: *Pedicularis veronicifolia* Franch.

Luding, Erlang Shan, 2000 m, 9 Sept. 1953, *X. L. Jiang* 35536 (PE). **Ninglang**, Hongqi to Hongqiao, 2515 m, 23 ept. 2015, *J. D. Ya & C. Liu* 15CS11231 (KUN).

51. *Pedicularis bifida* (Buch.-Ham. ex D. Don) Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 144. 1943; Husain, Garg & Agnihotri, Genus *Pedicularis* L. (Scrophulariaceae) in India (A revisionary study), p126. 2010. ≡ *Rhinanthus bifidus* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 94. 1825; Prain, Ann. Roy. Bot. Gard. Calc. 3: 151. 1890. Type: Nepal, Narainhetty, Sept. 1802, *F. Buchanan-Hamilton s.n.* [lectotype designated by Garg & Singh (2020: 62): BM(BM000885992)].

Pedicularis gyirongensis H. P. Yang, Bull. Bot. Res. Harbin 2(4): 138. 1982; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 133. 1998. **syn. nov.** Type: China, Tibet,

Jilong, Jilong county to Mangmu, 2400 m, 16 Sept. 1981, *Z. C. Ni et al.* 2301 [holotype: PE(00031472)].

Pedicularis carnosa Wall., Plant Asiat. Rar. (Wall.). 2: 44. 1831. Type: Nepal, Shaopur (Shivapuri), Aug. 1821, *Wallich Cat.* 418A [lectotype designated by Garg & Singh (2020: 62): K(K001109996); isolectotypes: E(E00273665, E00273668), K(K000708942), M(M0188782), P(P02995823)].

Perennial, erect herbs 10–50 cm tall. Stems erect, hollow, rounded, ridged, hirsute below to densely hairy above, usually branched from base; branches alternate. Leaves both radical and cauline; radical petiole 0.5–1 cm long, slightly winged; leaf blade 2.5–5 cm long, 1–1.7 cm wide, narrow-elliptic, with coarse rounded teeth; cauline leaves 0.8–2 cm long, alternate, narrow-elliptic; petiole up to 5 mm long. Inflorescences

lax, leafy spike; flowers pedicellate; pedicels up to 5 mm long, hairy. Calyx 9–12 mm long; tube campanulate-cylindrical, deeply cleft, densely hairy, coriaceous, longitudinally nerved; teeth deflexed. Corolla purple, throat of labium white; tube 10–12 mm long, equal in length to calyx; galea nearly bent at a right angle apically, front very elevated, densely pubescent; beak 3–5 mm long; lower lip 11–15 mm long, 17–20 mm wide, ciliate. Stamens inserted at base of corolla tube; filaments all glabrous.

Phenology: flowering from July to September.

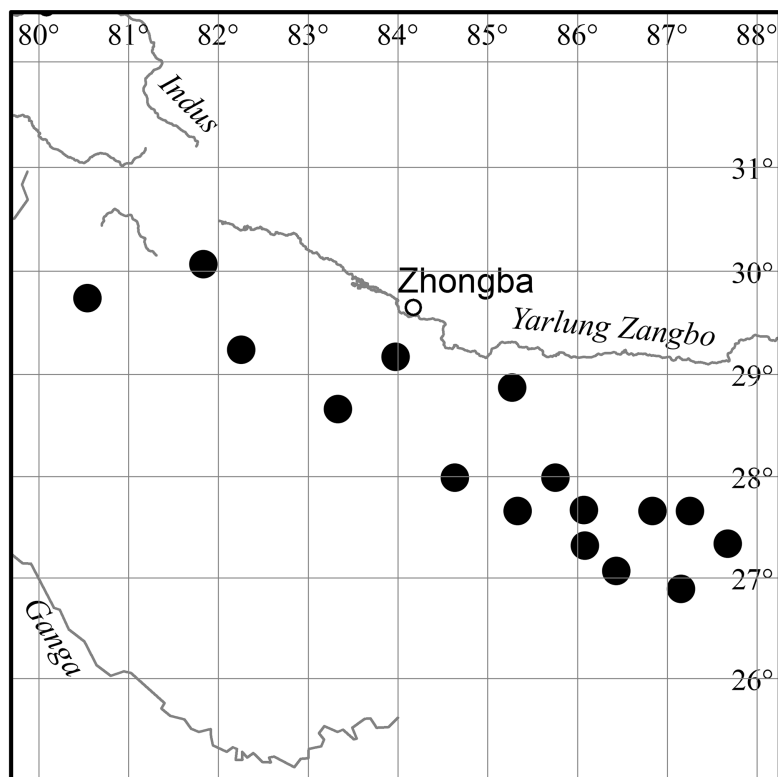
Habitats: in open grasslands on rocky slopes; 1000–4500 m.

Distribution: U Yarlung Zangbo, W Nepal, C Nepal, E Nepal [Map 45(2)–51]; also in other regions of Nepal.

Notes: When Yang described *P. gyirongensis* H. P. Yang as new based on a collection

(*Z. C. Ni et al. 2301*) from Gyirong (Tibet, China) near the border of China/Nepal, she compared it with *P. crenata* Maxim. On 18 Aug. 2006, we collected *P. gyirongensis* at type location and found that *P. gyirongensis* fits well with the description of *P. bifida* (Buch.-Ham. ex D. Don) Pennell, and an examination of types confirmed that it should be merged in *P. bifida*. This treatment is supported by our results of phylogenetic analysis because *P. bifida* (Buch.-Ham. ex D. Don) Pennell and *P. gyirongensis* H. P. Yang form a monophyletic clade.

U YARLUNG ZANGBO: Gyirong, Jilong county to Mangmu, 2400 m, 16 Sept. 1981, *Z. C. Ni et al. 2301* (PE). **W NEPAL:** Karnali, Humla, Yangchu Gaon-Simikot, 2800 m, 1983, *H. Tabata et al. 24091* (KYO); Karnali, Jumla, Maharigaon, 4090 m, 27 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 1645* (BM). Karnali, Mugu, 3150 m, 18 Aug. 1983, *H. Tabata*



Map 45(2)–51: *Pedicularis bifida* (Buch.-Ham. ex D. Don) Pennell.

et al. 20308 (BM). **C NEPAL:** Bagmati, Lalitpur, 2180 m, 4 Oct. 1955, *M. Mikage, Y. Shimizu & K. Yonekura* 9552673 (BM); Bagmati, Rasuwa, Gatlang, 2000 m, 19 Aug. 1974, *J. H. de Haas* 2405 (BM); Sindhupalchok, Melamchi Khola, 2000 m, 17 Sept. 1974, *J. H. de Haas* 2779 (BM). **Dhawalagiri**, Mustang, 2420 m, 15 Sept. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 7859 (BM); Dhawalagiri, Myagdi, 1780 m, 5 Sept. 1996, *M. Mikage et al.* 9685159 (E). **Gandaki**, Gorkha, Arught, 1828 m, 84°62' E, 28°12' N, 25 May 1962, *J. D. A. Stainton* 3891 (BM). **Janakpur**, Dolkaha, 1950–2700 m, 31 Aug. 1983, *H. Ohba et al.* 8351142 (E); Janakpur, Ramechhap, 1650–2550 m, 18 Aug. 1985, *H. Ohba et al.* 8530867 (BM). **E NEPAL:** Kosi, Sankhuwasabha, Barun Nadi, 3500 m, 25 Aug. 1981, *C. Grey-Wilson et al.* 4225 (BM); Kosi, Maghang Khola, Arun Valley, 2743 m, 11 Sept. 1956, *J. D. A. Stainton* 1722 (BM). **Mechi**, Taplejung, Thapalu Khola, Tamur Valley, 2286 m, 1956, *J. D. A. Stainton* 5214 (BM); Mechi, Taplejung, Amjilosa, 2200 m, 22 Aug. 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 773922 (BM). **Sagarmatha**, Solukhumbu, Phaplu, 2400–2750 m, 1930, *L. Dhwoj* 76 (BM).

52. *Pedicularis crenata* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 559. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 129. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 133. 1998. ≡ *Pedicularis crenata* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 45. 1949. Type: China, NW Yunnan, Tapin-tze, Oct. 1882, *Delavay s.n.* [lectotype designated here: P(P02987139)].

Pedicularis crenata subsp. *crenatiformis* (Bonati) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 129. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 133. 1998. **syn. nov.** ≡ *Pedicularis crenata* var. *crenatiformis* Bonati, Notes Roy. Bot. Gard. Edinb. 15: 159. 1926. Type: China, Yunnan, “between Tengyueh and Talifu”, 1922, *J. F. Rock* 6318 [lectotype designated here: E(E00438447); isolectotype: S(S11-793)].

Herbs perennial, 20–35 cm tall, more or less woody, densely gray-pubescent. Stems

erect, leafy, not or sometimes 2- or 3-branched; branches forked or ascending. Leaves short-petiolate (barely 1 mm) to more or less sessile; leaf blade linear-oblong, sometimes ovate-elliptic basally, 2–6 cm long, 0.3–1.8 cm wide, more or less fleshy, densely tomentose on both surfaces, base attenuate to subcordate-clasping, double, crenate; teeth callose, apex obtuse. Inflorescences short-racemose, many-flowered, interrupted at base; bracts leaflike, ovate, longer than calyx; pedicels 1.5–2 mm long, hispid. Calyx 10–12 mm long, membranous, densely villous, scarcely cleft anteriorly; lobes 2(or 4), serrate. Corolla white, red or purple, 22–24 mm long; tube erect, exceeding calyx; galea recurved apically; beak ca. 2 mm long, apex truncate; lower lip 9–11 mm long, 11–14 mm wide, slightly longer than galea, ciliate. Filaments 2 sparsely pubescent, 2 glabrous. Figure 45(2)–26.

Phenology: flowering from July to September.

Habitats: alpine meadows, grassy slopes, among limestone rocks; 2600–3400 m.

Distribution: S Hengduan [Map 45(2)–52]; also in S Yunnan, China.

Notes: Maximowicz in the protologue of *P. crenata* recorded: “Yunnan, pratis montium supra Tapin-tze (*Delavay!* In Mus. Paris)”, but the record number is unknown. Seven sheets of *Delavay's* collections between the years 1882–1885 deposited in the herbarium P were examined, and one sheet (P02987139) is here selected as lectotype.

Bonati listed three collections (*J. F. Rock* 5875, *J. F. Rock* 6318, and *J. F. Rock* 10625) when he described *P. crenata* var. *crenatiformis* Bonati as new, and one sheet of *J. F. Rock* 6318 in the herbarium E is designated here as lectotype. Our molecular phylogenetic results indicate that four accessions of *P. crenata* Maxim. are clustered into one clade.

S HENGDUAN: Daocheng, 24 Aug. 1998, *Qinghai-Xizang Exped.* 4263 (PE). Heqing, 2600 m, 3 Sept. 1929, *R. C. Ching* 24317 (PE). Ninglang, Ningli, 2940 m, 12 Sept. 1981, *Z. X. Tang* 1041 (PE). Shangri-la (Zhongdian), 3000 m, 5 Sept. 1937, *T. T. Yü* 13508 (PE). Yulong (Lijiang), eastern slopes of Likang snow range, Nguluke, open meadow, Aug. 1922,

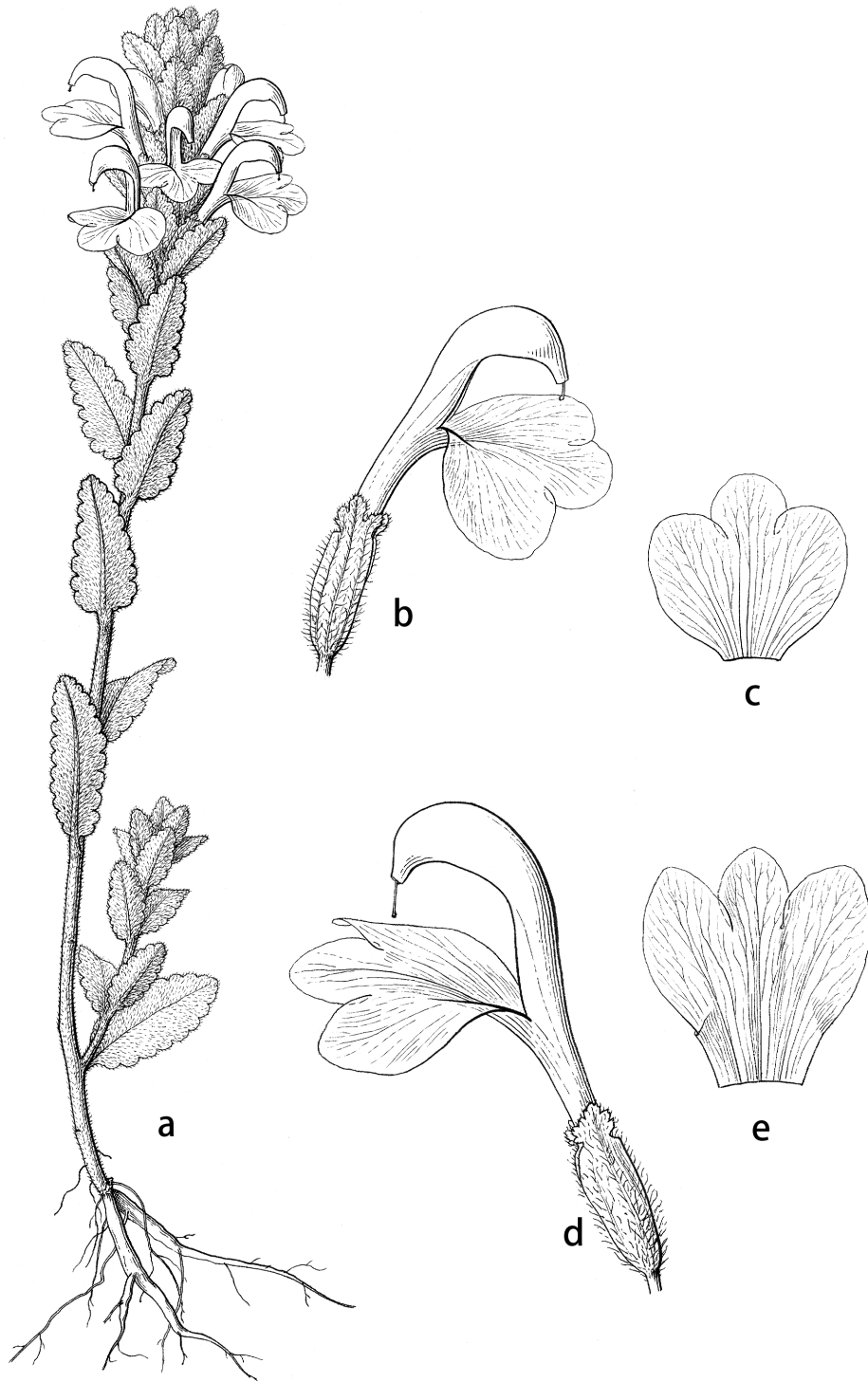
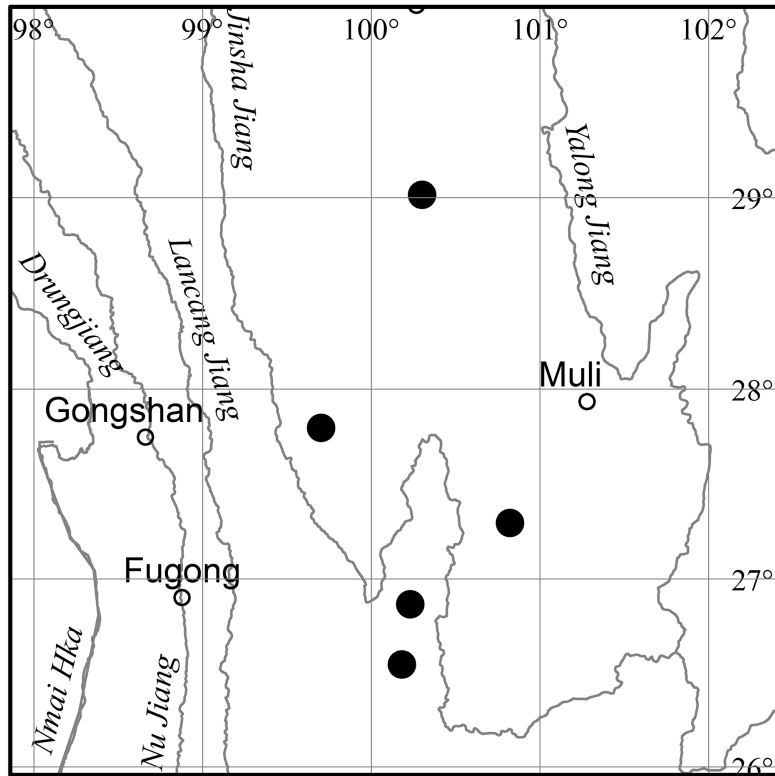


Figure 45(2)-26: ***Pedicularis crenata*** Maxim. a-c: a, habit; b, flower; c, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 126, figure 25: 1-3. 1963]. ***Pedicularis crenularis*** H. L. Li. d-e: d, flower; e, corolla lip. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 126, figure 25: 6-7. 1963].



Map 45(2)-52: *Pedicularis crenata* Maxim.

J. F. Rock 5875 (US); Yulong (Lijiang), 3000 m, 11 Sept. 1937, *T. T. Yü* 15571 (PE); Yulong (Lijiang), Daju village, 1914 m, 7 Nov. 2013, *C. Liu & J. Cai* 13CS6777 (KUN); Yulong (Lijiang), Baisha, 2650 m, 25 Aug. 2001, *F. S. Yang* Y0210 (PE); Yulong (Lijiang), 2600 m, 1910, *G. Forrest* 6405 (PE).

53. *Pedicularis crenularis* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 48. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 127. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 132. 1998. Type: China, Yunnan, Dali, *G. Forrest* 7217 [holotype: UC; isotype: PH].

Herbs 10–30 cm tall. Stems single, branched apically, densely pubescent. Leaves more or less sessile; leaf blade linear-oblong, 2–4 cm long, 0.8–1.2 cm wide, more or less fleshy, adaxially tomentose, abaxially densely villous, base rounded or subcordate, pinnatilobate; segments rounded, 8–10-crenate on each side, apex acute. Inflores-

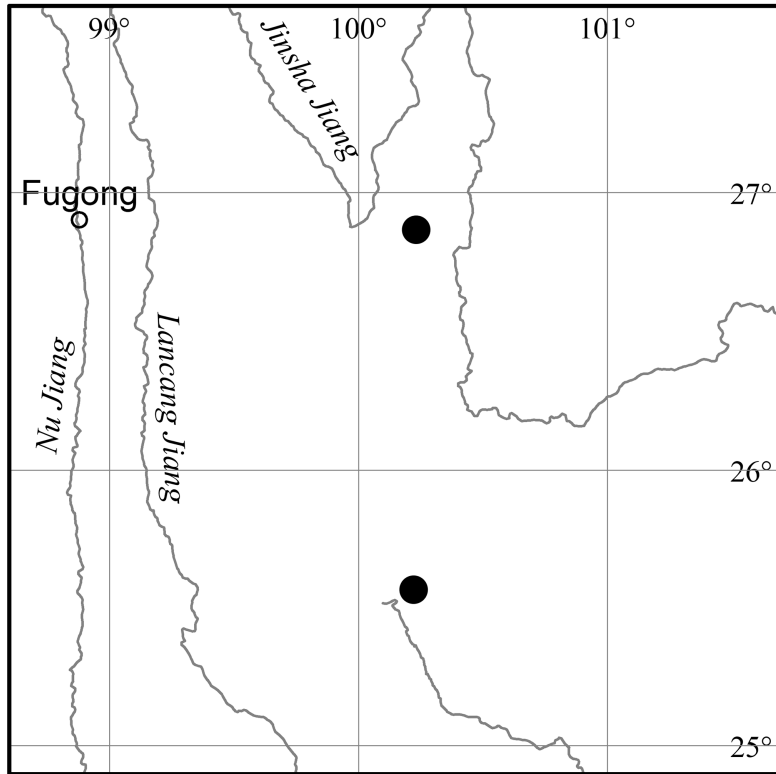
cences spicate, 3.5–5 cm long; bracts leaflike, 1–1.5 cm long, 4–6 mm wide, densely pubescent on both surfaces. Flowers more or less dense. Calyx cylindric, densely pubescent, deeply cleft anteriorly; lobes 2, flabellate, serrate. Corolla rose, 25–30 mm long, glabrous; tube erect, 15–18 mm long; galea falcate apically, 10–12 mm long, 4–6 mm wide; beak conical, barely 1 mm, apex truncate; lower lip ca. as long as galea, glabrous. Filaments sparsely long-pubescent. Capsule obliquely lanceolate, 10–13 mm long, 10–5 mm wide. Figure 45(2)–26.

Phenology: flowering from July to August.

Habitats: grassy slopes, under shrubs; 2500–3500 m.

Distribution: S Hengduan [Map 45(2)–53]; also in other regions of Yunnan Province, China.

Notes: Specimens in the herbaria K, UC, and PH were examined, with one sheet in PH noted by Li as “type” and another deposited in UC noted



Map 45(2)-53: *Pedicularis crenularis* H. L. Li

as “isotype”. However, Li in the protologue of *P. crenularis* H. L. Li stated that the holotype has been deposited in the herbarium UC. Hence, a sheet of *G. Forrest* 7217 in UC should be holotype, and that in PH should be isotype.

SHENGDUAN: Dali, 2250 m, 2 Oct. 1946, *S. Liu* 21003 (PE); Dali, 2300 m, 3 Oct. 1946, *S. Liu* 21041 (PE). **Yulong** (Lijiang), Xuesongcun, 3000 m, 11 Sept. 1937, *Y. B. Zhang* 15571 (IBSC).

Ser. 23. Racemosae

Ser. Racemosae Prain, Ann. Roy. Bot. Gard. Calc. 3: 77. 1890.

Plants more or less woody. Stems usually many-branched apically. Leaves alternate or sometimes opposite at base, ovate to linear-lanceolate, margin crenate, and double dentate. Inflorescences racemose or flowers axillary; bracts sessile. Calyx deeply cleft anteriorly, 2-lobed. Corolla tube nearly 2 times as long as calyx; beak distinct.

About six species; one in the Pan-Himalaya.

54. *Pedicularis resupinata* L., Sp. Pl. 2: 608. 1753; Li, Proc. Acad. Nat. Sci. Philad. 101: 49. 1949; Tsoong in Chien & Chun,

Fl. Reipubl. Popularis Sin. 68: 120. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 130. 1998. Type: *Herb.*

Linn. No. 763.7 [lectotype designated by Yu *et al.* (2014: 174) : LINN].

Herbs perennial, 30–70 cm tall, not black when dry. Roots fascicled, fibrous. Stems often single, erect, many-branched apically, sparsely pubescent, or subglabrous. Stem leaves numerous, petiolate or uppermost sometimes sessile; petiole up to 12 mm long, glabrous or pubescent; leaf blade ovate to oblong-lanceolate, 2.5–5.5 cm long, 1–2 cm wide, membranous to papery, glabrous or sparsely pubescent, base broadly cuneate to rounded, margin crenate or serrate, apex acuminate. Flowers axillary. Pedicel short or absent. Calyx 6–9 mm long, glabrescent; lobes 2, broad, entire. Corolla pink to purple or yellowish, 20–25 mm long; tube straight, 12–15 mm long; galea falcate; beak conical, ca. 3 mm long; lower lip slightly longer than galea, ciliate. Filaments 2

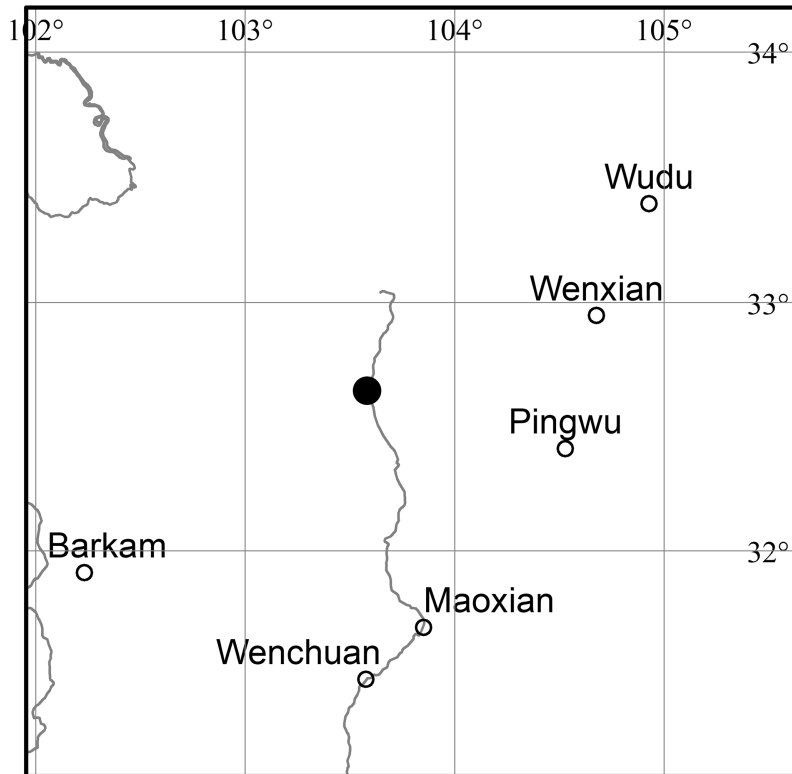
pubescent, 2 glabrous. Capsule obliquely oblong-lanceolate, 11–16 mm long, slightly longer than calyx. **Chromosomes:** $2n = 16, 32$.

Phenology: flowering and fruiting from May to November.

Habitats: grassy slopes, meadows, open forests; 300–2000 m.

Distribution: N Hengduan [Map 45(2)–54]; also in Anhui, Gansu, Guangxi, Guizhou, Hebei, Heilongjiang, Hubei, Jilin, Liaoning, Inner Mongolia, Shaanxi, Shandong, Shanxi, and Sichuan Provinces of China, Japan, Kazakstan, Korea, Mongolia, and Russia.

N Hengduan: Songpan, grassy slope, precise location unknown, 2 Sep. 1928, *W. P. Fang 4406* (PE, CQNM); Songpan, roadside, 2000 m, 22 Oct. 1937, *K. T. Fu 2127* (WUK).



Map 45(2)–54: *Pedicularis resupinata* L.

Ser. 24. Microphyllae

Ser. Microphyllae Prain, Ann. Roy. Bot. Gard. Calc. 3: 76. 1890. Type: *Pedicularis gruina* Franch. ex Maxim.

Stems erect or branches diffuse at base, many-branched or unbranched. Leaves alternate or sometimes pseudo-opposite; leaf blade lanceolate-oblong, pinnatifid to pinnatisect. Inflorescences racemose or subcapitate. Calyx deeply cleft anteriorly; lobes (3 or) 5-lobed. Corolla tube up to 2 times as long as calyx; galea curved, often dentate, beak 1–5 mm long.

Notes: Prain first established the series *Microphyllae*, which includes five species, *i.e.*, *P. flagellaris* Benth., *P. gruina* Franch. ex Maxim., *P. henryi* Maxim., *P. polyphylla* Franch. ex Maxim., and *P. tenuisecta* Franch. ex Maxim. Bonati (1921. Notes Roy. Bot. Gard. Edinb. 13: 121) in his classification system transferred *P. gruina* Franch. ex Maxim. and *P. henryi* Maxim. to the series *Polyphyllatae* Bonati, a new series including five *Pedicularis* species. Bonati's taxonomic treatment was adopted by Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 33–38) and Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 133–136). The main difference between the two series is the length of beak, which is shorter than galea in the series *Microphyllae* while is equal to, or longer than, galea in the series *Polyphyllatae*. Increasing studies reveal that corolla of *Pedicularis* has experienced parallel evolution in different lineages, with evolution pattern of corolla frequently repeated in sections and series. Our molecular phylogenetic results indicate that species of the series *Microphyllae* and the series *Polyphyllatae* are clustered into one clade, supporting our taxonomic treatment. Hence, it is reasonable to merge the series *Polyphyllatae* Bonati with the series *Microphyllae* Prain.

Eight species; all in the Pan-Himalaya (2 endemics).

- 1a. Pedicel often shorter than 5 mm; beak of galea short or obscure, less than 3 mm long.
 - 2a. Leaves 1- or 2-pinnatisect; segments pinnatifid, lanceolate-oblong to linear-lanceolate 55. *tenuisecta*
 - 2b. Leaves 1-pinnatisect or pinnatifid; segments ovate to oblong, crenate to pinnatifid.
 - 3a. Laminas 18–24 mm long, 10–15 mm wide; beak of galea perpendicular to tube
 - 4a. Corolla 2.5–3 cm long; beak of galea 2–3 mm; lower lip sparsely ciliate 56. *labordei*
 - 4b. Corolla 1.8–2.5 cm long; beak of galea 1–1.5 mm; lower lip glabrous 57. *henryi*
 - 3b. Laminas 8–11 mm long, 4–7 mm wide; beak of galea crescent 58. *flagellaris*
- 1b. Pedicel relatively long (5–20 mm); beak of galea slender and longer, often more than 5 mm long.
 - 5a. Corolla tube 15–17 mm long.
 - 6a. Galea not marginally toothed; calyx more than 1/2 cleft anteriorly; filaments all glabrous 59. *limprichtiana*
 - 6b. Galea marginally 2-toothed; calyx shallowly cleft anteriorly; filaments all pubescent 60. *kariensis*
 - 5b. Corolla tube less than 10 mm long.
 - 7a. Beak of galea bent upward; middle lobe of corolla lip rounded, apex not emarginate 61. *pinetorum*
 - 7b. Beak of galea straight or bent downward; middle lobe of corolla lip often ovate, apex emarginate.
 - 8a. Herbs 15–40 cm tall; leaves segments 7–11 pairs 62. *gruina*
 - 8b. Herbs 6–10 cm tall; leaves segments 4–5 pairs 63. *stadlmanniana*

55. *Pedicularis tenuisecta* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 558. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 130. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 133. 1998. Type: China, Yunnan, “monte Pee-ugay-tze supra Tapintze in sylvis (Delavay! In Mus. Paris)”, 4 Sept. 1882, *J. M. Delavay* 329 [holotype: P(P01029597); isotypes: K(K000708834), E(E00438441), NY(00090953)].

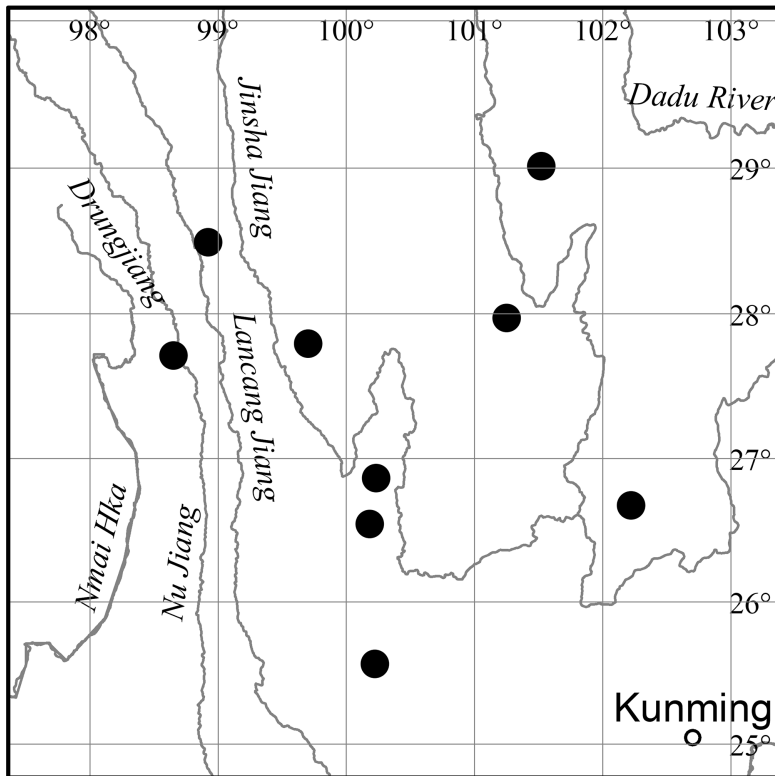
Herbs perennial, 30–60 cm tall, black when dry. Rhizome 8–15 cm long, 5 mm in diameter, branched. Stems 1 to several, erect, rigid, leafy, sometimes many-branched, densely pubescent. Leaves sessile; leaf blade ovate-elliptic to lanceolate-oblong, 1–3 cm long, 3–15 mm wide, pubescent on both surfaces, 1- or 2-pinnatisect; segments 7–10 pairs, lanceolate-oblong to linear-lanceolate, pinnatipartite. Inflorescences

racemose, 5–20 cm long, many-flowered; bracts leaflike, longer than calyx, shorter than flowers; pedicels barely 1 mm long. Calyx ovoid, 6–9 mm long, deeply cleft anteriorly, sparsely pubescent; lobes 5, serrate. Corolla purple-red, 15–24 mm long; tube slightly bent at base, ca. 2 times as long as calyx tube, expanded apically; galea curved at middle, apex obtuse or truncate; beak obscure; lower lip shorter than galea, 9–11 mm long, 14 mm wide, ciliate. Filaments sparsely villous. Capsule obliquely lanceolate-ovoid, 10–12 mm long, 4–6 mm wide.

Phenology: flowering and fruiting from July to September.

Habitats: alpine meadows, grassy slopes, among limestone rocks; 2400–3400 m.

Distribution: S Hengduan [Map 45(2)–55]; also in other regions of Yunnan and Sichuan Provinces, China [Map 45(2)–51].



Map 45(2)–55: *Pedicularis tenuisecta* Franch. ex Maxim.

Notes: Maximowicz cited one collection “China, Yunnan, monte Pée-ngay-tze supra Tapintze in sylvis (*Delavay!* In Mus. Paris.)” in the protologue of *P. tenuisecta* Franch. ex Maxim., but he did not provide a record number. We examined specimens of main herbaria and find that *Delavay 329* matches the information in the protologue. One sheet of *Delavay 329* in the herbarium P should be holotype and sheets in other herbaria exchanged from the herbarium P should be isotypes. A type illustration in the herbarium LE was also examined. Our phylogenetic results reveal four accessions of *P. tenuisecta* Franch. ex Maxim. form a well-supported clade sister to *P. labordei* Vaniot ex Bonati, indicating a close relationship between these two taxa.

S HENGDUAN: Dali, July 1941, *H. C. Wang 1128* (PE); Dali, 2000 m, 6 Sept. 1942, *H. C. Wang 2866* (IBSC). **Dêqên**, 2500 m, Sept. 1935, *C. W. Wang 69379* (PE, WUK). **Gongshan**, 3000 m, Sept. 1935, *C. W. Wang 66667* (PE). **Heqing**, 14 Aug. 1929, *R. C. Ching 23663* (PE). **Huili**, 2900 m, 17 Sept. 1932, *T. T. Yü 1542* (IBSC, PE). **Jiulong**, Naiqu, 2350 m, 1 Aug. 1979, *Q. Q. Wang 21552* (CDBI). **Muli**, 3200 m, 12 Sept. 1983, *Qinghai-Xizang Exped. 13962* (PE). **Shangri-la** (Zhongdian), 2500 m, 16 Nov. 1939, *K. M. Feng 3376* (PE, KUN); Shangri-la (Zhongdian), near the city, 3300 m, 23 Aug. 2001, *F. S. Yang Y0207* (PE); Shangri-la (Zhongdian), Nirucun to Shuduhu, 2945 m, 16 Aug. 2011, *J. Cai et al. 11CS3207* (KUN). **Yulong** (Lijiang), 3000 m, 15 Sept. 1937, *T. T. Yü 15588* (PE); Yulong (Lijiang), Yulongxue Shan, 2900 m, 17 Aug. 1959, *No. 22637* (HNWP, no collector information); Yulong (Lijiang), Yulongxue Shan, 2900 m, 6 Sept. 1955, *K. M. Feng 21424* (PE); Yulong (Lijiang), E Yulongxue Shan, 2900 m, 5 Aug. 1981, *PE Hengduan Shan Exped. 02682* (PE); Yulong (Lijiang), Ganhaizi, 3400 m, 5 Aug. 1939, *R. C. Ching 21120* (PE); Yulong (Lijiang), Liming to Qiangui Shan, 2208 m, 18 Sept. 2015, *Y. W. Dong et al. 15PX310* (KUN).

56. *Pedicularis labordei* Vaniot ex Bonati, Bull. Acad. Int. Géogr. Bot. 13: 242. 1904; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 132. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 134. 1998. Type: China, Guizhou, “Mont de

Kao-Po (Tsin-Gay). Bords des ruisseaux, endroits marecageux”, 10 Sept. 1899, *E. M. Bodinier & J. P. Laborde 2724* [holotype: E(E00265813)].

Pedicularis stapfii Bonati, Arch. Bot. Caen Bull. 1: 3. 1927. Type: China, Yunnan, Huize, “Tong-Tchouan, Dans, les flaques, d’eau, derrière, la ville, alt. 2700 m; fleurs complètement roses (E. E. Maire)”. They have not been seen.

Herbs perennial, 10–30 cm tall. Rhizome 7–12 cm long, branched. Stems procumbent to ascending, numerous, many-branched, pubescent. Leaves alternate, sometimes pseudo-opposite; petiole 5–10 mm long, densely white-pubescent; leaf blade oblong, 2–4.5 cm long, pubescent on both surfaces, pinnatifid or sometimes 1-pinnatisect; segments 5–8 pairs, ovate-lanceolate to triangular-ovate, pinnatifid or incised double-dentate. Inflorescences subcapitate, 2.5–3 cm long; bracts leaflike, shorter than flowers; pedicels 5–6 mm long, slender, long-pubescent. Calyx 10–12 mm long, 1/2 cleft anteriorly, densely villous along veins; lobes 5, unequal to more or less equal, flabellate, serrate. Corolla purple-red, 25–30 mm long; tube straight or slightly curved at middle, 12–15 mm long, expanded apically; galea nearly rectangularly bent apically, front elevated; beak 2–3 mm long; lower lip 10–12 mm long, 12–14 mm wide, sparsely ciliate. Filaments all long pubescent. Capsule obliquely narrowly ovoid, 10–12 mm long, 4–5 mm wide, slightly exceeding calyx, apiculate. Figure 45(2)–27.

Phenology: flowering and fruiting from July to September.

Habitats: alpine meadows; 2800–3500 m.

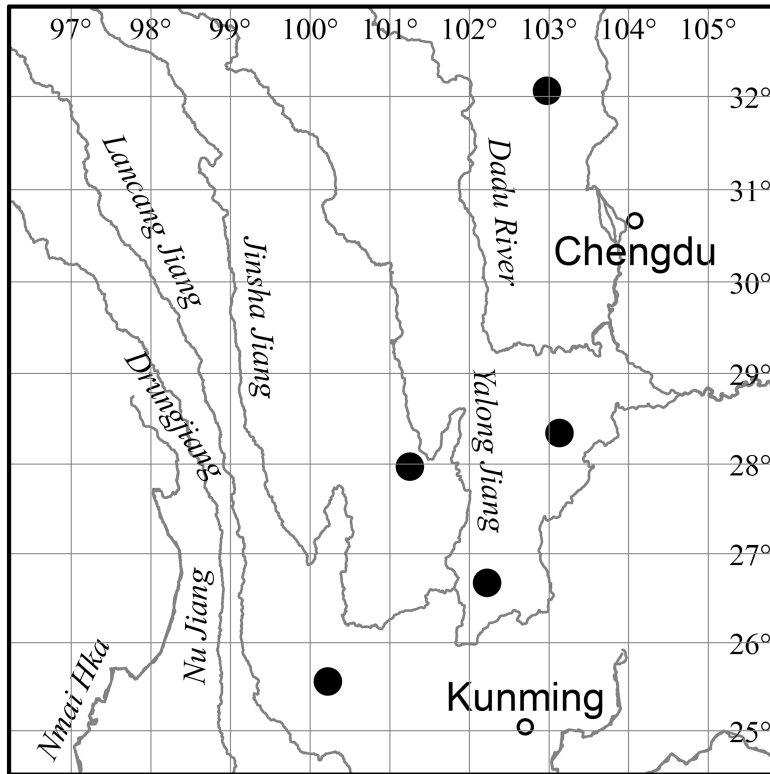
Distribution: N Hengduan, S Hengduan [Map 45(2)–56]; also in NW Guizhou and E Yunnan, China.

Notes: Our molecular phylogenetic results show that five accessions of *P. labordei* Vaniot ex Bonati form a monophyletic clade sister to *P. tenuisecta* Franch. ex Maxim.

N HENGDUAN: Heishui, Maqiao Shan, 3200 m, 12 Aug. 1957, *X. Li 73950* (IBSC). **S HENGDUAN:** Dali, 15 July 1944, *H. C. Wang 4449* (PE). **Huili**, 3000 m, 15 Sept. 1932, *T. T. Yü 1493* (PE). **Meigu**, 18 Aug. 1959,



Figure 45(2)–27: *Pedicularis labordei* Vaniot ex Bonati. a, habit; b, calyx; c, flower; d, corolla lip; e, beak. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 132, figure 26: 1-5. 1963].



Map 45(2)-56: *Pedicularis labordei* Vaniot ex Bonati

Chuanjingliang (59) 1691 (PE). **Muli**, Buchang, 3200 m, 12 Sept. 1983, *Qinghai-Xizang Exped.* 13962 (KUN).

57. *Pedicularis henryi* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 560. 1888; Li, Proc. Acad. Nat. Sci. Philad. 101: 27. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 131. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 134. 1998. Type: China, Hubei, Yichang, collected between 1885–1888, *A. Henry* 4687 [**lectotype designated here**: LE; isoclectotypes: E(E00438435), PE(00031366)].

Pedicularis bodinieri Vaniot ex Bonati, Bull. Intern. Acad. Géogr. Bot. 13: 243. 1904; Limpricht, Repert. Sp. Nov. 20: 240. 1924. Type: China, Guizhou, precise location unknown, 26 May 1898, *Bodinier* 2285 [**lectotype designated here**: E(E00265809)].

Herbs perennial, 10–35 cm tall, black when dry. Stems ascending, often several, more or less diffuse, leafy, densely rust-colored pubescent. Leaf petiole 0.5–1.5 cm long, slender, pubescent; leaf blade oblong-lanceolate to linear-oblong, 1.5–3.5 cm long, 5–8 mm wide, papery, pubescent on both surfaces, pinnatisect; segments 5–12 pairs, oblong to ovate, dentate; teeth white and callose. Inflorescences racemose, 5–20 cm long, often interrupted at base. Pedicel 3–5 mm long, slender, densely pubescent. Calyx to 6–8 mm long, 1/2–2/3 cleft anteriorly; lobes (3 or)5, unequal, pubescent, serrate. Corolla purplish red, 18–25 mm long; tube straight, 9–13 mm long; galea curved apically; beak 1–2 mm long, apex shallowly 2-cleft; lower lip as long as, or slightly longer, than galea, glabrous. Filaments densely villous. Capsule obliquely lanceolate-ovoid, ca. 16 mm long, 4.5 mm wide, short-apiculate. Figure 45(2)–28.

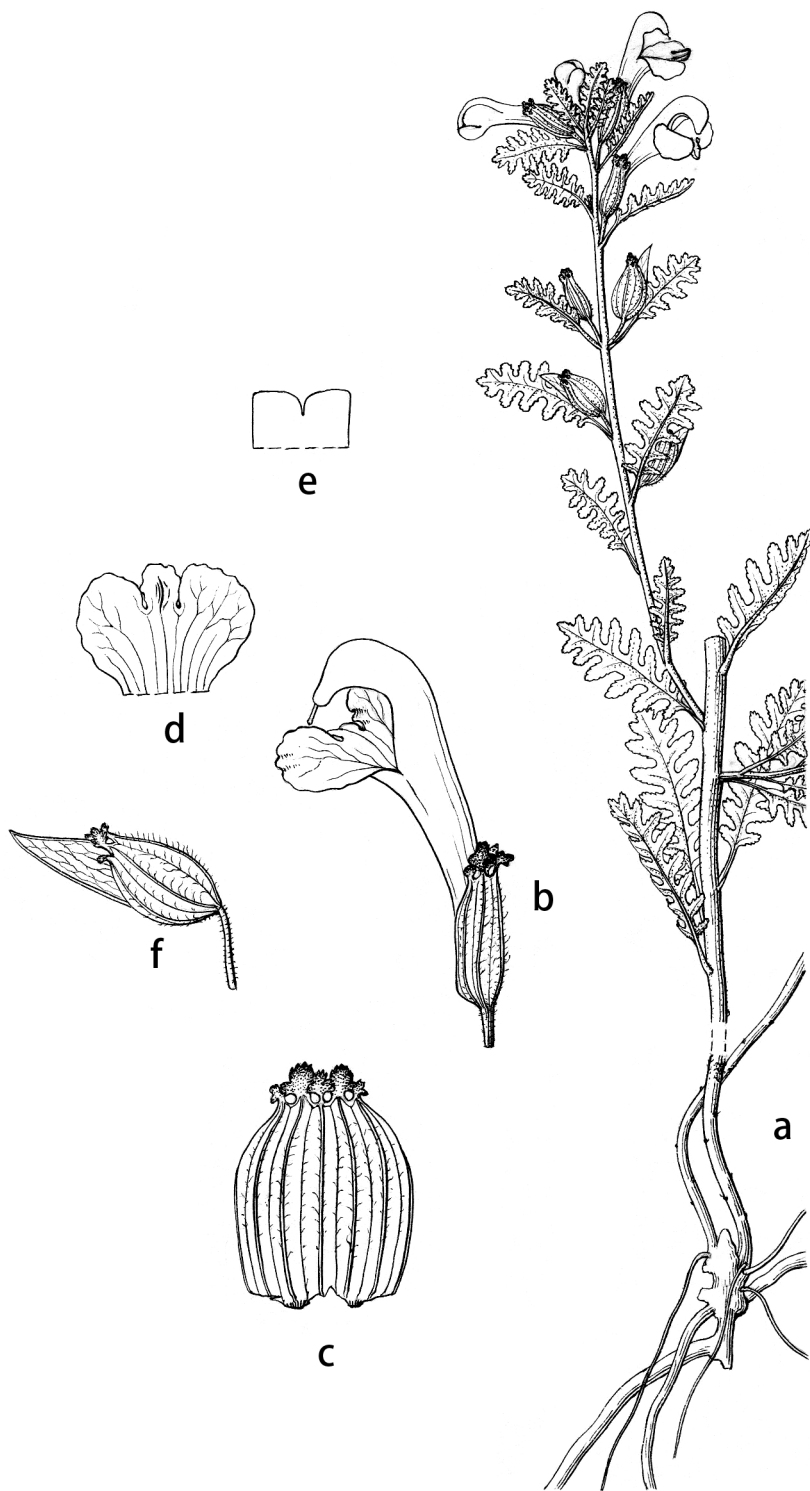


Figure 45(2)-28: *Pedicularis henryi* Maxim. a, habit; b, flower; c, calyx; d, corolla lip; e, beak; f, capsule. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 131, figure 26: 6-11. 1963].

Phenology: flowering from July to October, and fruiting from August to November.

Habitats: Open mountain slopes, meadows, open forests; 400–2500 m.

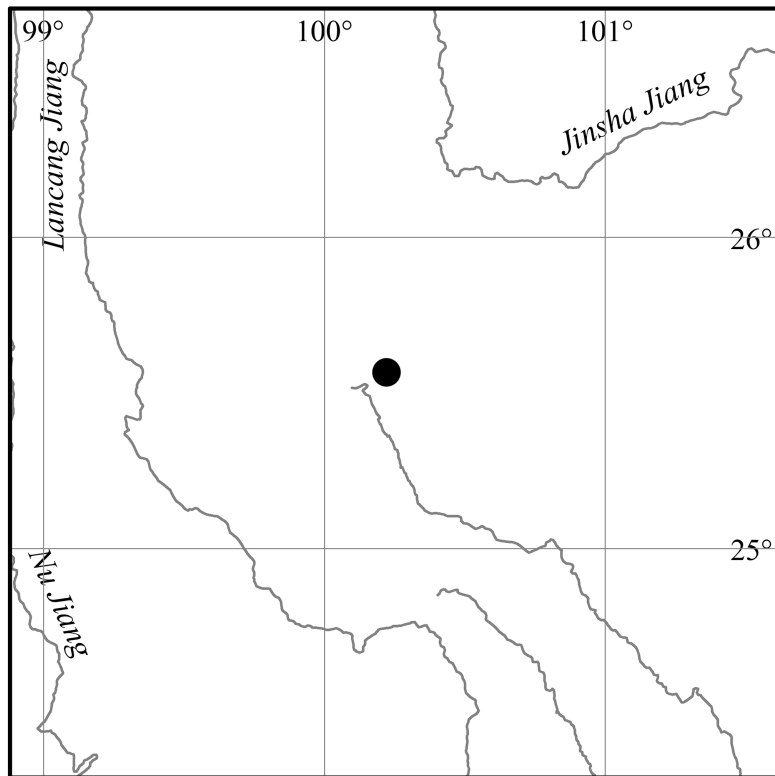
Distribution: S Hengduan [Map 45(2)–57]; also in N Guangdong, NW Guangxi, W Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Yunnan, Zhejiang Provinces of China, Laos, and Vietnam.

Notes: Maximowicz described *P. henryi* Maxim. as new and provided brief information “Nant’o et montes boream versus (Dr. Henry! 1887)”. We find that four Henry’s collections (*Henry 2216, 4687, 6155, 6304*) match Maximowicz’s record. The three collections *Henry 2216, 4687, and 6155* were mounted on one sheet (LE), which was noted as type. Hence, we designate *Henry 4687* on this sheet as lectotype. *Henry 6304* has been deposited in the herbarium US.

When Bonati described *P. bodinieri* Vaniot ex Bonati as new, he did not list any specimens but Limpricht (1924. *Repert. Sp. Nov.* 20: 240) listed three collections (*Bodinier 2285, 1601, and Cavalerie 808*) collected from Guizhou and Yunnan Provinces, China. Bonati (1926. *Notes Bot. Gard. Edinb.* 15: 161) treated it as a synonym of *P. henryi* Maxim. One sheet of *Bodinier 2285* is designated here as lectotype, and sheets of *Bodinier 1601* (E) and *Cavalerie 808* (E, P) were also examined.

S HENGDUAN: Dali, E Cang Shan, 2500 m, 17 Aug. 1933, *Y. Tsiang 1425* (IBSC). **Shimian**, precise location unknown, 1955, *C. C. Hsieh 41868* (IBSC, PE).

58. *Pedicularis flagellaris* Benth., in A. P. de Candolle, *Prodr.* 10: 581. 1846; J. D. Hooker, *Fl. Brit. India* 4: 315. 1884. Type: India, Sikkim, Assam, Upper Assam, precise location unknown, *Griffith s.n.* [lectotype designated by Garg &



Map 45(2)–57: *Pedicularis henryi* Maxim.

Singh (2020: 81): K(K000708941); isolectotypes: K(K000708939), P(P02985336)].

Prostrate, ascending herbs, 20–45 cm tall. Stems simple or sparingly branched, naked below, softly hairy, slender, diffused, flexuous. Basal leaves absent; cauline leaves 10 mm long, 5 mm wide, alternate, shortly petioled; leaf blade ovate or oblong-ovate, pinnatisect; segments crenate or toothed; pinnae 3–6 pairs, slightly decurved. Inflorescences racemose, or few-flowered axillary and sub-racemose; flowers pedicellate, bracteate; pedicels 3–5 mm long; bracts pinnatifid, longer than calyx. Calyx 5–6.5 mm long, narrowly oblong, lobes crested. Corolla pink; tube 11–13 mm long, 2–3 times as long as calyx, rather broad or slender; galea beaked, gradually narrowed to base and to an acute apex, inflated, arcuate-incurved, forming a semi-circular; beak short, stout, inflated, 1–2 mm long,

apex deeply notched; lower lip 10–12 mm wide, broadly lobed. Stamens inserted at lower half opposite to top of ovary; filaments all hairy. Ovary lanceolate, acuminate.

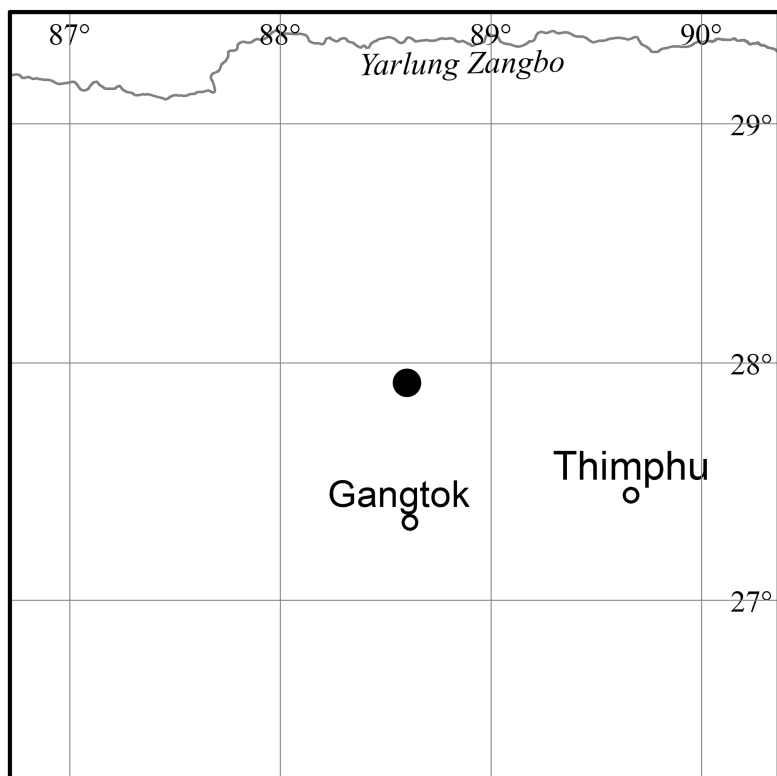
Phenology: flowering and fruiting from Autumn to September.

Habitats: alpine meadow; 3300–3800 m.

Distribution: Sikkim & Darjeeling [Map 45(2)–58]; also in E Bangladesh.

Notes: Bentham cited type information “in Assam superiore (Griffith !), ... (v. in herb. Hook.)” in the protologue of *P. flagellaris* Benth. Based on this information, Garg & Singh designated a specimen in the herbarium K as lectotype.

Sikkim: Upper Sikkim, precise location unknown, 3050 m, Dec. 1890, *C. B. Clark* (K).



Map 45(2)–58: *Pedicularis flagellaris* Benth.

59. *Pedicularis limprichtiana* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 62: 239. 1925; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 138. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 135. 1998. Type: China, Sichuan, Huili, "In montis Lungdschuschan prope urbem Huili regione temperata in cespite lapidoso et ad bambuseta", 3100–3400 m, 16 Sept. 1914, *H. R. E. von Handel-Mazzetti, Iter sinense (1914–1918) 5175* [holotype: WU(0060223)].

Herbs perennial, 8–20 cm tall. Rootstocks branched, fleshy, and more or less fusiform. Stems 1 to several, central stem erect, outer stems usually procumbent to ascending, longer, often long branched, white-pubescent. Leaves alternate or sometimes proximal ones opposite; petiole 3–8 mm long, pubescent; leaf blade oblong, 1.5–5 cm long, 4–8 mm wide, adaxially sparsely pubescent, abaxially densely pubescent along veins, pinnatipartite;

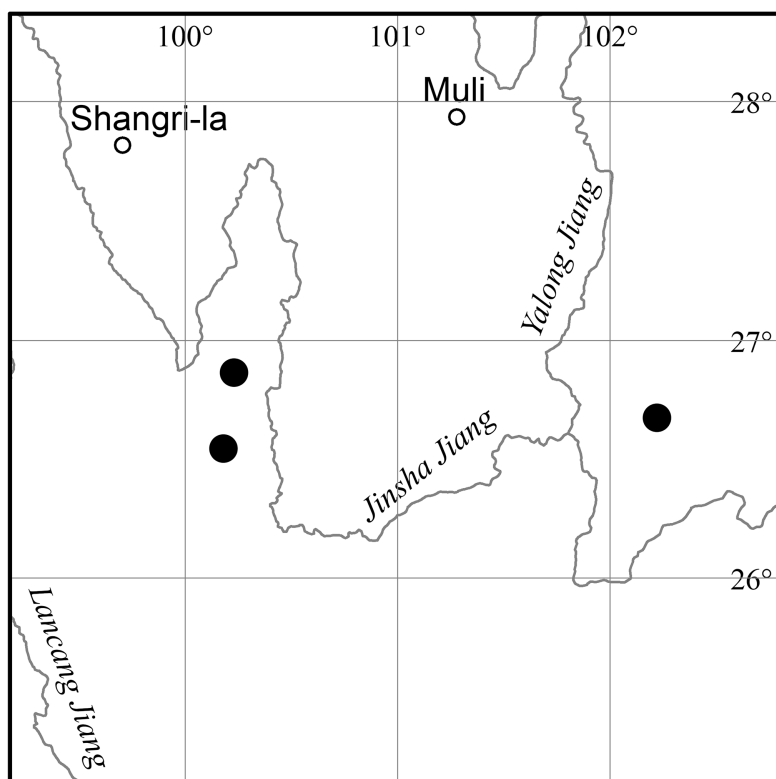
segments 8–12 pairs, oblong, incised-dentate. Inflorescences subcapitate, remotely axillary; bracts leaflike; pedicels 6–8 mm long, slender. Calyx tube 7–8 mm, more than 1/2 cleft anteriorly; lobes 3 or 5, leaflike. Corolla rose, glabrous; tube 12–16 mm long, expanded apically; galea 4–5 mm long, curved at 40–90°; beak bent downward, filiform, 3–5 mm long; lower lip 7–8 mm long, 12–15 mm wide, sparsely ciliate, middle lobe apex emarginate. Filaments all glabrous. Capsule narrowly ovoid, ca. as long as calyx, apex acuminate.

Phenology: flowering and fruiting from August to September.

Habitats: stony meadows, margins of bamboo groves; 2100–3400 m.

Distribution: S Hengduan [Map 45(2)–59]; also in other regions of Yunnan Province, China.

S HENGDUAN: **Heqing**, Maer Shan, 2546 m, 5 Oct. 2010, *H. Sun et al. 3157* (PE). **Yulong** (Lijiang), 2100 m, 7 Aug. 1916,



Map 45(2)–59: *Pedicularis limprichtiana* Hand.-Mazz.

O. Schoch 277 (WU). **Huili**, 3100–3400 m, 16 Sept. 1914, *H. R. E. von Handel-Mazzetti Iter sinense (1914–1918) 5175* (WU).

60. *Pedicularis kariensis* Bonati, *Notes Roy. Bot. Gard. Edinb.* 13: 120. 1921; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 138. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 135. 1998. Type: China, NW Yunnan, “Open, moist stony pasture on the Kari Pass, Mekong-Salween Divide”, 3960 m, Aug. 1914, *G. Forrest 13070* [holotype: E(E00346320); isotype: PH(00019492)].

Herbs perennial, 7–10 cm tall. Roots clavate, very elongated, and more or less fusiform. Stems flexuous, stout, angled, woolly, branched. Basal leaves withering early; cauline leaves few, alternate; petiole very short, ca. 1 mm, villous; leaf blade ovate-oblong, 2.5–3 cm long, 1–1.5 cm wide, 2-pinnatipartite; segments 3 or 4 pairs,

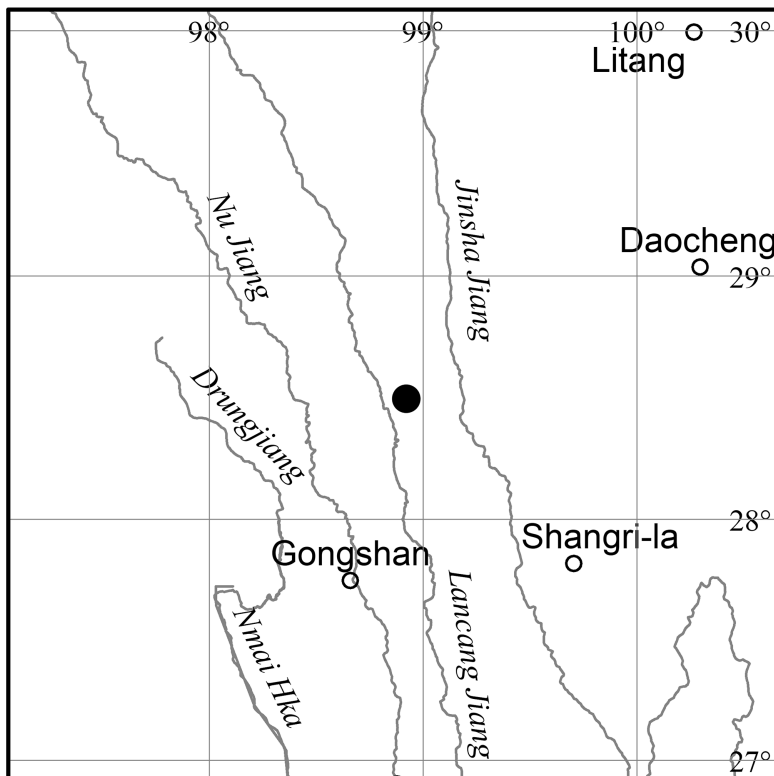
alternate, incised-dentate. Inflorescences capitate, axillary; pedicels 1–2 mm long. Calyx cylindric, shallowly cleft anteriorly, membranous; lobes 5, 3–4 mm long, unequal in size, posterior one sub-linear and entire, lateral lobes flabellate, deeply serrate. Corolla deep-rose, 22–26 mm long; tube curved, 15–17 mm long, expanded apically, externally glabrous; galea falcate, marginally 1-toothed on each side, glabrous abaxially; beak straight, 5–7 mm long; lower lip 20–22 mm long, 20–25 mm wide, ciliate. Filaments all long-pubescent.

Phenology: flowering and fruiting from August.

Habitats: open moist stony pastures; 3900–4100 m.

Distribution: endemic; S Hengduan [Map 45(2)–60].

S HENGDUAN: **Dêqên** (Mekong-Salween Divide), 3960 m, Aug. 1914, *G. Forrest 13070* (PE).



Map 45(2)–60: *Pedicularis kariensis* Bonati

61. *Pedicularis pinetorum* Hand.-Mazz., Symb. Sin. 7: 861. 1936; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 133. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 134. 1998. Type: China, Yunnan, Shangri-la, "Prov. Yunnan borocid.: Inter pagos Yungning et Dschungdien (Chungtien), in regionis calide temperatae pinetis supra vic. Tschwadse", 2500–2800 m, 12 Aug. 1915, *H. R. E. von Handel-Mazzetti 7624* [holotype: WU(0060218); isotype: (W-1934-0005451)].

Herbs perennial, 21–35 cm tall. Roots fascicled, fleshy, more or less fusiform. Stems single, long white-pubescent. Leaves alternate, more or less forming a basal rosette; petiole 0.5–1.3 cm long, distal ones more or less sessile; leaf blade elliptic or oblong, 2–5.5 cm long, 5–14 mm wide, sparsely long-pubescent on both surfaces, pinatifid; segments 6–11 pairs, callose-serrate. Inflorescences racemose, 8–18 cm long, interrupted at base; bracts leaflike, more than 1 cm apically; pedicels barely 5 mm long, slender. Calyx campanulate, 8–11 mm long; lobes 5, unequal in size, serrate. Corolla red, 16–18 mm long; tube ca. as long as calyx, glabrous; galea slightly falcate, glandular; beak bent slight upward, 4–5 mm long, marginally 2-toothed; lower lip 10–12 mm long, 20 mm wide, middle lobe rounded, apex not emarginate. Filaments sparsely pubescent apically.

Phenology: flowering in August.

Habitats: *Pinus* forests; 2500–2800 m.

Distribution: endemic; S Hengduan [Map 45(2)–61].

S HENGDUAN: Shangri-la (Zhongdian), 2500–2800 m, 12 Aug. 1915, *H. R. E. von Handel-Mazzetti 7624* (E).

62. *Pedicularis gruina* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 536. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 134. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 134. 1998. ≡ *Pedicularis gruina* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 34. 1949. Type: China, Yunnan, Lijiang, Sept. 1884, *J. M. Delavay 957* [**lectotype designated here:** P(P02976658)].

Pedicularis gruina subsp. *pilosa* (Bonati) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 136. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 135. 1998. **syn nov.** ≡ *Pedicularis polyphylla* Franch. ex Maxim. var. *pilosa* Bonati, Notes Roy. Bot. Gard. Edinb. 5: 80. 1911. Type: China, Yunnan, Lijiang, "Open, grassy situations amongst scrub on the eastern flank of the Likiang range", 3050–3350 m, July 1906, *G. Forrest 2640* (isotype: UC).

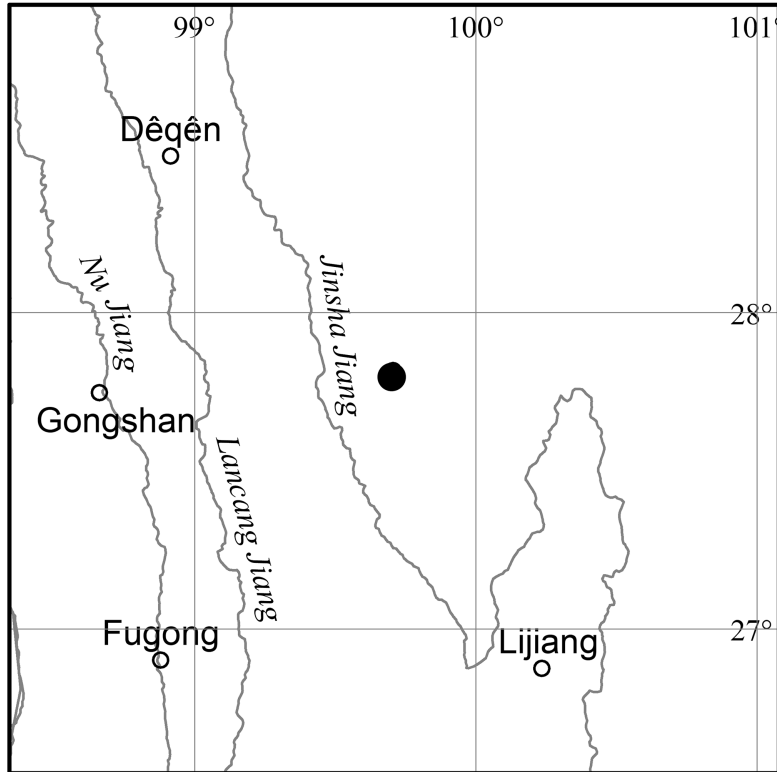
Pedicularis gruina subsp. *polyphylla* (Franch. ex Maxim.) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 136. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 135. 1998. **syn nov.** ≡ *Pedicularis polyphylla* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 543. 1888. Type: China, Yunnan, Heqing/Jianchuan, "Yunnan, prope Langkong monte Heechanmen, 3200 m, 1883–1885, Sept. 1884, *J. M. Delavay 206* [**lectotype designated here:** P(P02976728)].

Pedicularis margaritae Bonati, Notes Roy. Bot. Gard. Edinb. 5: 81. 1911. Type: China, Yunnan, Dali, open grassy situations amongst scrub on the eastern flank of the Tali range, 2740–3050 m, June–July 1906, *G. Forrest 4504* [holotype: E(E00346321)].

Pedicularis gruina var. *cinerascens* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 35. 1949. Type: China, Yunnan, Zhiziluo above Tapintze, *J. M. Delavay 336* [holotype: PH(00019479)].

Pedicularis polyphyloides Bonati, Notes Roy. Bot. Gard. Edinb. 8: 38. 1913. Type: China, Yunnan, Lijiang, "Dry open situations in pine forests on the eastern flank of Lichiang range", 3050 m, Aug. 1910, *G. Forrest 6321* [**lectotype designated here:** E(E00399301); isolectotypes: PH(00020150), K(K000708824)].

Herbs perennial, 15–40 cm tall, black when dry, sparsely to densely pubescent. Stems often several, usually many-branched; branches erect or procumbent at base, sparsely pubescent. Leaves alternate; petiole short; leaf blade more or less ovate-oblong, 1–2 cm (sometimes up to



Map 45(2)-61: *Pedicularis pinetorum* Hand.-Mazz.

10 cm) long, 6–8 mm wide (sometimes up to 3.5 cm), pubescent on both surfaces, pinnatipartite to pinnatifid; segments 5–11 pairs, oblong, incised double-dentate; teeth callose. Inflorescences short-racemose or subcapitate to long racemose, usually 3–10 cm long, sometimes up to 25 cm long; pedicels 0.5–3 cm long, slender, pubescent. Calyx 7–10 mm long, 1/3–1/2 cleft anteriorly; lobes 5, unequal in size, densely rust-colored pubescent, serrate. Corolla red to purplish-red, 15–20 mm long; tube erect, 7–10 mm long; galea bent at a right angle apically, dentate or protuberant on each side of margin; beak filiform, 4–5 mm long; lower lip longer than galea, 10–12 mm long, 14–16 mm wide, middle lobe smaller than lateral lobes, apex emarginate. Filaments all densely villous. Capsule ovoid, 10–12 mm long, 5–6 mm wide, apex acute. Figure 45(2)-29. **Chromosomes:** $n = 8$.

Phenology: flowering and fruiting from July to October.

Habitats: alpine meadows, mixed forests, damp soil by gully margins, mountain sides; 2600–3000 m.

Distribution: S Hengduan [Map 45(2)-62]; also in other regions of Yunnan, China.

Notes: *Pedicularis gruina* Franch. ex Maxim. varies in plant size, shape and size of leaves, and length of pedicel. Several varieties of this species were described, including *P. gruina* var. *laxiflora* Franch., *P. gruina* var. *polyphylla* (Franch. ex Maxim.) H. L. Li, and *P. gruina* var. *cinerascens* Franch. ex H. L. Li. Five accessions of this species and one undetermined individual form a well-supported clade in the phylogenetic tree.

Maximowicz in the protologue of *P. gruina* recorded “prope Li-kiang in paludibus, necnon quercetis cacumine montis Che-tcho-tze supra Ta-pin-tze, posterior forma cinerascens oliis pinnatipartitis (*Delavay!* In herb. Paris)”, but did not provide any record number. Several collections

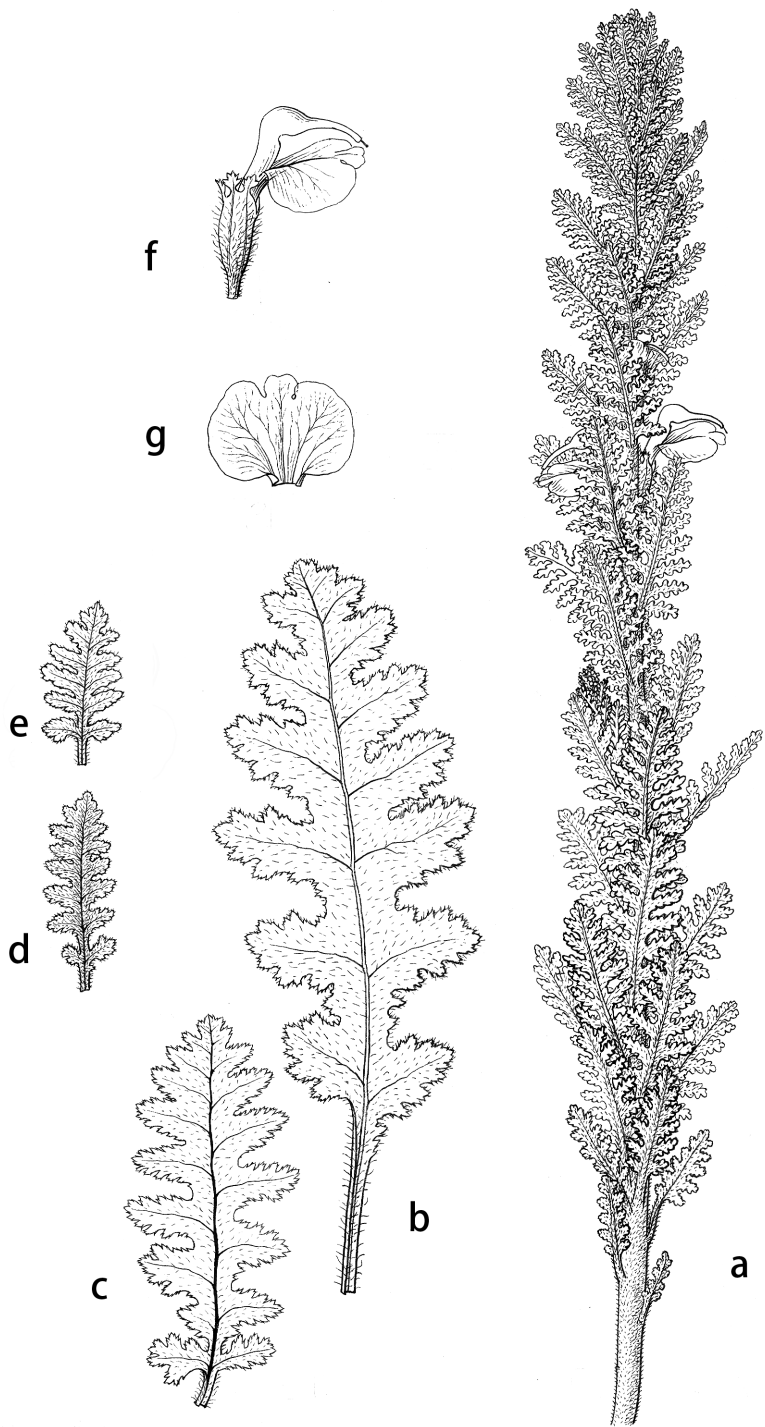
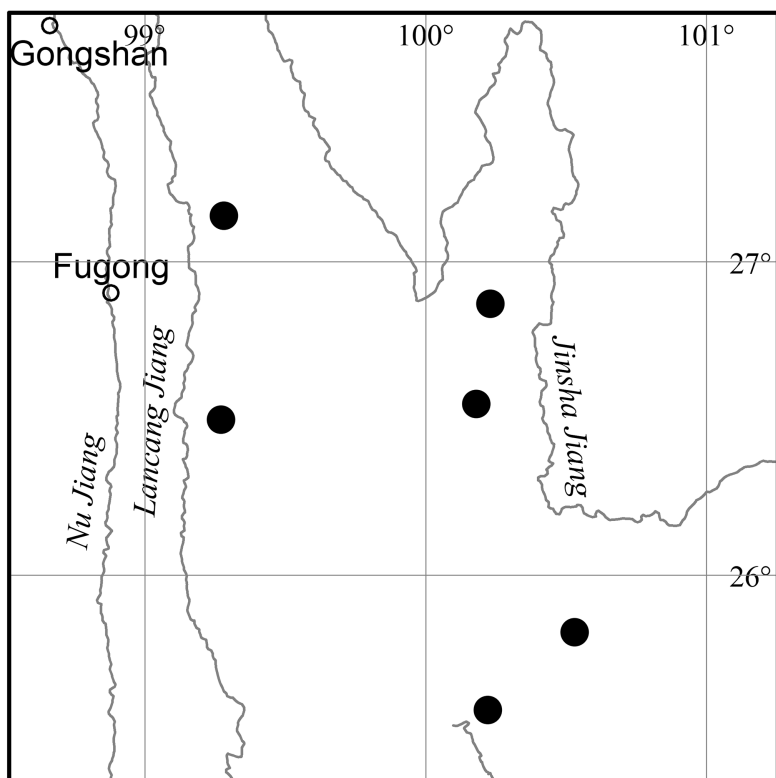


Figure 45(2)–29: *Pedicularis guina* Franch. ex Maxim. a, habit; b–e, leaf; f, flower; g, corolla lip. Drawn by J.-Y. FENG for *P. guina* and its subspecies [*Fl. Reipubl. Popularis Sin.* 68: 134, figure 27. 1963].



Map 45(2)-62: *Pedicularis gruina* Franch. ex Maxim.

of *Delavay* (196, 206, 336, 943, 957, 3067, 3125) collected in the year 1882–1885 were examined, which have been deposited in P and identified as *P. gruina* and its varieties. One sheet of *Delavay* 957 is designated as lectotype. When Maximowicz described *P. polyphylla* as new, he did not cite the record number but provided information “China, Yunnan, prope Lankong monte Hee-chan-men, 3000 m (*Delavay!* In herb. Paris)”. Hence, we designate one sheet deposited in P (P02976728) as lectotype.

S HENGDUAN: Binchuan, 2800 m, 19 July 1933, *H. T. Tsai* 52994 (PE). **Dali**, Lat. 25°40', 2740–3050 m, June–July 1906, *G. Forrest* 4504 (E); Dali, 2600 m, 4 Sept. 1981, *H. C. Wang* 4522 (IBSC); Dali, 2700 m, 25 Apr. 1945, *H. C. Wang* 4473 (IBSC); Dali, Fengyixiaoshao, 2650 m, 27 Sept. 1946, *S. Liu* 20899 (PE); Dali, Cangshan, 2600 m, 5 Oct. 1946, *S. Liu* 21175 (PE); Dali, Cangshan, 2700 m, 4 Oct. 1946, *S. Liu* 21089 (PE). **Heqing**, 2400 m, 27 Aug. 1884, *J. M.*

Delavay 959 (K); Heqing, 2800 m, 14 Aug. 1929, *R. C. Ching* 23679 (K); Heqing, 3000 m, 24 Aug. 1929, *R. C. Ching* 24064 (K). **Lanping**, 2600 m, 25 Aug. 1933, *H. T. Tsai* 54056 (PE). **Weixi**, 2800 m, 21 Sept. 1933, *H. T. Tsai* 57986 (PE). **Yulong** (Lijiang), between Baishui and Heishui, roadside banks, 2900 m, 6 Oct. 1990, *Chungtian-Lijiang-Dali Exped.* 915 (K); Yulong (Lijiang), Aug. 1910, *G. Forrest* 6405a (E); Yulong (Lijiang), 2800 m, 15 July 1939, *R. C. Ching* 20984A (PE); Yulong (Lijiang), eastern slopes of Likiang snow range, 3833 m, May 1922, *J. F. Rock* 5737 (PE); Yulong (Lijiang), 2700 m, 25 Sept. 1940, *R. C. Ching* 31071 (PE); Yulong (Lijiang), Baishan, 2650 m, 25 Aug. 2001, *F. S. Yang* Y0208 (PE).

63. *Pedicularis stadlmanniana* Bonati, *Notes Roy. Bot. Gard. Edinb.* 5: 87. 1911; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 137. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 135. 1998.

Type: China, Yunnan, Dali, “Grassy openings in pine forests on the eastern flank of the Tali range”, 2438–3048 m, July 1906, *G. Forrest 4488* [holotype: E(E00346319)].

Herbs low, 6–10 cm tall. Roots fibrous. Stems prostrate, several, branched at base. Leaves alternate; petiole 1–1.5 cm long, densely reddish-ciliate; leaf blade broadly ovate, 1.5–2 cm long, 1.5–2 cm wide, pinnatifid; segments 4 or 7 pairs, anterior linear, posterior triangular, apex obtuse, incised-dentate. Flowers alternate; bracts leaflike; pedicels erect, 0.5–2 cm long. Calyx campanulate, 1/2 cleft anteriorly; tube membranous, white villous; lobes 5, unequal in size, leaflike. Corolla pale-rose, 16–18 mm long; tube 7–8 mm long, slightly exceeding calyx; galea curved apically, pubescent abaxially, marginally 2-toothed; beak filiform, 5–7 mm long; lower lip longer than galea, ciliate; middle lobe emarginate. Filaments all pubescent, anterior 2 more densely.

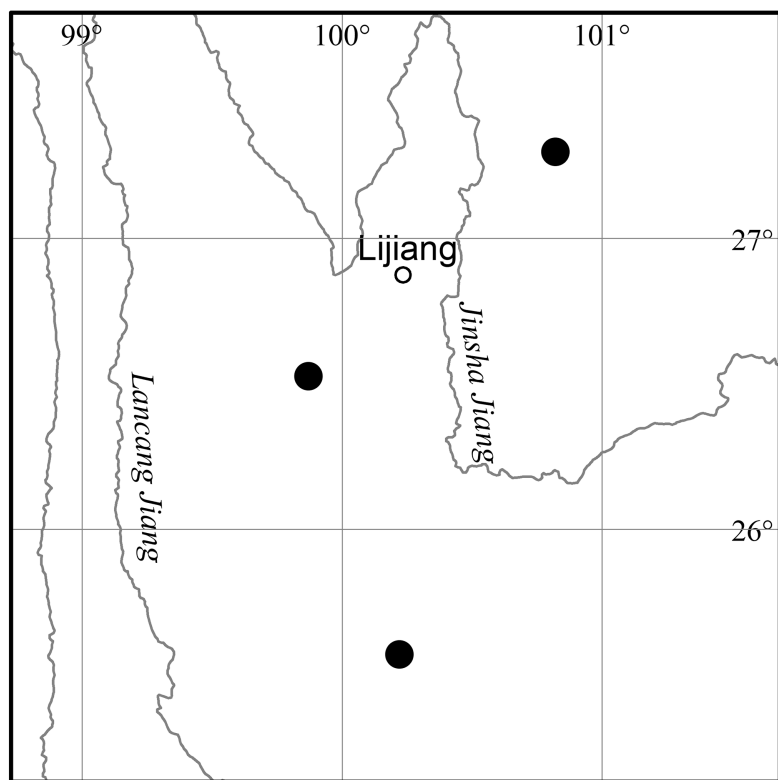
Phenology: flowering and fruiting from August to September.

Habitats: grassy openings in *Pinus* forests; 2400–3100 m.

Distribution: S Hengduan [Map 45(2)–63]; also in other regions of Yunnan, China.

Notes: When Bonati described *P. stadlmanniana* as new, he cited only one collection (*Forrest 4488*). A sheet of this collection in the herbarium E(E00346319) was designated as “type”, which should be the holotype of this species.

S HENGDUAN: Dali, Grassy openings in pine forests on the eastern flank of the Tali range, 2438–3048 m, July 1906, *G. Forrest 4488* (E). **Jianchuan**, Wenhua, 3300 m, 16 Sept. 2011, *Z. D. Fang & X. W. Shi 2011-254* (SABG). **Ninglang**, Hongqiao, 3485 m, 20 Sept. 2019, *X. X. Zhu et al. ZXX191376* (KUN).



Map 45(2)–63: *Pedicularis stadlmanniana* Bonati

Ser. 25. Furfuræ

Ser. Furfuræ Prain, Ann. Roy. Bot. Gard. Calc. 3: 75. 1890.

Stems branched at base or unbranched, not black when dry. Leaves mostly cauline, alternate, long-petiolate; leaf blade often ovate or elliptic, large, pinnatifid to pinnatisect; segments few. Inflorescences laxly racemose or axillary. Calyx deeply to shallowly cleft anteriorly, (2–)5-lobed. Corolla tube up to 2 times long as calyx; beak of galea slender.

Six species; all distributed in the Pan-Himalaya (5 endemics).

- 1a. Basal leaves ovate or triangular-ovate; lamina pinnatifid to pinnatipartite.
- 2a. Middle lobe of corolla lip emarginate apically; calyx deeply cleft anteriorly 64. *P. furfuracea*
- 2b. Middle lobe of corolla lip not emarginate apically; calyx slightly cleft anteriorly.
- 3a. Corolla pink or purple; galea arched over mid lobe of labium; anterior 2 filaments hairy, posterior 2 glabrous..... 65. *P. pantlingii*
- 3b. Corolla white with light pinkish tinged; galea deflexed opposite to mid lobe of labium; filaments all glabrous 66. *P. raghvendrae*
- 1b. Basal leaves oblong to lanceolate; lamina pinnatisect.
- 4a. Leaf segments 3–5 pairs; filaments sparsely pubescent..... 67. *P. taliensis*
- 4b. Leaf segments 5–10 pairs; at least two filaments glabrous.
- 5a. Calyx 1/2–1/3 cleft anteriorly; corolla lip ciliate; galea without auriculate protuberance on each side of margin; filaments all glabrous 68. *P. microcalyx*
- 5b. Calyx slightly cleft anteriorly; corolla lip not ciliate; galea with an auriculate protuberance on each side of margin; filaments 2 glabrous 69. *P. hemsleyana*

64. *Pedicularis furfuracea* Wall. ex Benth., Scroph. Ind. 54. 1835; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 143. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 137. 1998. Type: Nepal, Gossain Than, 2420–3650 m, *Wall. Cat. 412* [lectotype designated by Garg & Singh (2020: 82): K(K001109988); isolectotypes: BM(BM000885917), E(E00273659, E00273660), K(K000708929, K000708931)].

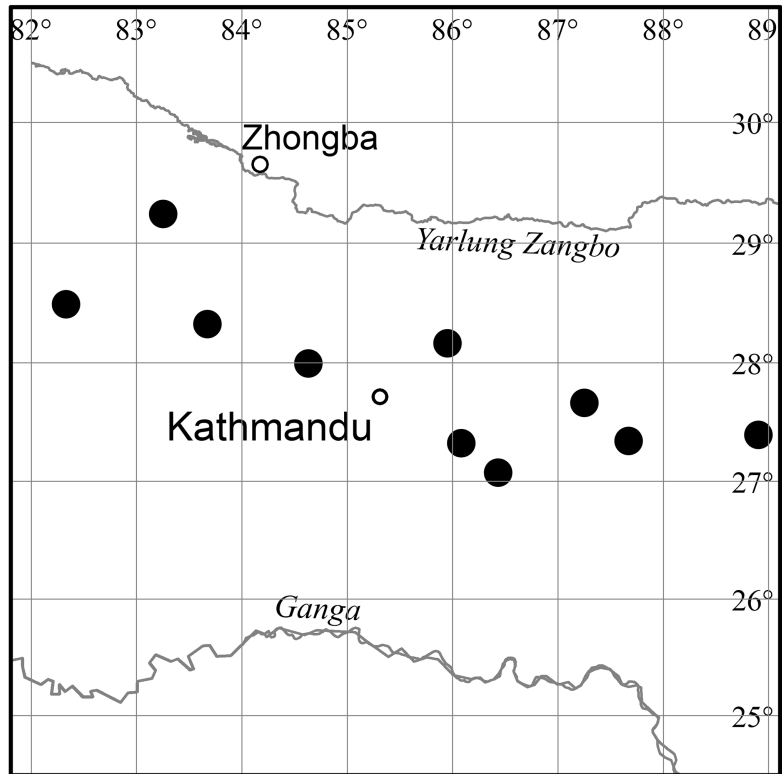
Herbs perennial, 6–45 cm tall. Rhizome short, covered by several ovate scales, membranous; roots cespitose, some branches fleshy, more or less fusiform. Stems branched at base; branches widely spaced, ascending, long, pubescent. Leaves alternate; petiole 1.5–4 cm long, slender, pubescent; leaf blade oblong-ovate to ovate, 2.5–6 cm long, 1.5–4 cm wide, adaxially sparsely pubescent or subglabrous, sometimes white-scurfy, abaxially sparsely pubescent and

densely white-scurfy, pinnatipartite; segments 4–6 pairs, ovate to lanceolate, dentate. Inflorescences laxly racemose; bracts leaflike, longer than flowers; pedicels 1–3 mm long, subglabrous. Calyx oblique-ovate, 6–7 mm long, membranous, 2/3 cleft anteriorly, densely white-pubescent; lobes 5, 0.3–1.5 mm long. Corolla purplish-red; tube 4–6 mm long, glabrous, expanded apically; galea bent at a right angle apically; beak 4–6 mm long; lower lip longer than galea, middle lobe oblong, apex emarginate. Filaments 2 sparsely pubescent, 2 glabrous. Capsule lanceolate, 10–15 mm long.

Phenology: flowering from June to July.

Habitats: damp stony ground, moist stream beds; 3500–4000 m.

Distribution: endemic; U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, M Yarlung Zangbo [Map 45(2)–64].



Map 45(2)-64: *Pedicularis furfuracea* Wall. ex Benth.

Notes: *Pedicularis furfuracea* Wall. ex Benth. and the next species *P. pantlingii* Prain are thought can be distinguished mainly by the shape of the middle lobe of lower lip. However, field investigation found that the shape of the middle lobe varies among and even within populations. Considering that these two “species” share the same geographical distribution and similar habitats, the variation of middle lobes of them may represent intra-specific morphological polymorphs, and these two “species” are here merged into one species. Our molecular phylogenetic results show that *P. furfuracea* and *P. pantlingii* are clustered into one clade.

U YARLUNG ZANGBO: Nyalam, 2900 m, 29 June 1975, *Qinghai-Xizang Exped.* 6635 (PE). **W NEPAL:** **Karnali,** Dolpa, Tarakot, 3180 m, 9 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams* 2412 (E). **Rapti,** Rukum, Ranmamikot,

3480 m, 1 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3333 (BM). **C NEPAL:** **Bagmati,** Rasuwa, Mailung Khola, 3750 m, 20 Aug. 1974, *J. H. de Haas* 2451 (BM). **Dhawalagiri,** Parbat, 2650–3170 m, 12 July 1983, *H. Ohba, H. Kanai, M. Wakabayashi et al.* 8330378 (E). **Gandaki,** Gorkha, Ganesh Himal, 2730 m, 9 July 1962, *J. D. A. Stainton* 3967 (BM). **Janakpur,** Ramechhap, 2700–3400 m, 6 July 1985, *H. Ohba, T. Kikuchi, M. Wakabayashi et al.* 8530126 (BM). **E NEPAL:** **Kosi,** Sankhuwasabha, 3410 m, 23 Aug. 1997, *S. Noshiro, N. Acharya, Y. Ibaragi et al.* 9760318 (E); Kosi, Sankhuwasabha, Arun Valley, 3030 m, 2 June 1956, *J. D. A. Stainton* 507 (BM). **Mechi,** Taplejung, Mane Bhanjyang, 3490–4080 m, 8 Aug. 1999, *Y. Omori, N. Acharya, K. Fujikawa et al.* 9950031 (E). **M YARLUNG ZANGBO:** **Yadong,** 3400 m, 12 June 1975, *Qinghai-Xizang Suppl. Exped.* 750292 (PE); Yadong, Zuomudabu Shan, 3400 m, 12 June 1975, *Qinghai-Xizang Suppl. Exped.* 750292 (HNWP).

65. *Pedicularis pantlingii* Prain, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 58(2): 273. 1889; Li, Proc. Acad. Nat. Sci. Philad. 101: 31; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 141. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 136. 1998. \equiv *Pedicularis pantlingii* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 31. 1949. Type: India, Sikkim, Lachen, 2740–3750 m, 13 June 1849, *Hook. fil. & Thomson 'Pedicularis No. 30'* [lectotype designated by Mill (2001: 92): K].

Pedicularis pantlingii subsp. *brachycarpa* P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 143. 1963. nom. inval. **syn nov.** Type: China, Yunnan, Dêqên, Cangjiang, Yongzi, 3600–3800 m, 14 Aug. 1940, *K. M. Feng 6634* [holotype: PE(00033063)].

Pedicularis pantlingii subsp. *chimiliensis* (Bonati) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 142. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 137. 1998. **syn nov.** \equiv *Pedicularis pantlingii* var. *chimiliensis* Bonati, Notes Bot. Gard. Edinb. 13. 125. 1921. Type: Myanmar, Chimili Woods, 3050 m, 31 July 1919, *R. Farrer 1143* [holotype: E(00273593)].

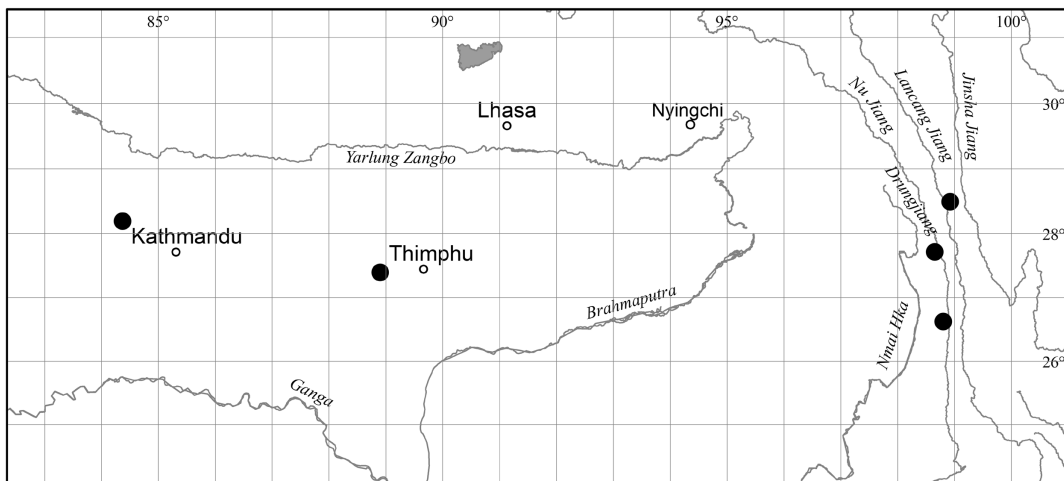
Herbs perennial, usually 30–60 cm tall. Rhizome short, densely pubescent; roots cespitose,

fleshy, and more or less fusiform. Stems often several, densely pubescent apically, branched apically or unbranched; branches slender, pubescent. Leaves alternate; petiole 1–6 cm long, pubescent; leaf blade ovate or triangular-ovate, sometimes orbicular, 2.5–5 cm long, 1.5–3 cm wide, adaxially sparsely pubescent, abaxially white-scurfy, pinnatifid to pinnatipartite; segments 3–5 pairs, ovate to triangular-ovate, dentate. Inflorescences racemose interrupted at base; bracts leaflike; pedicels 1.5–3 mm long, elongated in fruit. Calyx campanulate, 6–8 mm long, slightly cleft anteriorly, yellow-pubescent; lobes 5, unequal or more or less equal in size, large. Corolla pale-purple or pink, 14–17 mm long; tube 6–8 mm long, ca. as long as or longer than calyx, slightly expanded apically; galea bent at a right angle apically; beak 5–6 mm long; lower lip ciliate or glabrous, middle lobe rounded or triangular. Filaments 2 sparsely pubescent, 2 glabrous. Capsule triangular or lanceolate, 15–20 mm long. Seeds ovoid, ca. 1.5 mm long.

Phenology: flowering and fruiting from June to August.

Habitats: wet boggy places, wet banks in dense mixed forests, alpine meadows; 3500–4200 m.

Distribution: endemic; C Nepal, M Yarlung Zangbo, S Hengduan, U Irrawaddy [Map 45(2)–65].



Map 45(2)–65: *Pedicularis pantlingii* Prain

C NEPAL: Gandaki, Lamjung, 3960 m, 1954, *J. D. A. Stainton et al. 6188* (BM). **MYAR-LUNG ZANGBO:** Yadong, Chunpei, 27 July 1953, *P. C. Tsoong 5940* (PE). **S HENGDUAN:** Dêqên, along Cangjiang river, 3600–3800 m, 14 Sept. 1940, *K. M. Feng 6634* (PE, KUN). **Gongshan,** Dulong, 3300 m, 22 July 1982, *Qinghai-Xizang Exped. 8350* (PE). **U IRRAWADDY:** Chimili Woods, 3050 m, 31 July 1919, *R. Farrer 1143* (E).

66. *Pedicularis raghvendrae* Arti Garg & R. Kr. Singh, *Phytotaxa* 452 (1): 110–115. 2020. Type: India, Sikkim, North district, Bansoi, 2200 m, 30 Sept. 2013, *B. S. Kholia 38940* (holotype CAL; isotypes: BSA, BSHC).

Perennial, erect herbs, 7–15 cm high, not black when dry. Stem unbranched, slender, flexuous, villous. Roots 1.5–2 cm long, stout; rootlets fibrous. Leaves alternate; leaf blade ovate-orbicular, pinnatifid, 8–18 mm long, 8–19 mm wide, subcoriaceous, apex rounded, adaxially sparsely hispid, abaxially villous on midrib; segments 5–7 pairs, ovate, margins 1–3-toothed, apex obtuse-rounded; petiole 1–1.8 cm long in radical, villous. Inflorescence a short terminal raceme, 3–7-flowered; bracts 5–7 mm long, foliaceous. Flowers 1.8–2.3 cm long, pedicellate; pedicels 2–2.5 mm long, villous, elongated in fruit. Calyx 4–5 mm long, obliquely cupular, shallowly cleft anteriorly; tube 3–3.5 mm long, membranous, 4-nerved, villous, 4-toothed; teeth 1–1.5 mm long, unequal, ovate, distantly arranged, foliaceous, 2 on each side, deflexed, margins shallowly toothed or entire, apex acute-obtuse. Corolla white with a light pinkish tinged, 1.5–1.8 cm long, glabrous; tube 7–9 mm long, longer than calyx; galea sickle-shaped or navicular, 7–9 mm long, deflexed opposite to midlobe of labium, beaked; beak 3–4 mm long, nearly straight, bifid, emarginated at tip; labium 9–10 mm long, extended beyond galea, out curled distally, margins entire; lateral lobes 7–8 mm long, rotundate, midlobe 4–5 mm long. Stamens inserted at base of corolla tube, filaments all glabrous. Capsules 1.3–1.5 cm long, lanceolate, apex short-acuminate. Seeds 1.2–1.5 mm long, reticulate.

Phenology: flowering and fruiting from September to October.

Habitats: boggy soil among mosses along shady gentle slopes of Himalayan moist temperate forest; 2200 m.

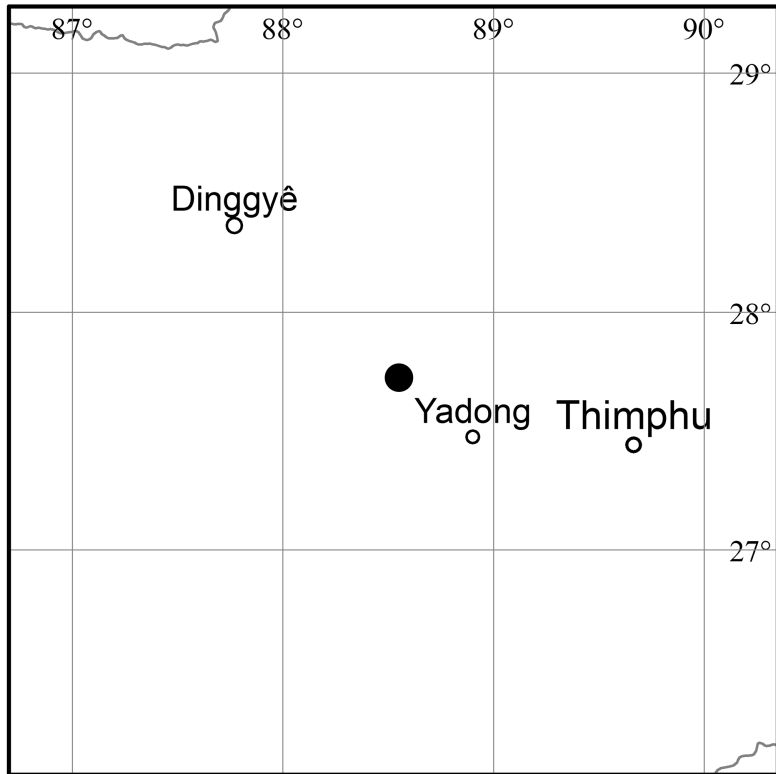
Distribution: endemic; Sikkim & Darjiling [Map 45(2)–66].

Notes: Garg *et al.* stated that “it (*P. raghvendrae* Arti Garg & R. Kr. Singh) is most closely allied to *Pedicularis pantlingii* Prain in having ovate-orbicular, pinnatifid leaves, base cordate, calyx obliquely cupular, shallowly cleft anteriorly, calyx teeth foliaceous, tip of galea beak emarginate, stamens equal, style slightly projected out of galea. Detailed studies of the herbarium specimens (including types) of *Pedicularis* species of India and adjacent countries, and perusal of relevant literature (Hooker 1884, Prain 1889 & 1890, Pennell 1943, Li 1948 & 1949, Yang *et al.* 1998, Husain *et al.* 2010, Garg & Singh 2015, Singh *et al.* 2016, Garg & Singh 2020) proved this to be a new species hitherto unknown to science, which is described here as a novelty.”

Sikkim & Darjiling: Lachen, North Sikkim district, 2200 m, 30 Sept. 2013, *B. S. Kholia 38940* (CAL, BSA, BSHC).

67. *Pedicularis taliensis* Bonati, *Notes Roy. Bot. Gard. Edinb.* 5: 87. 1911; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 139. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 136. 1998. Type: China, Yunnan, Dali, 2740–3350 m, July–Aug. 1906, *G. Forrest 4500* [holotype: E(E00399298); isotype: GH(00097287)].

Herbs perennial, 15–20 cm tall. Main root stout, branched. Stems soft, erect or ascending, single to several, glabrous, or with lines of hair. Basal leaves withering early; cauline leaves alternate, glabrous; petiole 4–10 mm long; leaf blade ovate-oblong, 2–3 cm long, 1–1.5 cm wide, pinnatisect; segments 3–5 pairs, widely spaced, linear-oblong, pinnatifid, dentate; teeth callose. Flowers solitary in leaf axils, widely spaced; pedicels erect, 1–3 mm long. Calyx campanulate, 3–4 mm long, villous, not reticulate, slightly cleft anteriorly; lobes 5–7, triangular, small, sometimes obscure, entire, or posterior lobe 2- or



Map 45(2)-66: *Pedicularis raghvendrae* Arti Garg & R. Kr. Singh

3-toothed. Corolla pale-rose, 8–11 mm long; tube erect, slightly longer than calyx, expanded apically; galea bent at a right angle apically, pubescent abaxially; beak more or less bent downward, 2–3 mm long; lower lip ca. as long as galea, long-ciliate, middle lobe hoodlike apically. Filaments all sparsely pubescent. Capsule prism-shaped, 2–2.5 times as long as calyx.

Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows, margins of *Pinus* forests; 2700–3400 m.

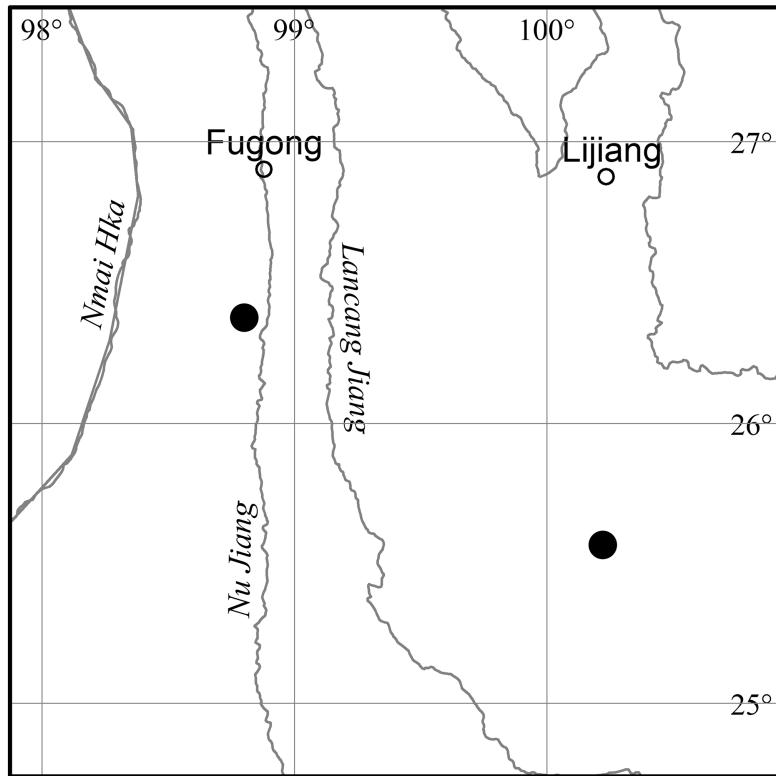
Distribution: endemic; S Hengduan, U Irrawaddy [Map 45(2)-67].

Notes: Type information in the protologue of *P. taliensis* Bonati records: “Plant of 2–10 inches. Flowers pale-rose. Grassy openings in pine forests on the eastern flank of the Tali range, 2743–3353 m, July–Aug. 1906, *G. Forrest* 4500”.

S HENGDUAN: Dali, precise location unknown, *G. Forrest* 18341(K). **U IRRAWADDY:** Upper Burma, 2750–3050 m, 1914, *F. Kingdon-Ward* 1692 (E).

68. *Pedicularis microcalyx* Hook. f., *Fl. Brit. India* 4: 315. 1885; Prain, *Ann. Roy. Bot. Gard. Calc.* 3: 149. 1890; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 140. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 136. 1998. Type: India, Sikkim, Lachen, 3657 m, 20 June 1849, *Hook. fil. & Thomson* ‘*Pedicularis* No. 25’ [lectotype designated by Mill (2001: 92): K].

Pedicularis flexosoides T. Yamaz., *J. Jap. Bot.* 78: 75. 2003. **syn. nov.** Type: Bhutan, Gasa Distr. Robluthang, open *Rhododendron* dwarf-scrub with on N-facing slope, 4840 m, 26 July 2000, *G. Miehe & S. Miehe* 00-242-13 [holotype: TI].



Map 45(2)-67: *Pedicularis taliensis* Bonati

Herbs perennial, 10–40 cm tall. Rhizome short, 1–2 cm long, covered by several ovate scales, membranous; roots cespitose, some branches fleshy, more or less fusiform, 3–5 cm long. Stems slender and flexuous, glabrous or with 2 lines of hairs, branched at base or unbranched. Basal leaves few, withering early; petiole 6–8 cm long; cauline leaves few, alternate; petiole 1.5–3 cm long; leaf blade lanceolate, 2.5–6 cm long, 1–1.5 cm wide, adaxially glabrous, abaxially scurfy, pinnatipartite and pinnatisect at base; segments 8–10 pairs, oblong-lanceolate, pinnatifid and dentate. Inflorescences racemose; bracts leaflike; pedicels 1–10 mm long. Calyx campanulate, 4–6 mm long, membranous, 1/3–1/2 cleft anteriorly; lobes 5, unequal. Corolla purplish-red; tube 6–9 mm long, ca. 2 times as long as calyx; galea bent at a right angle apically, lacking auriculate protuberance at margin; beak bent slightly downward, 4–6 mm long; lower lip ciliate. Filaments all glabrous. Capsule lanceolate, more than 2 times as long as calyx, apex acute. Figure 45(2)–30.

Phenology: flowering and fruiting from June to August.

Habitats: open *Rhododendron* dwarf-scrub; 3700–4500 m.

Distribution: endemic; C Nepal, E Nepal, Bhutan, L Yarlung Zangbo [Map 45(2)–68].

Notes: Yamazaki described *P. flexosoides* T. Yamaz. as new based on three collections from Bhutan. He stated that “This species resembles *P. annapurnensis* T. Yamaz. of Nepal, but differs in having smaller leaves, smaller calyx, and beak of corolla bilobed at apex”. However, these two species are quite different because leaves of *P. annapurnensis* T. Yamaz. are opposite or pseudo-opposite but those of *P. flexosoides* are alternate. Hence, *P. annapurnensis* is here transferred to the series *Debiles* Prain. Moreover, *P. flexosoides* T. Yamaz. is here treated as a new synonym of *P. microcalyx* Hook. f. because there are no morphological gaps between these two “species”.

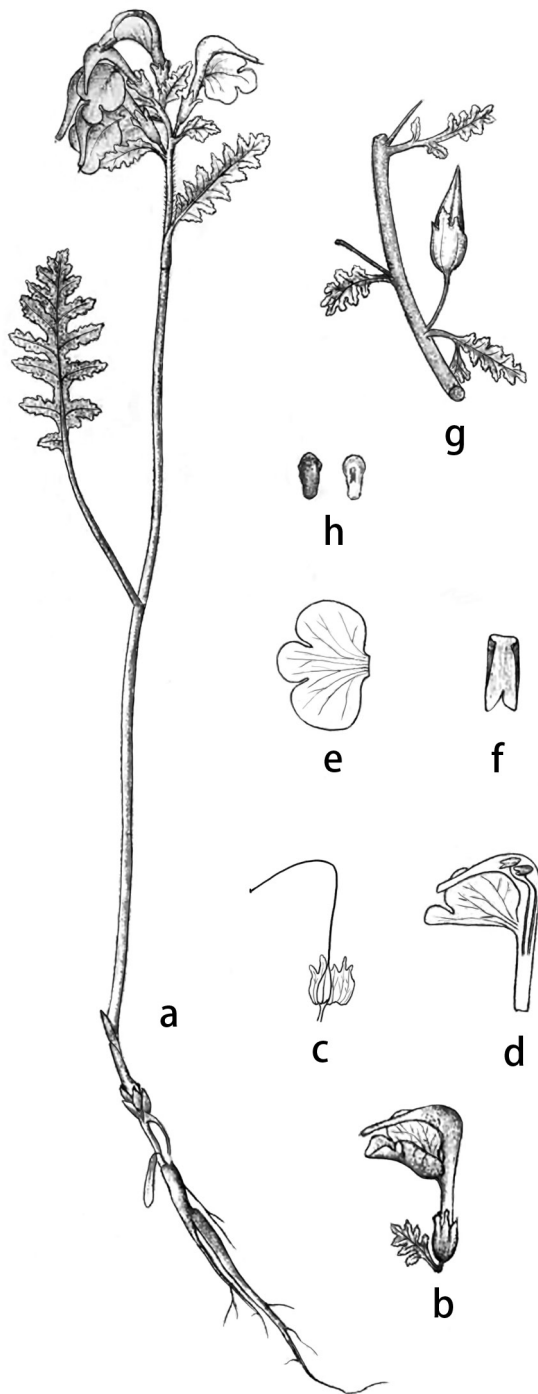
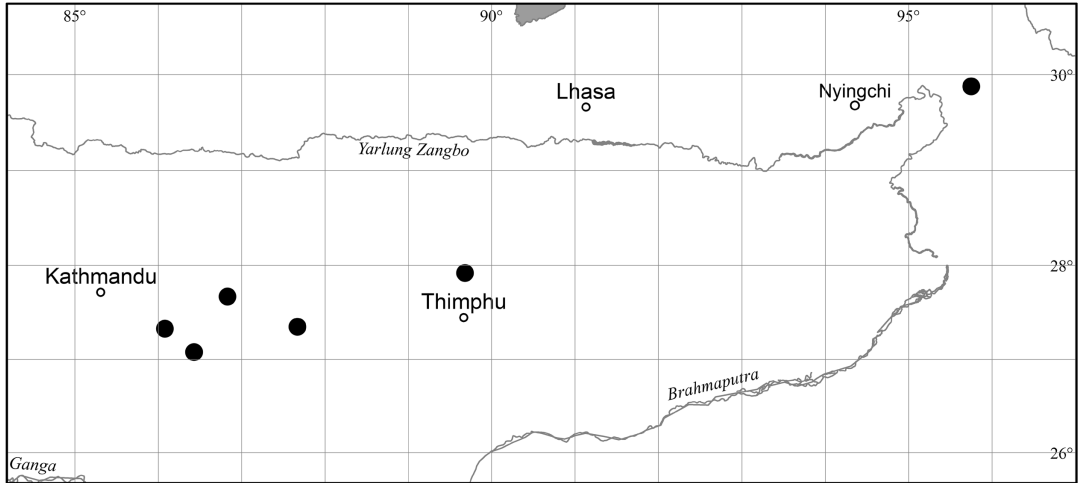


Figure 45(2)–30: *Pedicularis microcalyx* Hook. f. a, habit; b, flower; c, calyx; d, corolla; e, corolla lip; f, beak; g, capsule; h, seed. A.-L. LI modified from D. PRAIN [*Ann. Roy. Bot. Gard. Calc.* 3: 149, plate 16: 18-24. 1890].



Map 45(2)-68: *Pedicularis microcalyx* Hook. f.

C NEPAL: **Bagmati**, Rasuwa, Langtang, Ganja La, 4160 m, 17 July 1986, *Miehe G. & Miehe S.* 5728 (BM). **Janakpur**, Ramechhap, 3960–4100 m, 11 July 1985, *H. Ohba et al.* 8530224 (E); Ramechhap, 3960–4100 m, 11 July 1985, *H. Ohba et al.* 8580253 (BM, TI). **E NEPAL:** **Mechi**, Taplejung, Topke Gola, 4240 m, 4 July 1971, *L. W. Beer* 8275 (BM). **Sagarmatha**, Solukhumbu, 3730 m, 18 June 1964, *S. A. Bowes-Lyon* 2050 (BM). **BHUTAN:** **Gasa**, Robluthang, open *Rhododendron* dwarf-scrub with on N-facing slope, 4840 m, 26 July 2000, *G. Miehe & S. Miehe* 00-242-13 (TI). **L YARLUNG ZANGBO:** **Bomi**, 4000 m, 9 June 1947, *F. Ludlow, G. Sherriff & H. H. Elliot* 13121 (PE).

69. *Pedicularis hemsleyana* Prain, Hooker's Icon. Pl. 23: t. 2210. 1892; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 141. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 136. 1998. Type: China, Sichuan, Kangding, 2740–4100 m, *A. E. Pratt* 684 (purchased Dec. 1890) [**lectotype designated here:** K(K000708823); isolectotypes E(E00438427), P(P002976786)].

Herbs perennial, 30–45 cm tall, glabrous, Rhizome short, covered by several ovate scales, membranous; roots caespitose, some branches fleshy, more or less fusiform. Stems erect or more or less ascending. Leaves few; basal leaves withering early; cauline leaves alternate; petiole 1.5–3 cm long; leaf blade ovate-oblong, 6–8 cm long,

adaxially glabrous, abaxially scurfy, pinnatipartite to pinnatisect; segments 5–8 pairs, oblong, margin double-dentate. Inflorescences racemose, lax; bracts leaflike; pedicels 2–3 mm long. Calyx narrowly campanulate, 4–5 mm long, 2–3 mm wide, membranous, slightly cleft anteriorly; lobes 5, unequal. Corolla purplish-red; tube erect, 5–6 mm long, ca. 2 times as long as calyx tube, expanded apically; galea bent at a right angle apically, with an auriculate protuberance on each side of margin; beak straight or sometimes decurved, 3–4 mm long; lower lip 7–9 mm long, 7–8 mm wide, not ciliate. Filaments 2 pubescent, 2 glabrous.

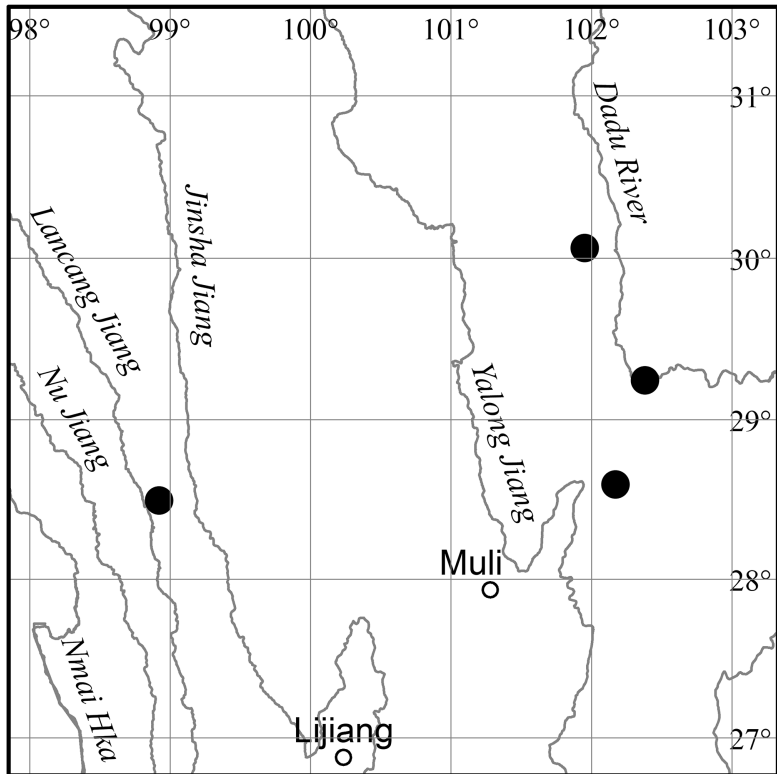
Phenology: flowering and fruiting June to August.

Habitats: under forests, along the stream; 2900–4100 m.

Distribution: S Hengduan; also in other parts of S Sichuan, China [Map 45(2)–69].

Notes: In the protologue of *P. hemsleyana* Prain recorded type collection “China Prov. Szechuen, *Pratt* 684”. We examined one sheet of *Pratt* 684 in the herbarium K, which is designated here as lectotype, and the others are designated as isolectotypes.

S HENGDUAN: **Dêqên:** Cizhong, 3600–3700 m, 10 July 1940, *K. M. Feng* 5257 (KUN). **Kangding**, *A. E. Pratt* 684 (PE). **Mianning**, Tuomajiangou, 19 Sept. 1959, *S. F. Zhu* 20385 (PE). **Shimian**, 1955, *C. J. Xie* 41872 (PE); Shimian, Aug. 1955, *C. J. Xie* 42056 (PE).



Map 45(2)-69: *Pedicularis hemsleyana* Prain

Ser. 26. *Comosae*

Ser. *Comosae* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 24: 77. 1878.

Herbs perennial, usually more than 15 cm tall. Roots fascicled, fibrous. Leaves basal and cauline, alternate; leaf blade oblong-lanceolate, usually 2-pinnatilobate, sometimes pinnatisect or pinnatifid. Inflorescences densely spicate and elongate, racemose, or subcapitate. Calyx slightly cleft anteriorly, 5-lobed. Corolla tube erect; galea 2-toothed, beakless or short-beaked; lower lip spreading.

About 30 species; two species in the Pan-Himalaya.

Notes: The series *Comosae* Maxim. was established in 1878, and its species are mainly distributed in N China, S Siberia, Mongolia, NE Asia, and Siberia. Two species extend to the geographical range of the Pan-Himalaya. The series *Striatae* includes three species, which are mainly distributed in N Asia and N America. These two series are different in corolla shape. Corolla lip of the series *Striatae* extends in the same direction as galea, while that of the series *Comosae* forms a right angle to galea. This difference should not be considered as a diagnostic character to define the two series, because this phenomenon could happen within one species, such as in *P. rex* C. B. Clarke and *P. thamnophila* (Hand.-Mazz.) H. L. Li. Hence, the series *Striatae* Maxim. is here merged into the series *Comosae*, which is supported by molecular evidence. Our molecular phylogenetic results reveal that species of the series *Comosae* are clustered in a well-supported clade, which includes two species of the series *Striatae*.

- 1a. Laminas usually 2–7 cm long; flowers purple, rose, or white; calyx lobes not connivent 70. *P. uliginosa*
 70. *P. uliginosa*
- 1b. Laminas usually 10–27 cm long; flowers yellow; calyx lobes connivent in 2 lateral pairs..... 71. *P. dolichorrhiza*
 71. *P. dolichorrhiza*

70. *Pedicularis uliginosa* Bunge, Del. Sem. Hort. Dorpat. 8. 1839; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 230. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 163. 1998. Type: Russia, Altai, *Flor. Orient Altaica 1839* [**lectotype designated here:** P(P02968496); isolectotype: HAL(HAL0116051)].

Pedicularis karakorumiana T. Yamaz., J. Jap. Bot. 68: 142. 1993. **syn. nov.** Type: Karakorum, North of Gilgit, Khunjerab (on the border of Pakistan and Tibet of China), 4600 m, 8 July 1989, *Bosshard, Klotzli & Schaffner 130/131-22* (holotype: TI; isotype: ZT).

Pedicularis mustanghatana T. Yamaz., J. Jap. Bot. 68: 144. 1993. **syn. nov.** Type: Karakorum, Mustang Ata Mt. W flank, 4330 m, July 1991, *G. Miehe & S. Miehe 5523* (holotype: TI).

Herbs perennial, 5–40 cm tall. Roots clustered, slightly thickened. Stems single, rigid, erect, or ascending, with membranous scales at base. Basal petiole slightly shorter than 1/2 as long as leaf blade; leaf blade glabrous or abaxially floccose-pubescent along veins, pinnatisect; segments lanceolate, pinnatifid, dentate, with teeth callose, apex acute; cauline leaves similar to basal leaves but short-petiolate. Flowers initially in a dense raceme, later elongated to 21 cm long in fruit, pubescent; proximal bracts leaflike, distal ones linear; pedicels 5–10 mm at base. Calyx 10–14 mm long, villous, densely reticulate-veined; lobes 5, unequal, posterior lobe smallest, entire, lateral lobes triangular-lanceolate, flabellate, ca. 1/3 as long as tube. Corolla purple-red, or white, 20–25 mm long; tube ca. 1.5 times longer than galea; galea more or less falcate, beakless, apex marginally 2-uncinate toothed; lower lip shorter than galea. Filaments all glabrous, or 2 pubescent and 2 glabrous. Capsule oblong-lanceolate, 10–20 mm long. **Chromosomes:** 2n = 16.

Phenology: flowering from July to August.

Habitats: shaded glades in forests, meadows along streams; 1500–4600 m.

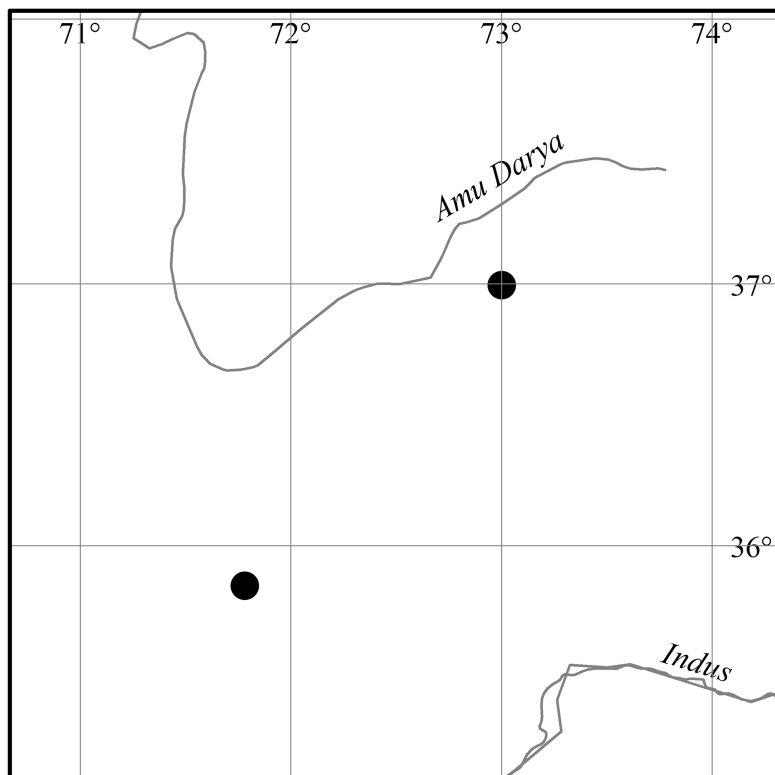
Distribution: Vakhani, N Pakistan [Map 45(2)–70]; also in China (Xinjiang), Afghanistan, Kazakstan, Kyrgyzstan, Mongolia, Russia, and Tajikistan.

Notes: It was recorded that *P. uliginosa* Bunge is distributed in the Vakhani but no specimen has been seen. Yamazaki published *P. karakorumiana* T. Yamaz. as new based on several specimens collected from N Gilgit, and he stated that *P. karakorumiana* T. Yamaz. resembles *P. uliginosa* Bunge but differs in having deltoid, slightly cupidate-dentate calyx lobes and glabrous staminal-filaments, but we find that variation of these characters fall into the range of *P. uliginosa* Bunge. The major difference is that *P. karakorumiana* T. Yamaz. is lower (5–9 cm) and laminas are smaller than that of typical *P. uliginosa* Bunge. Thus, *P. karakorumiana* T. Yamaz. might be treated as a variety of *P. uliginosa* Bunge. Yamazaki also described *P. mustanghatana* T. Yamaz. as new based on collections from Karakorum Mountains (Xinjiang), and it is here treated as a new synonym of *P. uliginosa* Bunge.

VAKHAN: Vakhani, no detailed information. **N PAKISTAN:** Chitral, Darkot, 3800 m, 13 Sep. 1991, *G. Miehe & S. Miehe 6907* (TI).

71. *Pedicularis dolichorrhiza* Schrenk, in Fischer & Meyer, Enum. Pl. Nov. 2: 23. 1842; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 235. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 165. 1998. Type: China: Dzungaria Alatau, along the Xinjiang/Siberian border “Inventa in montibus Dschabyk, d. 16 julii m.[Al. Schrenk]”, *A. G. Schrenk 1083* syntypes: PH(00019459), E(E00273635)].

Pedicularis brevirostris Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 142. 1943. **syn. nov.** Type: Pakistan, Baltistan, 3000–3400 m, 29



Map 45(2)-70: *Pedicularis uliginosa* Bunge

June 1892, *J. F. Duthie* 11640 [holotype: DD; isotype: E(E00273635)].

Pedicularis schugnana B. Fedtsch., Trav. Mus. Bot. Acad. Petersb. i. 156. 1902. Type: unknown.

Herbs perennial, 20–100 cm tall, sparsely pubescent, not black when dry. Roots more or less fleshy, and fusiform. Stems single to several, erect, unbranched, hollow, with lines of whitish hairs. Basal leaves clustered, petiole 6–27 cm long, withering in fruit; leaf blade narrowly lanceolate, 5–25 cm long, 1–4 cm wide, pinnatisect; segments 18–25 pairs, lanceolate, pinnatipartite, dentate; teeth callose; cauline leaves smaller than basal ones, distal ones short-petiolate. Inflorescences long spicate, more than 20 cm long; proximal bracts leaflike, distal ones 3-lobed. Calyx campanulate, 10–13 mm long, sparsely long-pubescent, slightly cleft anteriorly; lobes 5, triangular, 2 pairs of lateral lobes connected,

more or less triangular, ciliate. Corolla yellow; tube 13–16 mm long; galea falcate apically, 11–14 mm long; beak distinct, 3–4 mm long, apex 2-cleft, lobes toothlike; lower lip ca. as long as galea, erose-dentate. Filaments all pubescent. Capsule 10–15 mm long. Seeds long-ovoid. Figure 45(2)–31.

Phenology: flowering from June to July.

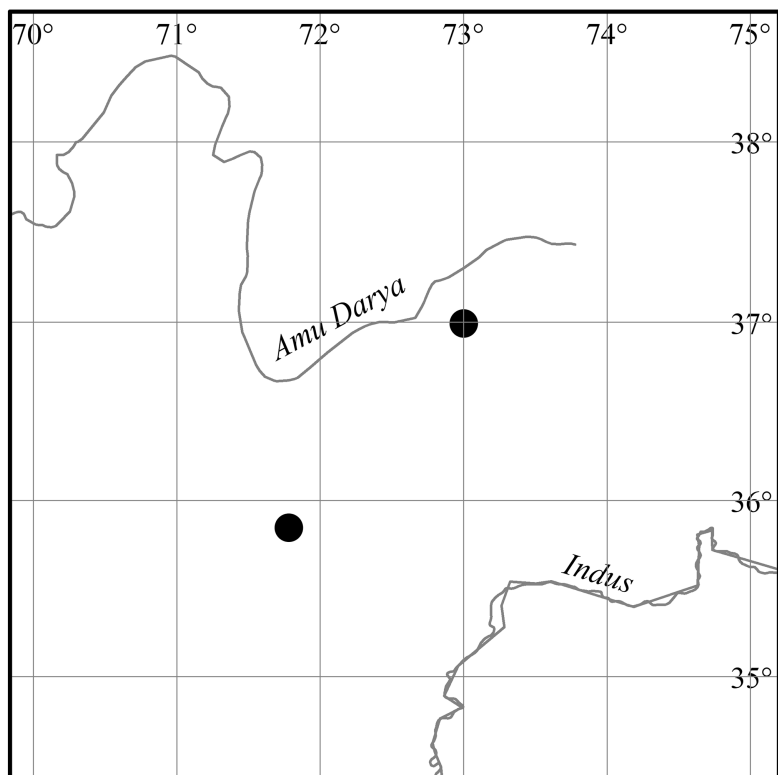
Habitats: alpine meadows, grassy slopes; 1800–4700 m.

Distribution: Vakhan, N Pakistan [Map 45(2)–71]; also in China (Xinjiang), Afghanistan, Kazakstan, Kyrgyzstan, Mongolia, Russia, and Tajikistan.

VAKHAN: Vakhan, 2 miles W of Sarhad, 3200 m, 22–25 July 1971, *C. Grey-Wilson & T. F. Hower* 1402, 1421, 1655 (K). **N PAKISTAN:** Chitral, 3500 m, *Gilgit Exped. (S Hindu Kush)* Dr. Giles 273 (K).



Figure 45(2)-31: **Pedicularis dolichorrhiza** Schrenk. a, habit; b, flower. Drawn by W.-J. JU [*Fl. Reipubl. Popularis Sin.* 68: 234, figure 54: 1-2. 1963].



Map 45(2)-71: *Pedicularis dolichorrhiza* Schrenk

Ser. 27. Paucifoliatae

Ser. Paucifoliatae Prain, Ann. Roy. Bot. Gard. Calc. 3: 80. 1890. Type: *Pedicularis yunnanensis* Franch. ex Maxim.

Herbs low to moderately tall. Roots numerous. Stems rigid, branched at base, or mostly unbranched. Leaves basal or basal and cauline, persistent, alternate; leaf blade pinnatifid to pinnatifid. Inflorescences short-racemose or subcapitate; bracts petiolate. Calyx slightly cleft anteriorly or not, 3–5-lobed.

Seven species; all in the Pan-Himalaya (7 endemic).

Notes: The series *Paucifoliatae* was established by Prain in 1890, and included *P. yunnanensis* Franch., *P. tsangchanensis* Franch. ex Maxim., and *P. wallichii* Bunge. In Li's monograph (1949. Proc. Acad. Nat. Sci. Philad. 101: 104–105), *P. micranth* H. L. Li, *P. aphyllocaulis* Hand.-Mazz., and *P. forrestiana* Bonati were added into the series *Paucifoliatae*, while *P. wallichii* Bunge was removed from the series. Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 314–320) added *P. umbelliformis* H. L. Li, *P. praeruptorum* Bonati, and *P. tsarungensis* H. L. Li into the series *Paucifoliatae*. To date, delimitation of the series *Paucifoliatae* remains extremely problematic.

Tsoong established the series *Strobilaceae* (nom. inval.), which was formally described by Yang [1995. Acta Phytotax. Sin. 33(3): 244–250] as series *Strobilaceae* P. C. Tsoong ex H. P. Yang. It included *P. gracilicaulis* H. L. Li, *P. dichrocephala* Hand.-Mazz., *P. strobilacea* Franch., and

P. pseudocephalantha Bonati. The former two species were imported from the series *Furfuraceae* and the latter two were from the series *Oliganthae* (1949. Proc. Acad. Nat. Sci. Philad. 101: 115–118). Our molecular phylogenetic results reveal that the species of the series *Paucifoliae* and *Strobilaceae* are clustered in a well-supported clade, but *P. umbelliformis* H. L. Li is nested into another clade. Hence, these two series are combined here, with the series *Strobilaceae* Franch. merged into the series *Paucifoliae* but *P. umbelliformis* H. L. Li transferred to the series *Asplenifoliae* Prain.

1a. Leaves almost all basal; leaf blade pinnatipartite to pinnatisect.

2a. Plants 9–22 cm tall; corolla tube 12–18 mm long.

3a. Leaf blade ovate-oblong, 2–3 cm long, 1–1.2 cm wide; filaments all glabrous72. *P. tsarungensis*

3b. Leaf blade ovate-oblong to oblong-lanceolate, 3.5–6.5 cm long, 1.5–2 cm wide; filaments densely pubescent73. *P. nobilis*

2b. Plants usually 4–13 cm tall; corolla tube 8–9 mm long.

4a. Leaf blade ovate-elliptic to oblong-lanceolate, 1.5–2.2 cm long, segments 5–7 pairs; filaments 2 pubescent, 2 glabrous74. *P. wanghongiae*

4b. Leaf blade lanceolate to linear-lanceolate, 1–6 cm long, segments 7–14 pairs; filaments all densely pubescent.....75. *P. praeurptorum*

1b. Leaves basal and cauline; leaf blade pinnatifid to pinnatipartite.

5a. Flowers axillary, lax or in a lax raceme; calyx lobes equal in size, flabellate, all dentate76. *P. forrestiana*

5b. Flowers in short-racemose; calyx lobes unequal in size, neither flabellate, nor all dentate.

6a. Leaf blade pinnatipartite; calyx 1/3 cleft anteriorly; roots fusiform77. *P. yunnanensis*

6b. Leaf blade pinnatifid; calyx slightly cleft anteriorly; roots filiform78. *P. micrantha*

72. *Pedicularis tsarungensis* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 100. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 317. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 190. 1998. Type: China, Tibet, Cawarong, 4000 m, May-June 1932, *J. F. Rock 22261* [holotype: NY(00090954); isotype: UC].

Herbs, 9–22 cm tall. Roots fascicled, filiform. Stems single to numerous, erect, woolly-villous. Leaves almost all basal; petiole 2–5 cm long, slender, sparsely pubescent; leaf blade ovate-oblong, 2–3 cm long, 1.0–1.2 cm wide, long-pubescent on both surfaces, pinnatisect or pinnatipartite; segments 6 or 7 pairs, widely spaced, oblong-ovate or oblong, pinnatifid or dentate. Inflorescences 2–3 cm long, 6–8-flowered; bracts leaflike. Calyx cylindrical, sparsely pubescent; lobes 5, more or less equal, dentate.

Corolla purplish-red, 17–20 mm long; tube erect, slightly expanded apically, 10–12 mm long; galea more or less bent at a right angle, 3–4 mm long; beak straight or bent slightly downward, 4–5 mm long; lower lip ca. as long as galea, sparsely ciliate, lobes more or less equal, rounded. Stamens inserted near the middle of corolla tube. Filaments all glabrous.

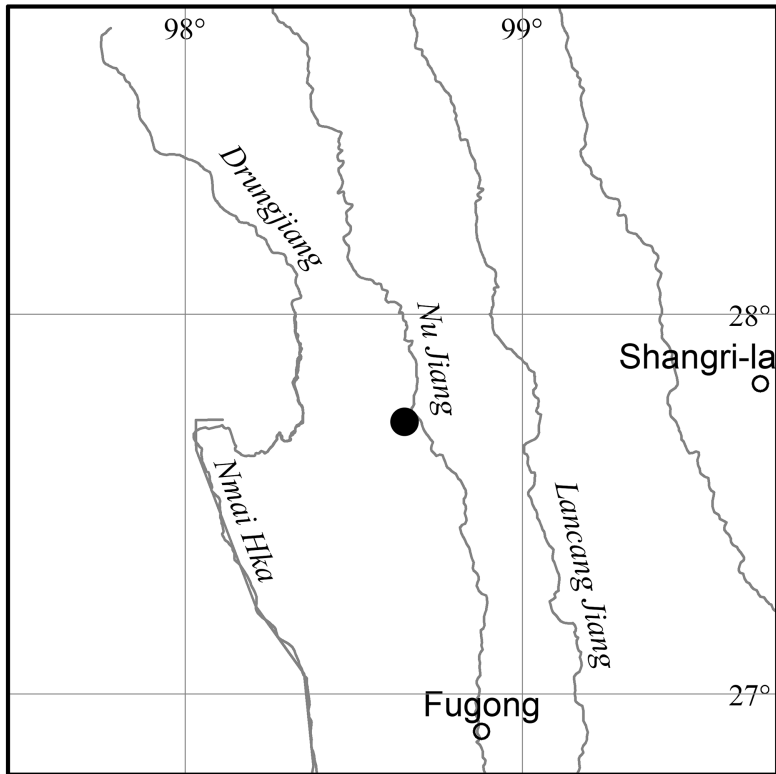
Phenology: flowering from May to June.

Habitats: alpine swamps; 3500–4000 m.

Distribution: endemic; S Hengduan [Map 45(2)–72].

S HENGDUAN: Gongshan, Dulongjiang village, 3200 m, 26 May 2009, *L. M. Gao & Z. R. Zhang GLM092517* (KUN).

73. *Pedicularis nobilis* Bonati, Notes Roy. Bot. Gard. Edinb. 13: 127. 1921. Type:



Map 45(2)-72: *Pedicularis tsarungensis* H. L. Li

Myanmar, meadow pockets on the N face of the mountains, 3960 m, July 1919, *F. Kingdon-Ward 3399* [**lectotype designated here:** E(E00273596)].

Herbs perennial, black when dry. Stems erect, several, with lines of hairs. Leaves mostly basal; petiole 3–4 cm long, glabrous; leaf blade ovate-oblong to oblong-lanceolate, 3.5–6.5 cm long, 1.5–2 cm wide, abaxially sparsely pubescent along veins, adaxially glabrous, pinnatipartite; segments 7–9 pairs, triangular-ovate to ovate-oblong, pinnatifid, pinnatilobate or incised-dentate. Inflorescences short racemose, with 2–10 flowers; bracts leaflike; pedicels 3–4 mm long. Calyx 8–10 mm long, 1/3–1/4 cleft anteriorly, sparsely long-pubescent; tube 6–8 mm long; lobes 5, unequal, posterior one smallest, entire, others more or less serrate. Corolla bright-crimson (sometimes white), 25–28 mm long; tube 14–18 mm long; galea more or less bent at a right angle apically, 8–10 mm long, 5 mm wide, slightly crested; beak bent downward, 4–5 mm long; lower

lip 10–12 mm long, 15–16 mm wide, margin dentate. Filaments all densely pubescent. Capsule ovoid-lanceolate, 10–12 mm long, short-apiculate.

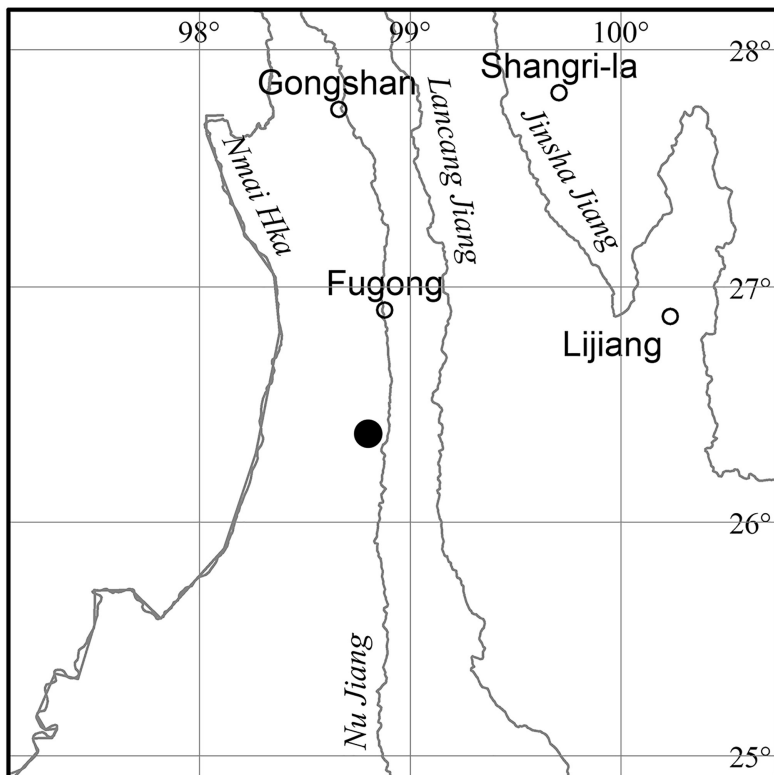
Phenology: flowering from July to August.

Habitats: open grassy hillsides, on a cliff or broken ground; 3800–4000 m.

Distribution: endemic; U Irrawaddy [Map 45(2)-73].

Notes: Bonati cited two collections (*F. Kingdon-Ward 3399*, *R. Farrer 1200*) when he described *P. nobilis* Bonati as new. Both have been deposited in the herbarium E, and one sheet (E00273596) of *F. Kingdon-Ward 3399* is here designated as lectotype.

U Irrawaddy: Chimili Valley, common on cliffs and broken ground in high alpine lawns, 3810 m, Aug. 1919, *R. Farrer 1200* (E); Chimili Valley, 3350–3650 m, Sept. 1924, *G. Forrest 24950* (E00644705).



Map 45(2)-73: *Pedicularis nobilis* Bonati

74. *Pedicularis wanghongiae* M. L. Liu & W. B. Yu, *Phytotaxa* 217 (1): 053–062. 2015. Type: China, Yunnan, Gongshan, Dulongjiang, wet meadow at the top of the mountain, 3500 m, 2 July 2014, Z. K. Wu, W. Zhou, M. L. Liu *et al.* HW2014118 (holotype: KUN).

Herbs perennial, 7–16 cm tall, slightly black when dry. Roots fascicled, fusiform. Stems erect, densely glandular-pubescent. Leaves basal, cauline leaves absent; petiole 1–2.5 cm long; leaf blade ovate-oblong to oblong-lanceolate, 1.2–2.6 cm, abaxially white-pubescent along veins, adaxially glabrous, pinnatifid to pinnatisect; segments 5–9 pairs, lanceolate, pinnatifid, dentate. Inflorescences short-racemose; bracts leaf-like; pedicels 5–6 mm long, densely pubescent. Calyx 6–7 mm long, 1/2–2/3 cleft anteriorly, with long hairs along midvein; lobes 5, unequal, posterior lobe smallest, more or less entire, others dentate, with 4 or 5 cleft divisions. Corolla purple or rose-red, white at throat, ca. 16 mm long; tube ca. 9 mm long, glabrous; galea bent at a right

angle apically, densely minute-pubescent; beak bent upward, 7–8 mm long; lower lip ca. 16 mm long, 17 mm wide, sparsely ciliate, middle lobe oblong-obovate, projected and stiped, ca. 12 mm long 9 mm wide. Anterior 2 filaments pubescent at lower part, posterior 2 filaments glabrous. Capsule ovoid-lanceolate, ca. 15 mm long, 5 mm wide, not oblique, apex acute.

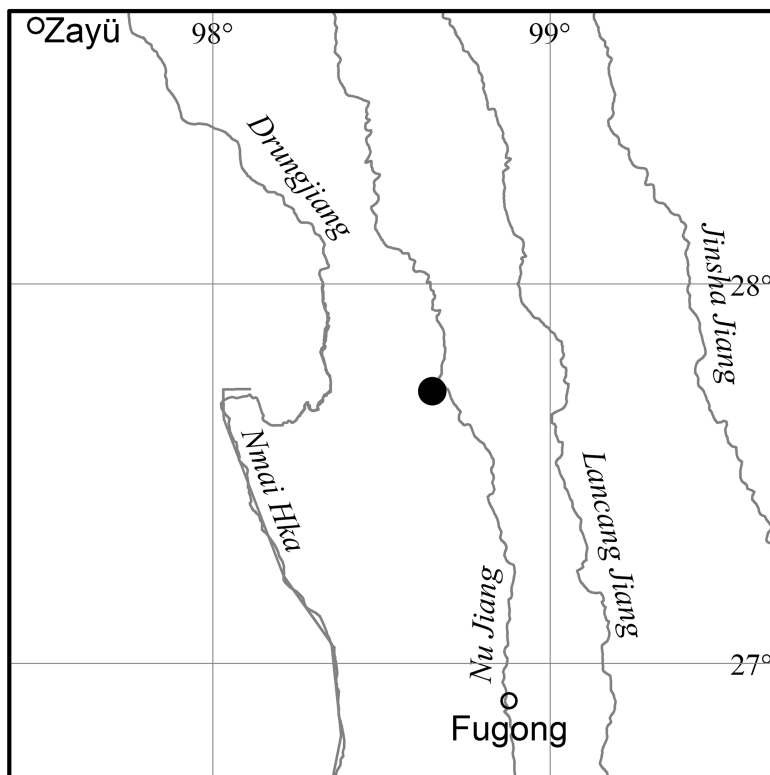
Phenology: flowering May to July.

Habitats: grassy slopes, 3200–3500 m

Distribution: endemic; S Hengduan [Map 45(2)–74].

Notes: Description of *P. wanghongiae* M. L. Liu & W. B. Yu refers to the protologue, and results of molecular data indicate that *P. wanghongiae* is closely related to *P. praeruptorum* Bonati and *P. micrantha* H. L. Li.

S HENGDUAN: Gongshan, Dulongjiang, 3200 m, 26 May 2009, L. M. Gao & Z. R. Zhang GLM092517 (KUN).



Map 45(2)-74: *Pedicularis wanghongiae* M. L. Liu & W. B. Yu

75. *Pedicularis praeruptorum* Bonati, Notes Roy. Bot. Gard. Edinb. 13: 126. 1921; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 316. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 189. 1998. Type: China, SE Tibet, "On precipices, alpine turf etc. at Ka-gur-pur", 4724 m, 19 July 1913, *F. Kingdon-Ward 812A* [holotype: E(E00438468)].

Pedicularis pseudoheydei P. C. Tsoong, Kew Bull. 1954: 449. 1954. **syn. nov.** Type: Myanmar, Seingku Wang, 3657 m, 10 July 1926, *F. Kingdon-Ward 7093* [holotype: K(K000739117)].

Pedicularis aphyll caulis Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 62: 239. 1925. Type: China, NW Yunnan, "In cespitibus alpinis jugorum Nisselaka inter fluvios Mekong et Salween legi 18. VI. 1916 (*Nr. 8959*) et Tschiangschel inter hunc et arawadi legi 4. VII. 1916 (*Nr. 9265*), 27°52'-

28° micoschistaceo, 3950–4200 m", *H. R. E. von Handel-Mazzetti 8959* [lectotype by Handel-Mazzetti (1937: 859): WU(0060235); isolectotype: E(E00438423)].

Herbs perennial, 4–10 (-19) cm tall, marcescent leaves with petiole and scales persistent at base, black when dry. Roots fascicled, fusiform, more or less fleshy. Stems erect, densely glandular-pubescent. Leaves almost all basal; petiole 3–6.5 cm long; leaf blade lanceolate to linear-lanceolate, 1–6 cm long, adaxially glabrous, abaxially white-pubescent along veins, pinnatipartite to pinnatisect; segments 7–14 pairs, ovate to lanceolate, pinnatipartite to pinnatisect. Inflorescences short-racemose; bracts leaflike; pedicels 2–6 mm long, densely pubescent. Calyx 7–9 mm long, 1/3–1/2 cleft anteriorly, with long hairs along midvein; lobes 5, unequal, posterior lobe smallest, more or less entire, others dentate. Corolla purple, 14–17 mm long; tube 8–10 mm long, glabrous; galea bent at a right angle apically, densely minute-pubescent; beak straight or bent slightly

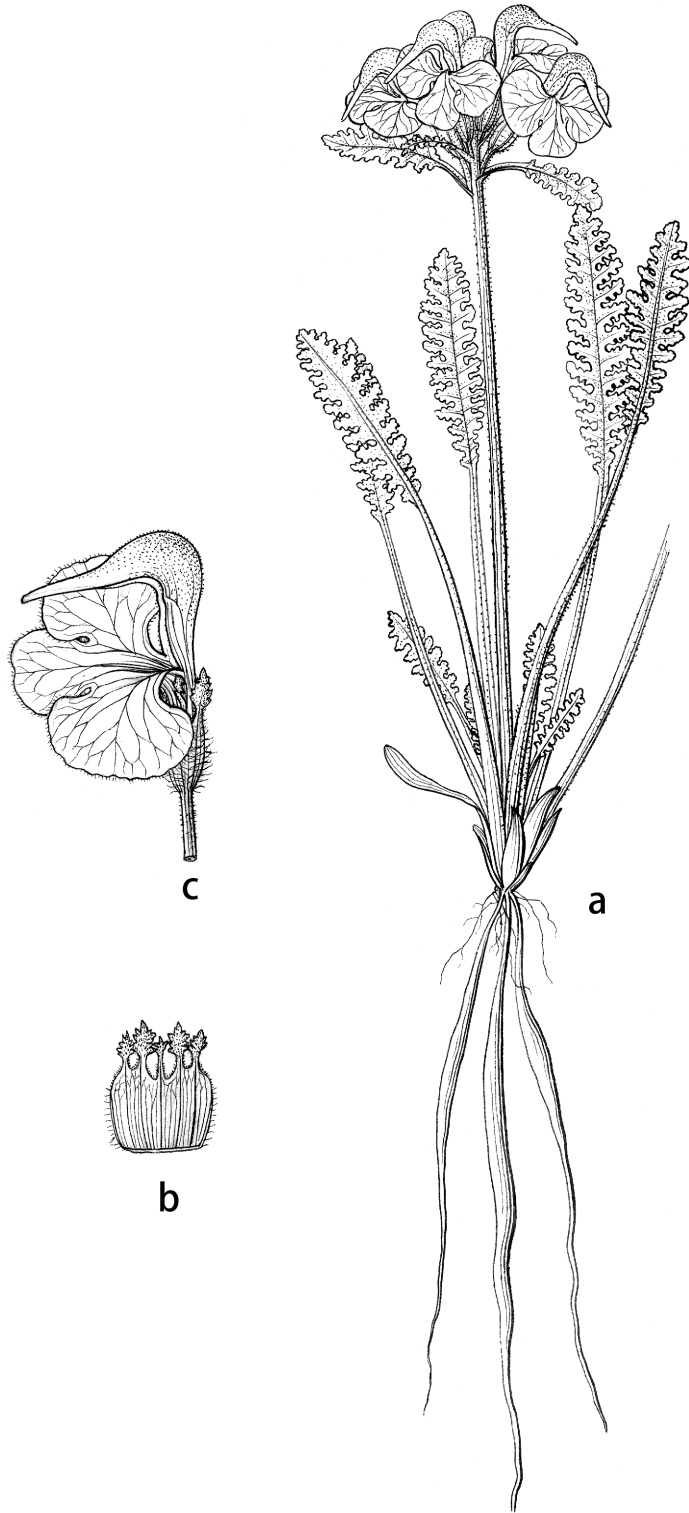


Figure 45(2)-32: **Pedicularis praeruptorum** Bonati. a, habit; b, calyx; c, flower. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 314, figure 71: 7-9. 1963].

downward, 4–5 mm long; lower lip 8–10 mm long, 12–15 mm wide, ciliate. Figure 45(2)–32.

Phenology: flowering and fruiting from June to August.

Habitats: grassy slopes, 3600–4200 m

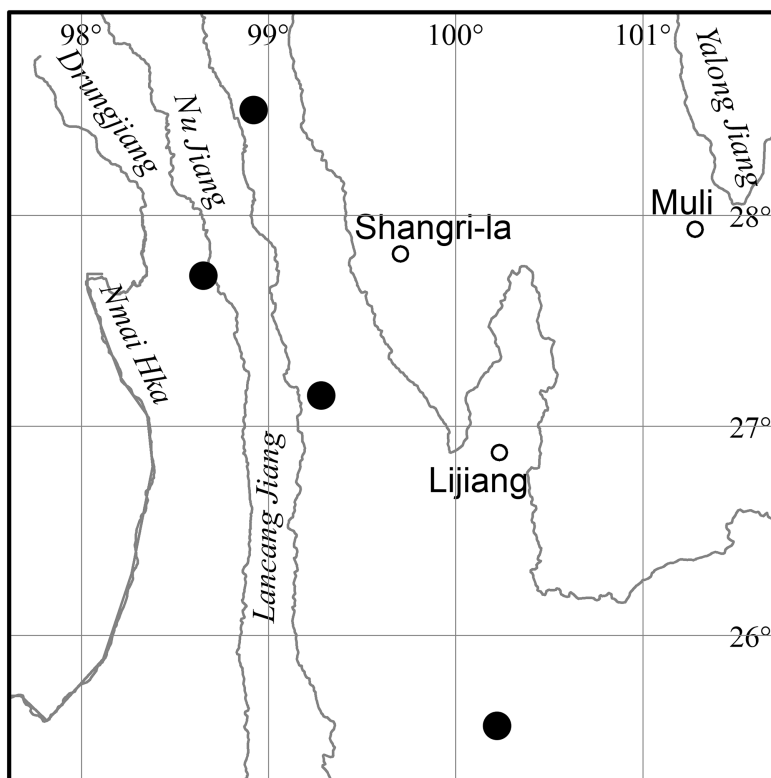
Distribution: endemic; S Hengduan [Map 45(2)–75].

S HENGDUAN: **Dali**, Cangshan, 3300 m, May 1935, *C. W. Wang 63185* (PE, KUN). **Dêqên**, Cizhong, 3700–3800 m, 4 June 1940, *F. M. Feng 5091* (PE, KUN); Dêqên, Cizhong, 3600 m, 13 Aug. 1940, *F. M. Feng 6586* (PE); Dêqên, 3600–4000 m, 1 Aug. 1940, *F. M. Feng 6095* (PE); Dêqên, Yongzhong, 4150–4400 m, 24 Aug. 1981, *PE Hengduan Shan Exped. 3589* (PE); Dêqên, Yunling, 4150–4400 m, 24 Aug. 1981, *PE Hengduan Shan Exped. 3603* (PE); Dêqên, Meilixue Shan, 4150 m, 29 July 1987, *Z. D. Fang 0244* (SABG); Dêqên, Baimaxue Shan, 4450 m, 30 June 2001, *F. S. Yang Y0011* (PE). **Gongshan**,

A-nan-tong, 4000 m, 16 Aug. 1938, *T. T. Yü 22347* (PE, KUN); Gongshan, Dulong, 3600 m, 26 July 1982, *Qinghai-Xizang Exped. 8722* (PE). **Weixi**, Biluoxue Shan, 3600 m, 13 July. 1981, *PE Hengduan Shan Exped. 01532* (PE).

76. *Pedicularis forrestiana* Bonati, Notes Roy. Bot. Gard. Edinb. 5: 86. 1911; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 318. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 190. 1998. Type: China, Yunnan, Lijiang, “Plants of 6–9 inches. Flowers bright rose-red. Dry, open situations on limestone drift at base of cliffs on the eastern flank of the Lichiang range, Lat. 27°25' N”, 3350–3650 m, Aug. 1906, *G. Forrest 2703* [holotype: E(E00399299); isotype: CAL(CAL0000019047)].

Herbs perennial, 15–20 cm tall or more, black when dry. Roots fleshy. Stems numerous, ascending or erect, unbranched, minutely pubescent. Basal leaves numerous; petiole 3–6 cm long, ciliate; leaf



Map 45(2)–75: *Pedicularis praeruptorum* Bonati

blade linear-oblong, 3–5 cm long, 1–2 cm wide, pinnatilobed to pinnatifid; segments 8–10 pairs, 2–4 mm wide, more or less incised-dentate; cauline leaves and bracts similar to basal leaves but short-petiolate. Flowers axillary and lax or in lax racemes, 5–12 cm long; bracts linear-oblong, petiolate; pedicels erect, 5–12 mm long, slender. Calyx tube 7–8 mm long, glabrous; lobes 5, 1–2 mm long, equal, flabellate, and incised-dentate. Corolla rose, 16–20 mm long; tube nearly 2 times as long as calyx; galea more or less bent at a right angle; beak falcate, 4–6 mm long; lower lip ca. as long as galea, 7–10 mm long, 10–14 mm wide, middle lobe emarginate, slightly hoodlike. Filaments all pubescent.

Phenology: flowering and fruiting from June to August.

Habitats: grassy slopes; 3300–4000 m

Distribution: endemic; S Hengduan [Map 45(2)–76].

Notes: Bonati cited only one collection (*Forrest 2703*) when he described *P. forrestiana* Bonati as new, with one sheet deposited in the herbarium CAL(CAL0000019047) and the other in the herbarium E(E00399299).

1a. Inflorescences less than 8 cm long; bracts linear-oblong 76a. subsp. *forrestiana*

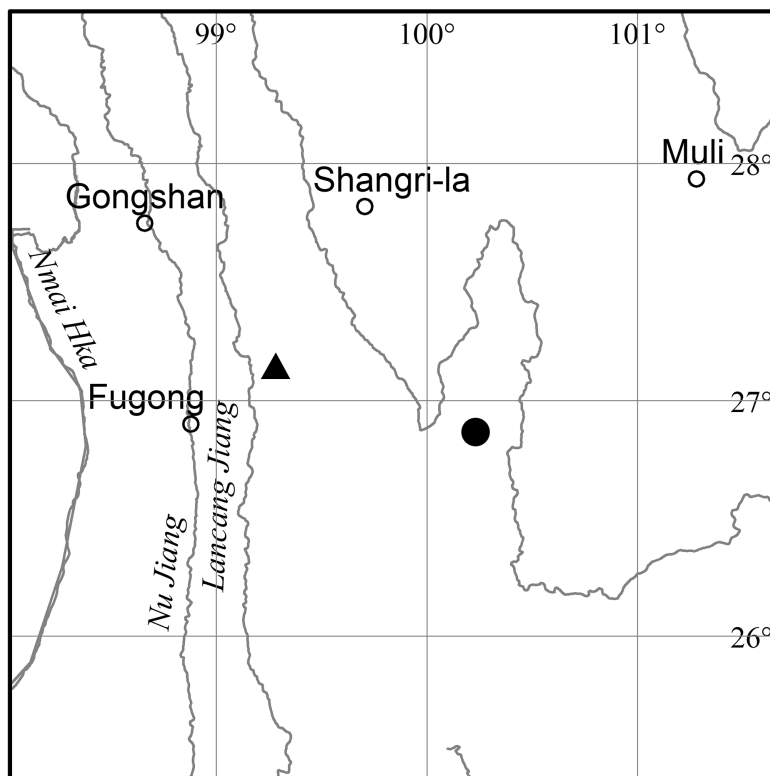
1b. Inflorescences 15–20 cm long; bracts flabellate 76b. subsp. *flabellifera*

76a. *Pedicularis forrestiana* subsp. *forrestiana*

Petiole 1.5–7 cm long. Inflorescences less than 8 cm long. Flowers axillary and lax; bracts leaflike, linear-oblong; pedicels 8–12 mm long, densely pubescent.

Phenology: flowering from July to August.

Habitats: alpine meadows, open areas, thick grass, and scrubs; 3300–3400 m.



Map 45(2)–76: *Pedicularis forrestiana* Bonati
● subsp. *forrestiana* ▲ subsp. *flabellifera*

Distribution: endemic; S Hengduan [Map 45(2)–71].

S HENGDUAN: Yulong (Lijiang), 3200 m, July 1914, *C. Schneider 2004* (K).

76b. *Pedicularis forrestiana* subsp. *flabellifera*
P. C. Tsoong, Bull. Misc. Inform. Kew 1954: 449; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 319. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 190. 1998. Type: China, Yunnan, “Kari Pass, Mekong-Salween Divide, open situation amongst heavy grass and scrub”, 3950 m, Aug. 1914, *G. Forrest 13130* [holotype: E(E00438417)].

Inflorescences up to 20 cm long. Flowers axillary or in lax racemes, pubescent; bracts flabellate, linear-oblong, sparsely pubescent.

Phenology: flowering from June to August.

Habitats: alpine meadows, grassy hillsides; 3900–4000 m.

Distribution: endemic; S Hengduan [Map 45(2)–76].

S Hengduan: Weixi, open situation amongst heavy grass and scrub, 3950 m, Aug. 1914, *G. Forrest 13130* (E00438417).

77. *Pedicularis yunnanensis* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 572. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 315. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 189. 1998. Type: China, Yunnan, Dali, Cangshan, 4000 m, 4 Aug. 1884, *J. M. Delavay 1100* [lectotype designated here: P(P03005290); islectotypes: P(P03005285, P03005286)].

Herbs perennial, 15–25 cm tall, marcescent leaves with petiole and scales persistent at base, not black when dry. Roots fascicled, fusiform. Stems erect, with lines of hairs. Leaves mostly basal; petiole 3–7 cm long, glabrous; leaf blade ovate-oblong to oblong-lanceolate, 1–4.5 cm long, abaxially sparsely pubescent along veins, adaxially glabrous, pinnatipartite; segments 5–12 pairs, triangular-ovate to ovate-oblong, pinnatifid or incised-dentate. Inflorescences short-racemose; bracts leaflike, proximal

ones longer than flowers; pedicels 5–10 mm long. Calyx 7–8 mm long, 1/3 cleft anteriorly; tube 4–5 mm long; lobes 5, unequal, posterior one smallest, entire, others serrate. Corolla red, 15–20 mm long; tube slightly longer than calyx; galea more or less bent at a right angle apically, slightly crested; beak bent downward, 4–5 mm long; lower lip 8–10 mm long, 12–14 mm wide, lobes more or less equal, rounded, ciliate. Filaments all sparsely pubescent. Capsule ovoid-lanceolate, 1–1.2 cm long, short-apiculate. Figure 45(2)–33.

Phenology: flowering and fruiting from May to August.

Habitats: alpine meadows; 3000–4000 m.

Distribution: endemic; S Hengduan [Map 45(2)–77].

Notes: When Franchet described *P. yunnanensis* as new, he did not cite the record number but only provided information “China, Yunnan, monte Tsang-chan supra Tali, 4000 m (*Delavay!* In herb. Paris.)”. We examined seven specimens, which were collected by *J. M. Delavay* in the years 1884–1887, deposited in the herbarium P, and one sheet (P03005290) of *J. M. Delavay 1100* is here designated as lectotype. Molecular phylogenetic results reveal that *P. yunnanensis* Franch. ex Maxim. and *P. wanghongiae* M. L. Liu & W. B. Yu form a well-supported clade, indicating a close relationship between the two species.

S HENGDUAN: Dali, Shenyinfeng, Mountain top, July 1941, *H. C. Wang 1102, 1106* (PE); Dali, Cangshan, 4000 m, 4 Aug. 1884, *J. M. Delavay 203* (P); Dali, 3000 m, May 1935, *C. W. Wang 63185* (WUK); Dali, 2800 m, 1913, *G. Forrest 11563* (PE). **Dêqên** (no more detailed information), 8 Aug. 1938, *T. T. Yü 22235* (IBSC); Dêqên, Sept. 1924, *G. Forrest 24934* (PE); Dêqên, N of Maikha-Salween Divide, on stony alpine meadow slopes on the western flank, 4000 m, June 1925, *G. Forrest 26853* (PE).

78. *Pedicularis micrantha* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 106. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 317. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 190. 1998. Type:

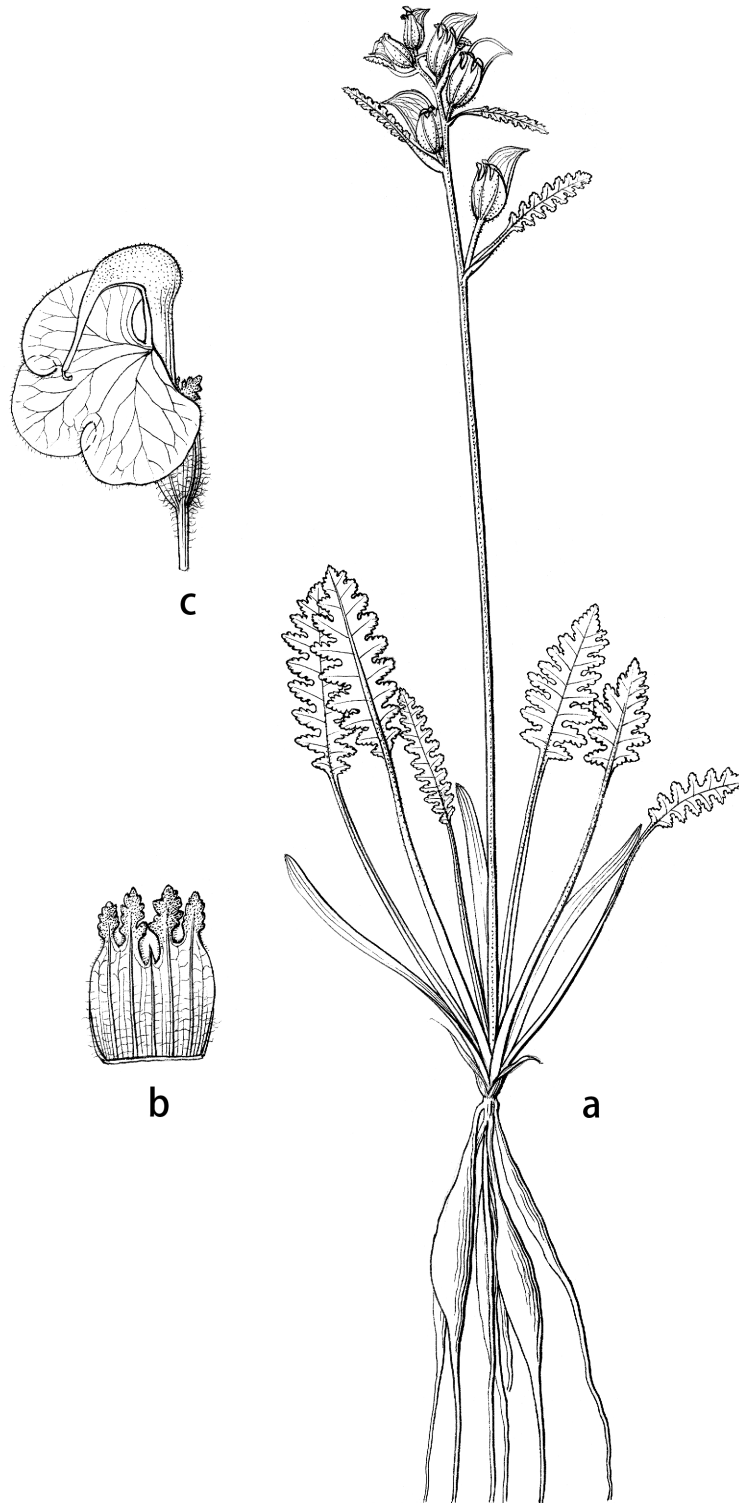
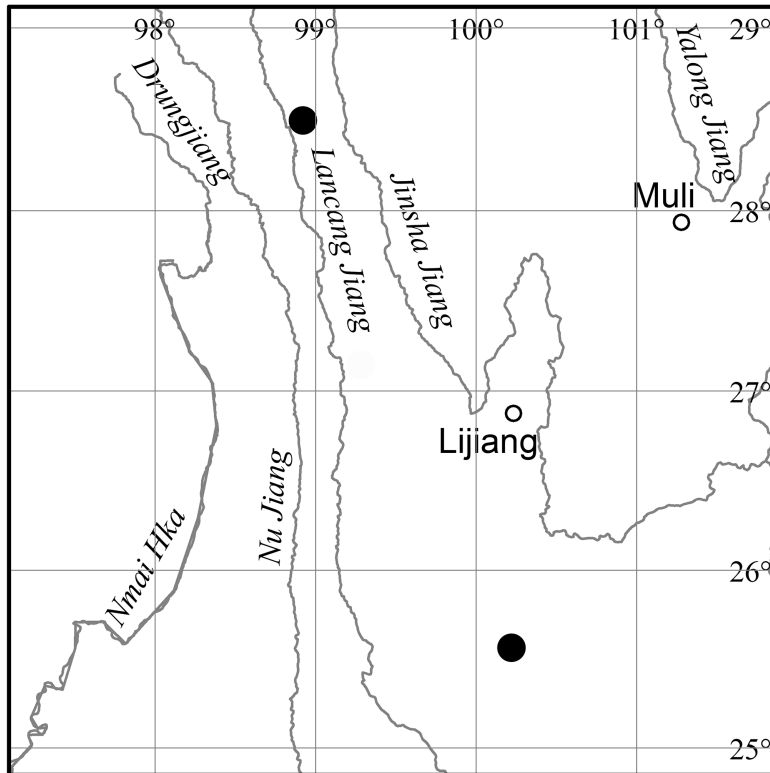


Figure 45(2)–33: *Pedicularis yunnanensis* Franch. ex Maxim. a, habit; b, calyx; c, flower. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 314, figure 71: 4-6. 1963].



Map 45(2)-77: *Pedicularis yunnanensis* Franch. ex Maxim.

China, NW Yunnan, Gongshan, “Salween, Kiukiang Divide, Tsuhwang, the margin of thickets, shrub perennial”, 3100 m, 17 Sept. 1938, *T.T. Yü 20344* [holotype: A(00097274); isotype: E(E00284022)].

Herbs perennial, 10–20 cm tall, glabrous. Roots filiform. Stems single, erect, unbranched, rigid. Basal leaves numerous; petiole 7–15 cm long, slender; leaf blade oblong-ovate, 6–7.5 cm long, 2–2.7 cm wide, pinnatifid; segments 6–8 pairs, ovate, crenate-pinnatifid, dentate; cauline leaves 1 or 2, alternate, widely spaced, similar to basal leaves but smaller. Inflorescences short-racemose, less than 3 cm long, lax at base, many-flowered; bracts leaflike, shorter than flowers; pedicels erect, 2–3 mm long. Calyx 6–8 mm

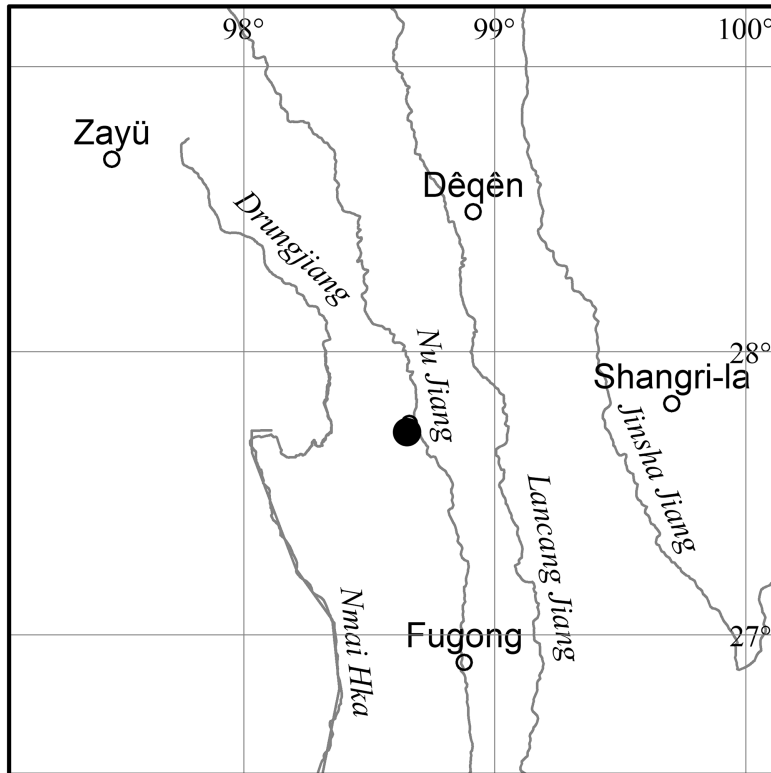
long, sparsely pubescent, slightly cleft anteriorly; lobes 5, unequal in size. Corolla pink, barely 12 mm long; tube erect, slightly longer than calyx, expanded apically; galea falcate; beak straight or bent slightly downward, 4–5 mm long; lower lip ca. as long as galea, ciliate. Filaments long-pubescent apically.

Phenology: flowering from July to August.

Habitats: margins of thickets; ca. 3100 m.

Distribution: endemic; S Hengduan [Map 45(2)-78].

S Hengduan: Gongshan, “Salween, Kiukiang divide, Tsuhwang, the margin of thickets, shrub perennial”, 3100 m, 17 Sept. 1938. *T.T. Yü 20344* (E).



Map 45(2)-78: *Pedicularis micrantha* H. L. Li

Ser. 28. Oliganthae

Ser. Oliganthae Prain, Ann. Roy. Bot. Gard. Calc. 3: 75. 1890.

Stems usually many-branched at base. Leaves basal and cauline, alternate, sometimes proximal ones more or less opposite, long-petiolate, leaf blade oblong to lanceolate, pinnatisect, or pinnatifid. Inflorescences short-spicate, capitate, or racemose, few-flowered. Calyx deeply cleft anteriorly, 2–5-lobed. Corolla purple or yellowish white; tube less than 2 times as long as calyx; galea purple, strongly twisted laterally, commonly with 1 or 2 reflexed marginal teeth; beak slender.

Eight species; seven in the Pan-Himalaya (4 endemics).

Notes: *Pedicularis macilentata* Franch. ex F. B. Forbes & Hemsl. is here transferred from the series *Oxycarpae* to the series *Oliganthae*, which is supported by results of molecular data (Yu *et al.* 2015. BMC Plant Biol. 15: 176). Our molecular phylogenetic results indicate that the species of the series *Oliganthae* form a well-supported clade.

- 1a. Cauline leaves 2–3.5 cm wide; corolla yellow; filaments all glabrous 79. *P. oligantha*
- 1b. Cauline leaves usually 0.8–1.5 cm wide; corolla more or less reddish-purple or rose; filaments 2 or 4 pubescent.

- 2a. Segments of leaves usually 10–15 pairs; calyx lobes 2 or 5 80. *P. cephalantha*
- 2b. Segments of leaves 5–8 pairs; calyx lobes 2 or 3.
- 3a. Leaves mostly basal; galea conspicuously crested.
- 4a. Corolla lip not emarginated; 2 anterior filaments pubescent.
- 5a. Corolla beak slightly cleft at apex, more or less horizontal; corolla purplish-red..... 81. *P. dissectifolia*
- 5b. Corolla beak filiform, bent downward; corolla whitish-yellow, with purple galea 82. *P. strobilacea*
- 4b. Corolla lip emarginated; filaments all pubescent83. *P. cephalanthoides*
- 3b. Leaves mostly cauline; galea inconspicuously crested.
- 6a. Stems ascending, often shortly branched apically, with lines of hairs 84. *P. macilenta*
- 6b. Stems crawling, glabrous.....85. *P. hongii*

79. *Pedicularis oligantha* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 542. 1888; Li, Proc. Acad. Nat. Sci. Philad. 101: 123. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 245. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 168. 1998. Type: China, Yunnan, Jianchuan to Heqing, 3000 m, 8 June 1886, *J. M. Delavay 2378* [**lectotype designated here:** P(P02981335); isolectotypes: P(P02981333, P02981336)].

Herbs perennial, 40–50 cm tall. Stems several, erect or ascending, many-branched, glabrous. Basal leaves withering early; cauline leaves numerous, 8–10 cm long, alternate; petiole 2–3.5 cm long, glabrous; leaf blade ovate-oblong to oblong-lanceolate, 5–10 cm long, 2–3 cm wide, glabrous on both surfaces, abaxially sparsely whitish-scurfy, pinnatipartite to pinnatisect; segments 8–14 pairs, ovate-lanceolate to more or less oblong, pinnatifid, spinescent double-dentate. Inflorescences short-racemose; bracts leaf-like. Calyx 6–8 mm long; 1/2 cleft anteriorly; tube 5–6 mm long; lobes 3, unequal, posterior lobe smallest, lateral pair flabellate. Corolla yellow; tube erect, ca. as long as calyx; galea more or less bent at a right angle apically, with 1 triangular reflexed marginal tooth on one side; lower lip 6–8 mm long, 5–7 mm wide, ciliate. Filaments all glabrous.

Phenology: flowering and fruiting from July to August.

Habitats: unknown.

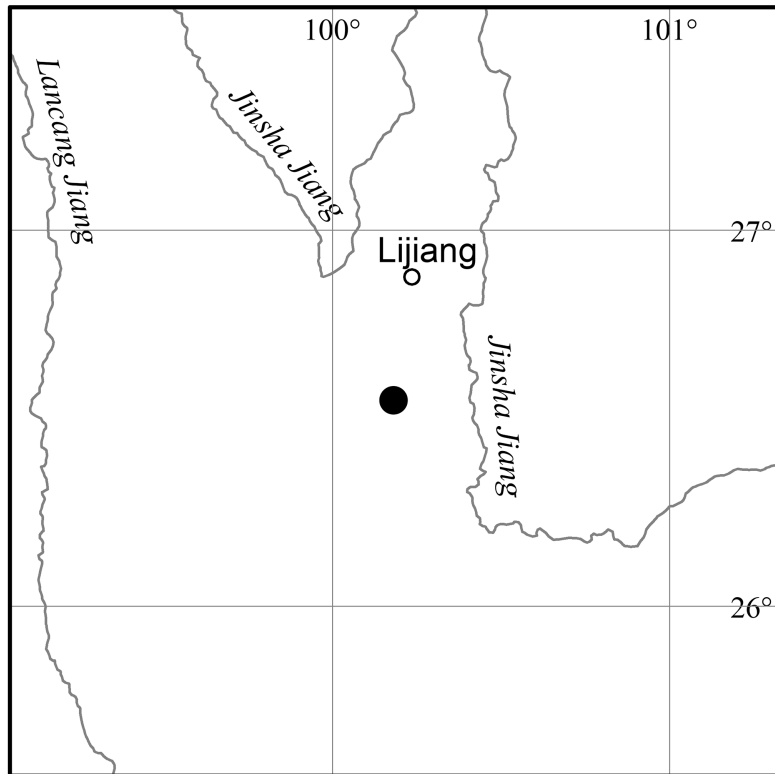
Distribution: endemic; S Hengduan [Map 45(2)–79].

Notes: Maximowicz recorded field information “prope Langkong, sylvis prope trajectum Yen-tze-hay, 3000 m (*Delavay!* In herb. Paris.)”. After examining specimens in the herbarium P, *J. M. Delavay 2378* is here determined as type collection, and one sheet (P02981335) is designated as lectotype.

S Hengduan: Heqing/Jianchuan, 3000 m, 8 June 1886, *J. M. Delavay 2378* (P).

80. *Pedicularis cephalantha* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 540. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 240. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 166. 1998. ≡ *Pedicularis cephalantha* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 121. 1949. Type: China, Yunnan, Dali/Heqing, *J. M. Delavay 98* [**lectotype designated here:** P(P00587589); isolectotypes: P(P00587590, P00587591)].

Pedicularis longipetiolata Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 541. 1888; Tsoong in Chien & Chun, Fl. Reipubl.



Map 45(2)-79: *Pedicularis oligantha* Franch. ex Maxim.

Popularis Sin. 68: 242. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 167. 1998. **syn. nov.** Type: China, Yunnan, Jianchuan to Heqing “ad Lankang in paludibus, 2800 m (Delavay! In herb. Paris.)”, Sept. 1884, *J. M. Delavay* 720 [**lectotype designated here:** P(P02985120); isoelectotypes: P(P02985121, P02985122, P02985123, P02985125, P02985126)].

Herbs perennial, usually 12–50 cm tall, more or less black when dry. Stems single or several, central stem often more or less ascending, outer stems usually procumbent at base, often branched at base, glabrous, or sometimes with lines of hairs. Leaves mostly basal; petiole 2–4 cm long, glabrescent; leaf blade elliptic-oblong to lanceolate-oblong, 6–8 cm long, 1.7–2 cm wide, adaxially glabrous, abaxially sparsely whitish-villous along midvein, pinnatisect; segments 7–14 pairs, ovate to ovate-

lanceolate, pinnatifid, spinescent-dentate; cauline leaves few, similar to basal leaves but smaller; segments 5–9 pairs. Inflorescences subcapitate, few-flowered; bracts leaflike; pedicels 1–4 mm long. Calyx 8–10 mm long, 2/3 cleft anteriorly, sparsely pubescent; lobes 2 or 5, unequal or when 2, equal, small. Corolla deep red, purple, or purplish-red, 20–30 mm long; tube erect, 12–14 mm long, glabrous externally; galea falcate apically, more or less crested, glandular-pubescent abaxially, with 1 distinct reflexed marginal tooth on one side; beak 5–6 mm long; lower lip 10–12 mm long, 15–20 mm wide, sparsely ciliate sometimes. Filaments 2 pubescent, 2 glabrous. Capsule long ovoid. Figure 45(2)–34.

Phenology: flowering from June to July.

Habitats: alpine meadows, *Picea* forests; 2800–4900 m.

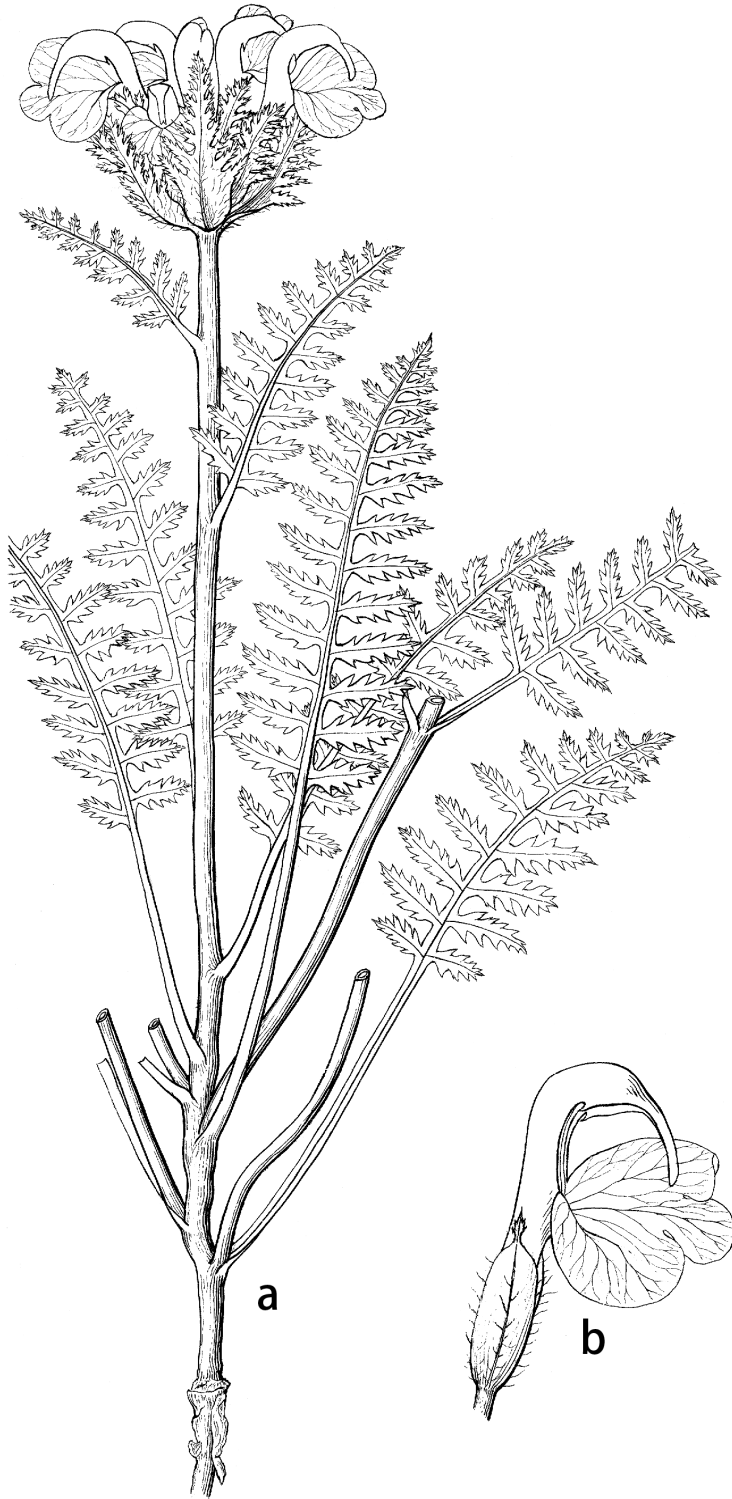


Figure 45(2)-34: *Pedicularis cephalantha* Franch. ex Maxim. a, habit; b, flower. Drawn by F.-X. WANG for *P. cephalantha* var. *szetchuanica* Bonati [*Fl. Reipubl. Popularis Sin.* 68: 241, figure 56: 1-2. 1963].

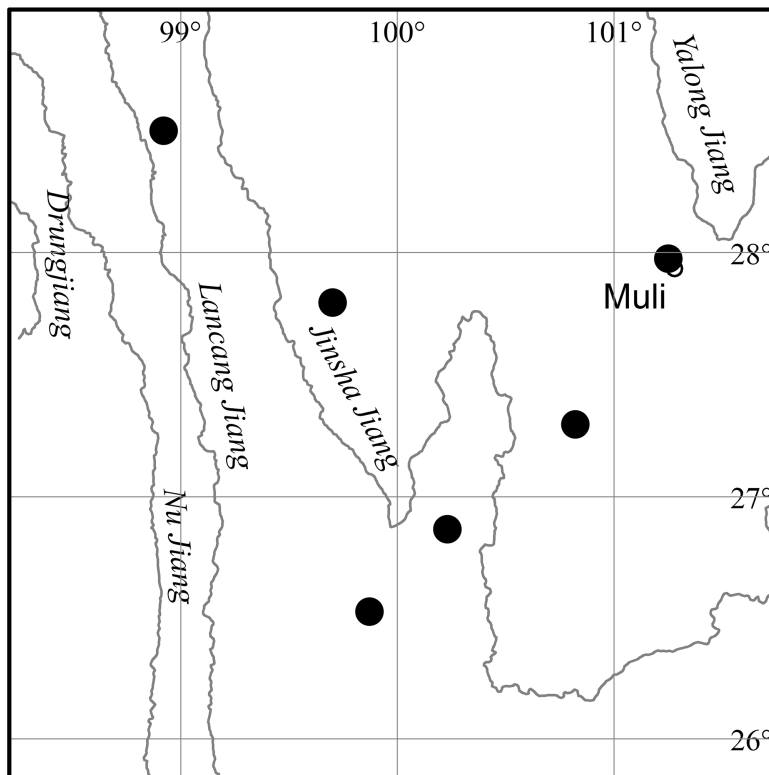
Distribution: S Hengduan [Map 45(2)–80]; also in SE Yunnan, China.

Notes: Only one collection was cited in the protologue of *P. cephalantha* Franch. ex Maxim. “*augustilis* Koua-la-po inter Tali et Hokin (*Delavay!* In herb. Paris)”. The collection *J. M. Delavay 98* in the herbarium P matches well the protologue, and thus a sheet of the collection is designated here as lectotype. When Maximowicz described *P. longipetiolata* Franch. ex Maxim, he recorded field information: “Prov. Yunnan, ad Lankong in paludibus, 2800 m (*Delavay!* in herb. Paris)” but did not provide a record number. We here designate one sheet of *J. M. Delavay 720* as lectotype based on the field information.

After examinations of more herbarium specimens, Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 118–119) stated that the floral structure of *P. cephalantha* Franch. ex Maxim. and *P. longipetiolata* Franch. ex Maxim. is very similar, except that flower of the former (23–30 mm long) is slightly

larger than that of the latter (18–23 mm long). He thought that more discernible and reliable differences between the two species are in vegetative characteristics, and *P. cephalantha* differs from *P. longipetiolata* in having smaller plant (15–20: 20–40), stems branched at base not above, and leaves mostly basal with a few cauline. With more herbarium specimens examined, we find that these vegetative characters are continuous between two “species”, and *P. longipetiolata* should be treated as a synonym of *P. cephalantha* Franch. ex Maxim. Our molecular phylogenetic results indicate that all individuals of *P. cephalantha* Franch. ex Maxim. are clustered into one clade.

S HENGDUAN: Dêqên, 3700 M, Aug. 1935, *C. W. Wang 68827* (PE). **Jianchuan**, Luoping Shan, 2 July 1929, *R. C. Ching 23088* (PE, KUN). **Muli**, Deongomba, 3450 m, 15 June 1937, *T. T. Yü 6240* (PE). **Ninglang**, Yongning, Tuo-ohibar-ze, 2500 m, 17 May 1937, *T. T. Yü 5393* (PE). **Shangri-la** (Zhongdian), 3100 m,



Map 45(2)–80: *Pedicularis cephalantha* Franch. ex Maxim.

6 July 1937, *T. T. Yü 11969* (PE); Shangri-la (Zhongdian), Alpine Botanic Garden, 3298 m, 11 Aug. 2008, *Q. S. Yang et al. Zhouzk-07ZX-0199* (KUN); Shangri-la (Zhongdian), Shikaxue Shan, 4000–4200 m, 21 June 1981, *Qinghai-Xizang Exped. 1297* (PE). **Yulong** (Lijiang), Xuesong Shan, 3000 m, 24 Sept. 1937, *T. T. Yü 15624* (PE); Yulong (Lijiang), 3000 m, July 1935, *C. W. Wang 71112* (PE, KUN); Yulong (Lijiang), 3400 m, 17 July 1940, *R. C. Ching 30882* (PE); Yulong (Lijiang), 3400 m, 1910, *G. Forrest 5925* (PE); Yulong (Lijiang), Longshangongshe, 2500 m, 15 Oct. 1983, *Qinghai-Xizang Exped. 14976* (PE, KUN); Yulong (Lijiang), Yulongxue Shan, 3600–4000 m, 23 July 1981, *PE Hengduan Shan Exped. 01969* (PE, KUN); Yulong (Lijiang), Yulongxue Shan, 4000–4200 m, 28 July 1981, *PE Hengduan Shan Exped. 01969* (PE, KUN); Yulong (Lijiang), near bank, 3231 m, 14 Aug. 2015, *Y. J. Guo et al. 15CS10409* (PE).

81. *Pedicularis dissectifolia* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 119. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 244. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 167. 1998. Type: China, Yunnan, no detailed field information, collected in 1938, *T. T. Yü 6866* [holotype: A(00097216); isotypes: PE(00031373, 00031374)].

Pedicularis fengii H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 120. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 244. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 167. 1998. **syn. nov.** Type: China, Shangri-la (Zhongdian), north flank of the Haba snow range, 20 Aug. 1938, *K. M. Feng 2101* [holotype: A(00097221); isotypes: KUN(1218272, 1218273), PE(00031456)].

Herbs perennial, 20–30 cm tall, black when dry. Stems several, branched near base; branches erect or ascending, slender, glabrous, or sparsely pubescent. Leaves mostly basal, alternate or proximal ones often pseudo-opposite; petiole of basal leaves 4–9 cm long, sparsely villous; leaf blade oblong-lanceolate to ovate-oblong, 3–7 cm long, 1–3.5 cm wide, glabrous on both surfaces, sparsely whitish-scurfy, pinnatipartite

to pinnatisect; segments 5–7 pairs, more or less oblong, pinnatipartite, spinescent-dentate; cauline leaves smaller than basal leaves, short-petiolate, alternate or pseudo-opposite. Inflorescences subcapitate, 3–7-flowered; bracts leaflike; pedicels 7–15 mm long. Calyx 5–7 mm long, 1/2 cleft anteriorly; lobes 2 or 3, unequal, lateral pair flabellate, longer than the posterior one. Corolla purplish-red, 17–22 mm long; tube erect, longer than calyx, glabrous; galea falcate, more or less crested, with 1 reflexed marginal tooth on one side; beak 4–5 mm long, slightly cleft at apex, more or less horizontal; lower lip slightly longer than galea, sparsely pubescent. Filaments 2 pubescent, 2 glabrous. Capsule barely completely enclosed by accrescent calyx, oblong-ovoid, compressed, 10–12 mm long, 5–6 mm wide, apex acute. Figure 45(2)–35.

Phenology: flowering from June to July.

Habitats: under *Picea* forest; 2900–3800 m.

Distribution: S Hengduan [Map 45(2)–81]; also in other regions of Yunnan Province, China.

Notes: Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 119–121) described *P. dissectifolia* H. L. Li and *P. fengii* H. L. Li as new based on one or two collections in his monograph. He stated that the former is similar to *P. cephalantha* Franch. ex Maxim. and *P. longipediolata* Franch. ex Maxim., but differs in calyx with teeth two, sometimes with a very small one acute additional anterior tooth, and in leaflets fewer and pinnatisect to deeply pinnatifid. At the same time, he stated that *P. fengii* resembles *P. cephalantha* and *P. longipediolata*, but differs from them in two flabellate, deeply incised lateral calyx teeth with an additional posterior small and oblong one, and more strongly curved galea. In *Fl. China* the two species are discriminated (in the keys) by leaves mostly basal or mostly cauline, and galea conspicuously crested or inconspicuously crested. After examining more herbarium specimens, we find that the calyx lobes of *P. fengii* are slightly larger than that of *P. dissectifolia*, calyx teeth are some deeper than that of the latter, and in both species, galea is crested or inconspicuously crested. Hence, the two species should be merged. Our molecular phylogenetic results show that two accessions of *P. fengii* H. L. Li and one

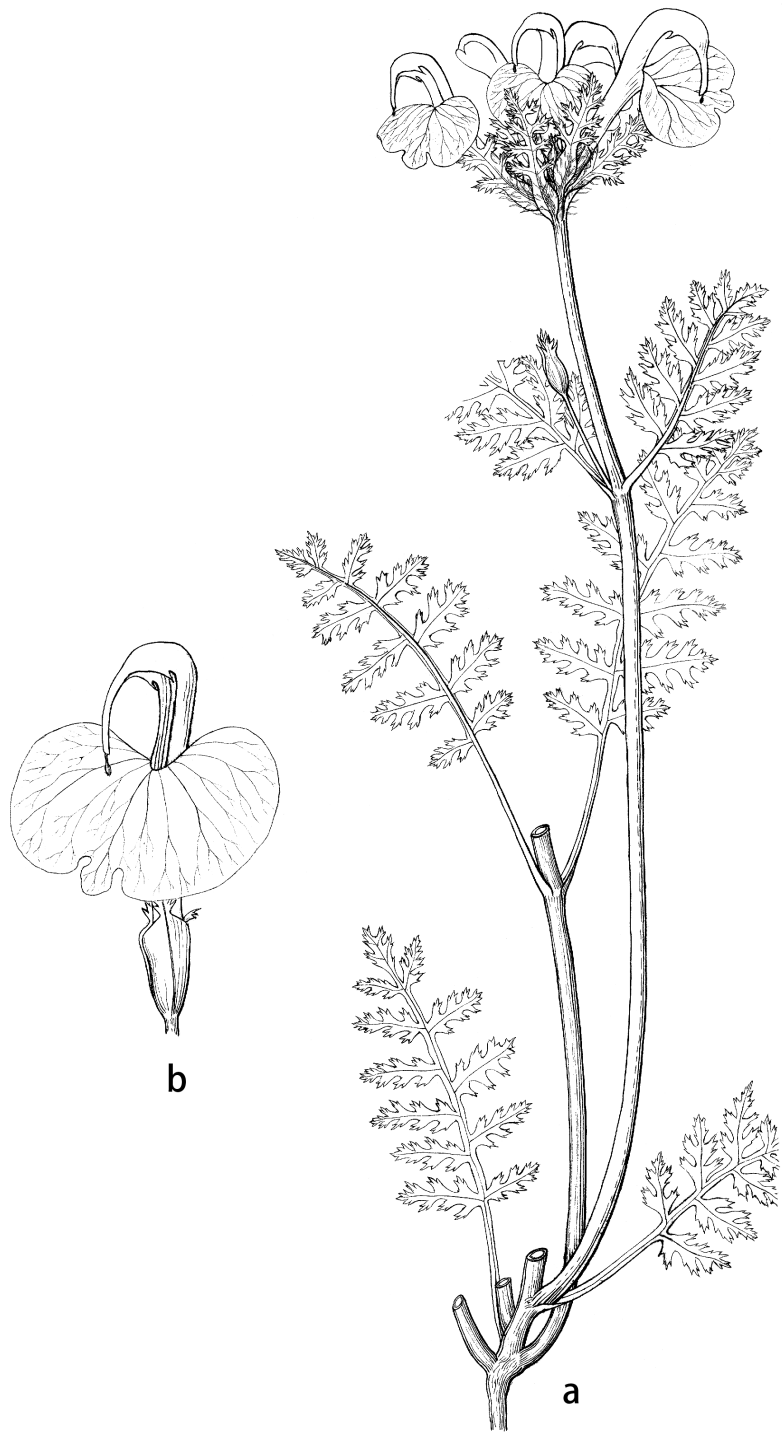
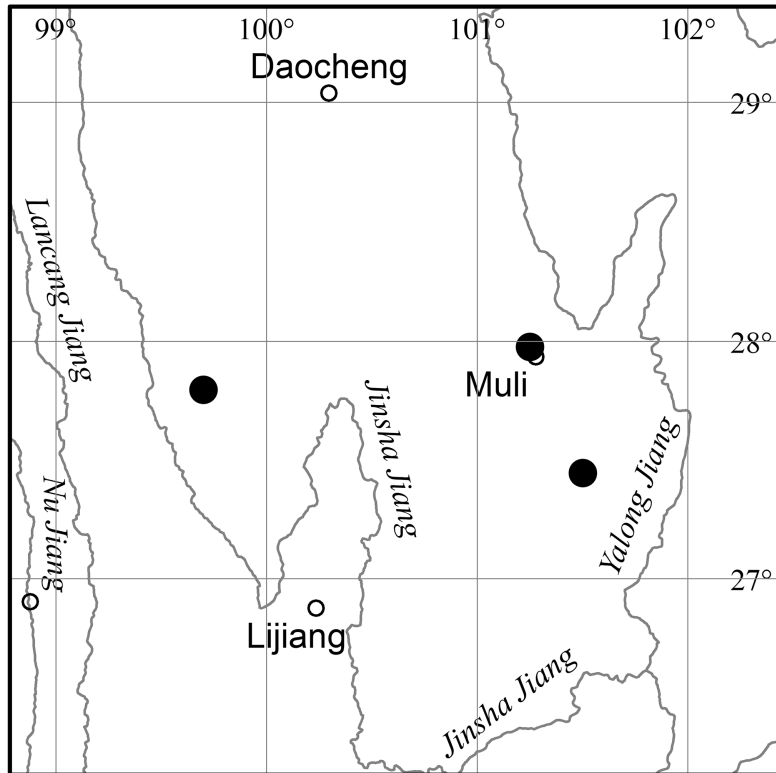


Figure 45(2)-35: *Pedicularis dissectifolia* H. L. Li. a, habit; b, flower. Drawn by F.-X. WANG for *P. fengii* H. L. Li [*Fl. Reipubl. Popularis Sin.* 68: 244, figure 56: 3-4. 1963].



Map 45(2)-81: *Pedicularis dissectifolia* H. L. Li

of *P. dissectifolia* H. L. Li form a monophyletic clade.

S HENGDUAN: Muli, Yazuilinchang, 19 Aug. 1983, *Qinghai-Xizang Exped.* 13055 (PE). **Shangri-la** (Zhongdian), Lai-cha-tze-ka near Hsia-Chungtien, 3700 m, 31 July 1939, K. M. Feng 1920 (PE). **Yanyuan**, Yuanbao Dist., Huolou Shan, 3800 m, 21 July 1983, *Qinghai-Xizang Exped.* 12205 (PE); Yanyuan, Huolu Shan, 4000 m, 23 July 1983, *Qinghai-Xizang Exped.* 12342 (PE00155860-PE00155862, PE00155956-PE00155957). NW Yunnan: precise locality unknown, T. T. Yü 6866 (PE).

82. *Pedicularis strobilacea* Franch. ex F. B. Forbes & Hemsl., J. Linn. Soc. Bot. 26: 216. 1890; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 238. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 165. 1998. Type: China, Yunnan, Yentzehay, 3500 m,

8 July 1888, J. M. Delavay 3402 [**lectotype designated here:** K(K000708682); isolecotypes: K(K000708683), P(P02908996), P(P02908998), P(P02909001), P(P02909003), P(P01029621)].

Pedicularis anomala P. C. Tsoong & H. P. Yang, Acta Phytotax. Sin. 18: 243. 1980; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 199. 1998. **syn. nov.** Type: China, Tibet, Bomi, Guxiang, 3800 m, 22 Aug. 1965, T. C. Ying & D. Y. Hong 650989 [lectotype designated by Lin in 2007: PE(00031447)].

Pedicularis dichrocephala Hand.-Mazz., Symb. Sin. 7: 863. 1936; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 114. 1998. **syn. nov.** Type: China, Yunnan, Shangri-la (Zhongdian), “Inter vicos Bödö (Peti) et Alo ad austro-orient. pagi Dschungdien (‘Chungtien’), in regionis frigide temperatae fructicetis ad jugum”, 4100 m, 7 Aug. 1914, H.

R. E. von Handel-Mazzetti 4521 [holotype: WU].

Pedicularis lanpingensis H. P. Yang, Acta Bot. Yunnan. 6: 278. 1984; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 166. 1998. **syn. nov.** Type: China, Yunnan, Lanping, 3800 m, 22 June 1981, *PE Hengduan Shan Exped. 764* [holotype: PE(00033131)].

Herbs 20–60 cm tall. Stems erect, often branched at base; branches alternate or sometimes pseudo-opposite, whitish-pubescent. Basal leaves withering early; cauline leaves alternate, widely spaced; petiole 1.5–3 cm long; leaf blade oblong to ovate-oblong, usually longer than petiole, 2–4 cm long, 1–2 cm wide, sparsely whitish-pubescent and scurfy on both surfaces, pinnatifid to pinnatisect; segments 5–9 pairs, oblong or triangular-ovate to obliquely triangular-ovate, triangular-dentate. Inflorescences subcapitate-racemose; proximal bracts leaflike; pedicels 1–5 mm long, pubescent. Calyx obliquely funnelform-campanulate, whitish-villous, 1/2 to 2/3 cleft anteriorly; tube 4–7 mm long; lobes 5, leaflike, whitish-pubescent internally. Corolla whitish-yellow, with purple galea, 17–22 mm long; tube erect, longer than calyx; galea falcate, whitish-villous, inconspicuously crested; beak filiform, 4–6 mm long, bent downward; lower lip 8–10 mm long, 10–12 mm wide, ciliate, middle lobe obovate. Filaments 2 pubescent, 2 glabrous (sometimes sparsely pubescent). Capsule obliquely ovoid, apiculate. Figure 45(2)–36. **Chromosomes:** $2n = 16$.

Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; 2500–3800 m.

Distribution: endemic; Tangut, S Hengduan [Map 45(2)–82].

Notes: Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 32–33) described *P. gracilicaulis* H. L. Li as new and designated a holotype (*C. W. Wang 64788*) and a paratype (*T. T. Yü 19701*). He stated that it resembles *P. hemsleyana* Prain but “differs from the latter in the calyx cleft anteriorly, the teeth broader and more profoundly

dentate...”. He placed these two species in the series *Furfuraceae*. However, some morphological characters of the paratype are inconsistent with the original description. We compared the two specimens and find that *C. W. Wang 64788* differs from *T. T. Yü 19701* in prominently crested galea and larger middle lobe of the corolla lip. The former is congruent with Li’s description of *P. gracilicaulis* H. L. Li, but the latter should be a different taxon (will be discussed below). Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 236–238) stated that *P. gracilicaulis* H. L. Li is similar to *P. dichrocephala* Hand.-Mazz. but differs slightly in the shape of bracts, and thus he transferred *P. gracilicaulis* H. L. Li and *P. dichrocephala* Hand.-Mazz. from the series *Furfuraceae* to the series *Strobilaceae*.

Yang published *P. anomala* P. C. Tsoong & H. P. Yang as new based on a collection from SE Tibet, and she compared it with *P. tsangchanensis* Franch. and placed it in the series *Filiculae*. However, after a survey of type collection and other herbarium specimens, we find that *P. anomala* is the same as, or identified as, *P. strobilacea* Franch. ex F. B. Forbes & Hemsl. Yang also described *P. lanpingensis* H. P. Yang as new based on a collection (*Hengduan Shan Exped. 764*) from NW Yunnan. She stated that it is different from *P. dichrocephala* Hand.-Mazz. by larger leaves, deeper calyx cleft (1/2 vs. 2/3), and narrower crested galea.

In *Fl. China*, the series *Strobilaceae* includes five species, i.e., *P. gracilicaulis* H. L. Li, *P. dichrocephala* Hand.-Mazz., *P. strobilacea* Franch. ex F. B. Forbes & Hemsl., *P. lanpingensis* H. P. Yang, and *P. pseudocephalantha* Bonati. These taxa are generally defined based on the length of corolla and calyx, the shape of galea, and the size of middle lobes of corolla. After examinations of herbarium specimens, we find that the morphological characters used to define these “species” vary within and among “species”. Taxa of the series *Strobilaceae* could be categorized into two complexes. Complex I (subsp. *strobilacea*) includes *P. lanpingensis* H. P. Yang, *P. strobilacea* Franch. ex F. B. Forbes & Hemsl., *P. anomala* H. P. Yang, and *P. dichrocephala*

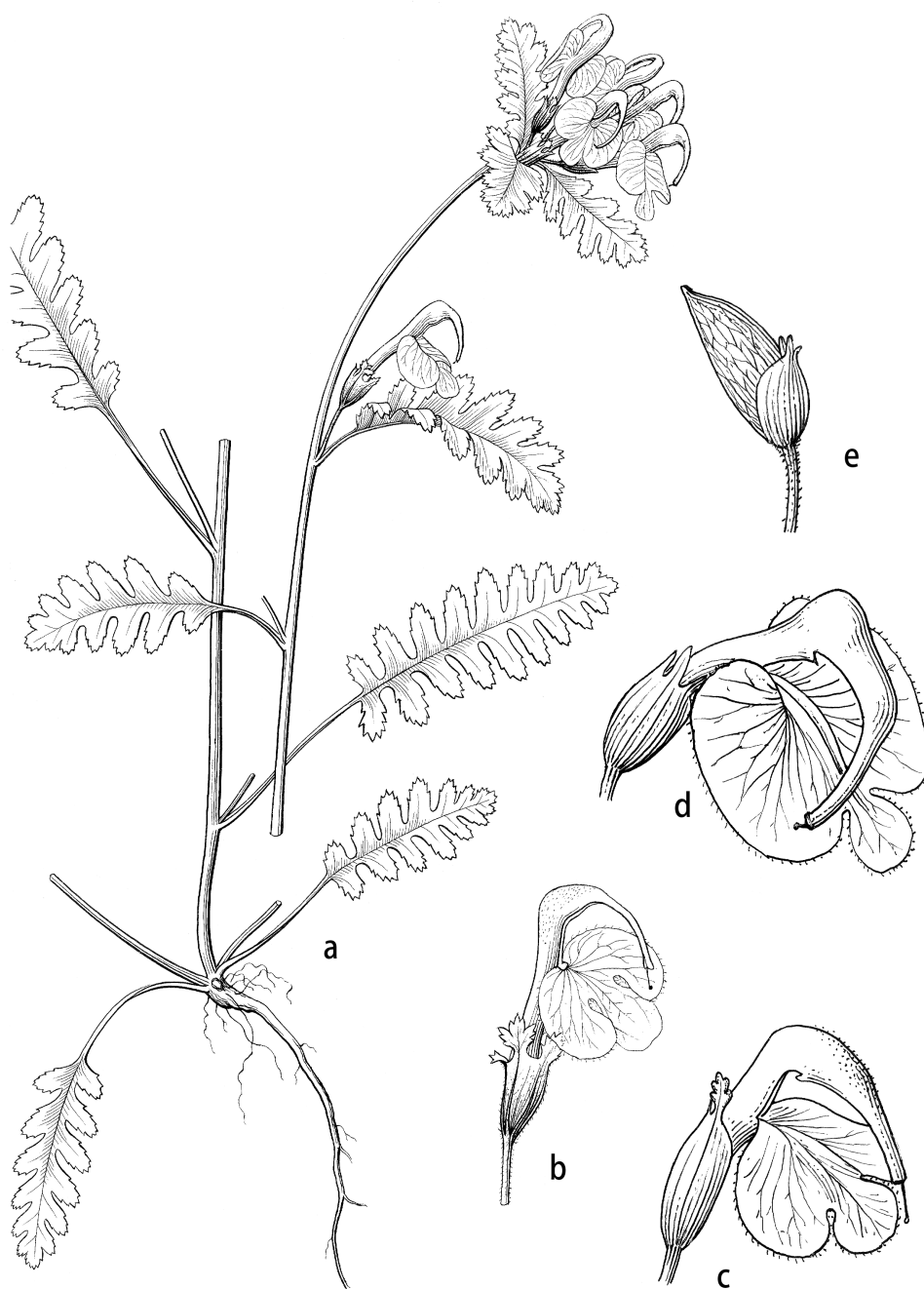
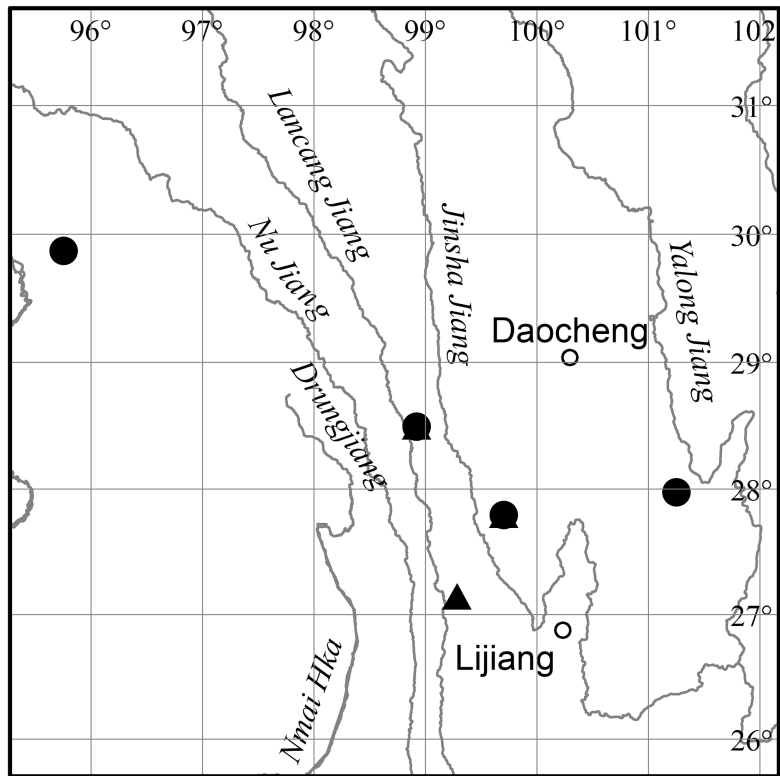


Figure 45(2)–36: **Pedicularis strobilacea** Franch. ex F. B. Forbes & Hemsl. a-b: a, habit; b, flower. Drawn by R.-H. ZHANG [*Fl. Reipubl. Popularis Sin.* 68: 244, figure 55: 1-2. 1963]. **Pedicularis macilenta** Franch. ex F. B. Forbes et Hemsl. c, flower. C.-Z. JI modified from R.-H. ZHANG [*Fl. Reipubl. Popularis Sin.* 68: 248, figure 57: 6. 1963]. **Pedicularis oxycarpa** Franch. ex Maxim. d-e: d, flower; e, capsule. C.-Z. JI modified from J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 249, figure 57: 4-5. 1963].



Map 45(2)–82: *Pedicularis strobilacea* Franch. ex F. B. Forbes & Hemsl.
 ● subsp. *strobilacea* ▲ subsp. *pseudocephalantha*

Hand.-Mazz., which are characterized by inconspicuously crested galea and smaller middle lobe of the lower lip; while complex II (subsp. *pseudocephalantha*) includes *P. gracilicaulis* and *P. pseudocephalantha*, which have prominently crested galea and larger middle lobes. The paratype (*T. T. Yü* 19701) of *P. gracilicaulis* mentioned above should be a member of complex I rather than *P. gracilicaulis* (complex II). We treat the two complexes as two subspecies, considering narrow geographical distribution and subtle morphological variation.

- 1a. Middle lobe of corolla lip obovate or obovate-rounded, no more than 5 mm long; galea inconspicuously crested or not crested..... 82a. subsp. *strobilacea*
- 1b. Middle lobe of corolla lip elliptic to oblong, 7–8 mm long; galea prominently crested..... 82b. subsp. *pseudocephalantha*

82a. *Pedicularis strobilacea* subsp. *strobilacea*

Stems single or several, branched or unbranched. Middle lobe of corolla lip obovate or obovate-rounded, no more than 5 mm; galea inconspicuously crested or not crested.

Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; 3000–3500 m.

Distribution: L Yalung Zangbo, S Hengduan [Map 45(2)–82].

L Yalung Zangbo: Bomi, Guxiang, 3200 m, 30 July 1965, *T. C. Ying & D. Y. Hong* 650841 (PE). **S HENGDUAN:** Dêqên, 3400 m, 8 Aug. 1940, *K. M. Feng* 6402 (PE, KUN). **Muli,** 2800 m, 1 Aug. 1937, *T. T. Yü* 7613 (PE, KUN). **Shangri-la** (Zhongdian), 4100 m, 7 Aug. 1914. *H. R. E. von Handel-Mazzetti* 4521 (WU).

82b. *Pedicularis strobilacea* subsp. *pseudocephalantha* (Botani) F. S. Yang. comb. et stat. nov.

≡ *Pedicularis pseudocephalantha* Bonati, Bull. Soc. Bot. Genève, Ser. 2, 5: 314. 1913; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 239. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 166. 1998. Type: China, Yunnan, “Tsikou, Tibet Oriental (Monbeig)”, 20 July 1912, *no record number* [lectotype designated here: P(P02977037)].

Pedicularis gracilicaulis H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 32. 1949 pro parte, quoad, paratype *T. T. Yü 19701*; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 236. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 165. 1998. **syn. nov.** Type: China, Yunnan, Dêqên, “Atuntsi, meadow stream side”, 3000 m, July-Aug. 1935, *C. W. Wang 64788* [holotype: A(00097224); isotypes: PE(00033140), PE(00031471)].

Pedicularis strobilacea var. *riparia* Bonati, Notes Bot. Gard. Edinb. 13: 117. 1921. Type: China, NW Yunnan, near streams in forest, 3050–3350 m, July 1913, *F. Kingdon-Ward 14367* [lectotype designated here: E(E00438465); isolectotype: K(K000708679)].

Stems erect, usually many-branched. Middle lobe of corolla lip elliptic to oblong, 7–8 mm long; galea prominently crested, 1–1.5 mm wide.

Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; 3000–3800 m.

Distribution: endemic; S Hengduan [Map 45(2)–82].

Notes: When Bonati described *P. strobilacea* var. *riparia* Bonati as new, he listed three collections, *F. Kingdon-Ward 683*, *G. Forrest 14367*, and *14581*. One sheet of *F. Kingdon-Ward 683* is designated here as lectotype. Our molecular phylogenetic results reveal that *P. gracilicaulis* H. L. Li is nested in the clade including two accessions of *P. strobilacea*, supporting our taxonomic treatment based on morphological evidence.

S HENGDUAN: Dêqên, 4000 m, 1 Aug. 1940, *K. M. Feng 6017* (PE); Dêqên, Atuntsi, Paima Shan, Kuchianung, 3800 m, 8 Aug. 1937, *T. T. Yü 9431* (PE); Dêqên, near the city, 2700 m,

Sept. 1935, *C. W. Wang 69899* (KUN, IBSC); Dêqên, Atuntsi, 3700 m, Aug. 1935, *C. W. Wang 68785* (IBSC); Dêqên, mountains near the city, 4160 m, 24 July 1987, *Z. D. Fang 0224* (SABG); Dêqên, Renzhixue Shan, 3750–3800 m, 11 July 2001, *F. S. Yang Y0031* (PE); Dêqên, 3900 m, 12 Aug. 1937, *T. T. Yü 9616* (PE); Dêqên, Yangtsa, snow range, 3800 m, 23 Aug. 1937, *T. T. Yü 9776* (PE); Dêqên, Jiansheju, 3000 m, 8 July 1935, *C. W. Wang 64788* (PE); Dêqên, Benzilan, 3600 m, 9 July 1981, *Qinghai-Xizang Exped. 2513* (PE). **Shangri-la** (Zhongdian), 3600 m, 17 Aug. 1981, *Hengduan Shan Exped. (PE) 3162* (PE). **Weixi**, Tungchuling, Sungyenka, 3800 m, 11 July 1937, *T. T. Yü 8889* (PE).

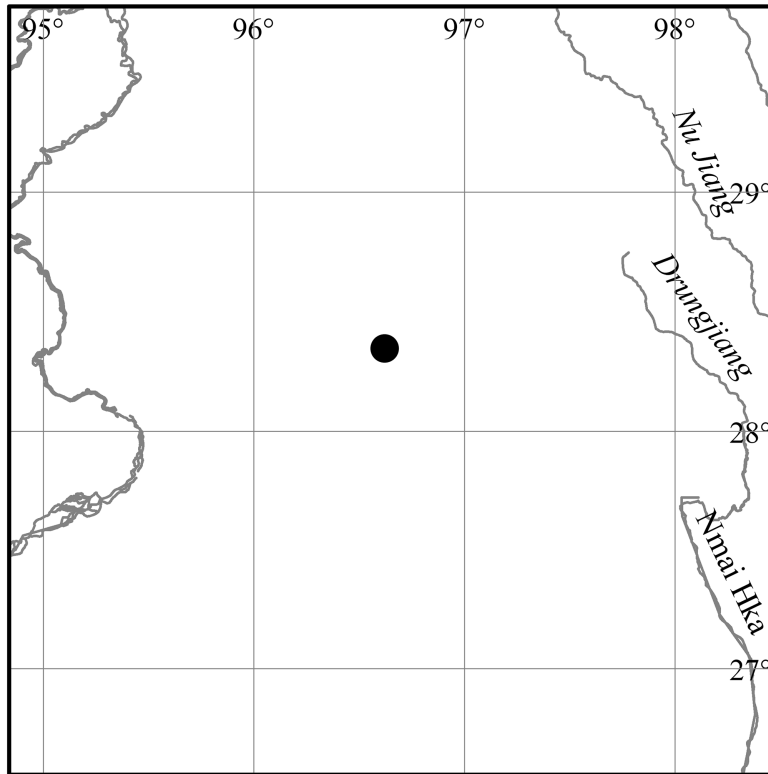
83. *Pedicularis cephalanthoides* P. C. Tsoong, Kew Bull. 9: 447. 1954. Type: Yarlung Zangbo-Brahmaputra, Delei Valley, 3050–3650 m, 28 June 1928, *F. Kingdon-Ward 8379* [holotype: K(K000739103)].

Herbs 8–15 cm tall. Rhizome short, covered by several ovate scales on nodes, membranous; roots cespitose, some branches fleshy, more or less fusiform. Stems more or less pilose. Basal leaves lanceolate, membranous; cauline leaves one or two, alternate, usually long-petioled; petiole 10–25 mm long, densely pubescent; leaf blade oblong or oblong-lanceolate, 1–3 cm long, 0.6–1.2 cm wide; pinnatifid or pinnatisect; segments 6–8 pairs, ovate. Inflorescences axillary; flowers 2–5, pedicels 5–10 mm long. Calyx 4–6 mm long; lobes 1–2 mm long, triangular, scarcely serrate. Corolla pinkish-purple; tube 12–16 mm long, two to two and half times as long as calyx; galea beaked, basal part erect, 3–4 mm long, anther pouch horizontal; beak 4–5 mm long, attenuate; lower lip 10–13 mm long, 12–15 mm wide, 3-lobed; median lobe obovate, lateral lobes distinctly emarginate. Filaments all pilose.

Phenology: flowering from June to July.

Habitats: on grassy ledges of gneiss and granite cliffs in open places, 3700–4000 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra [Map 45(2)–83].



Map 45(2)-83: *Pedicularis cephalanthoides* P. C. Tsong

YARLUNG ZANGBO-BRAHMAPUTRA: **Delei Valley**, 28°21' N, 96°37' E, 3050–3650 m, 28 June 1928, *F. Kingdon-Ward 8379* (PE).

84. *Pedicularis macilenta* Franch. ex F. B. Forbes et Hemsl., *J. Linn. Soc. Bot.* 26: 212. 1890; Tsong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 248. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 168. 1998. Type: China, NW Yunnan, “in humid localities on the slopes on the mount Yentze-hay, (*Delavay 1888 ex Franchet*)”, *J. M. Delavay 3698* [**lectotype designated here:** P(P02981467); isolectotype: P(P02981468)].

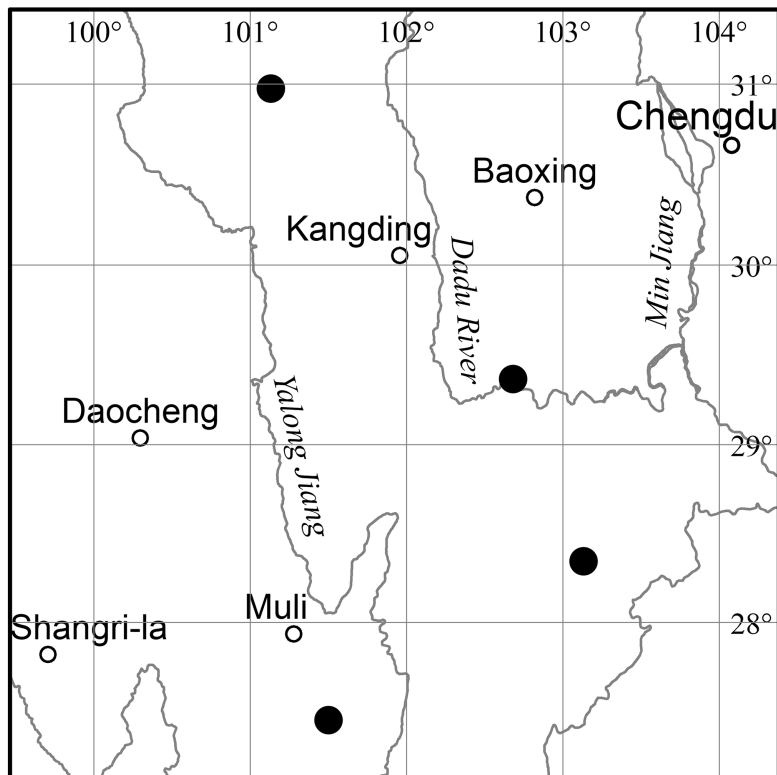
Herbs annual or biennial, 20–40 cm tall, glabrescent, scarcely black when dry. Stems 6–12, ascending, often shortly branched apically, with lines of hairs. Leaves mostly cauline, alternate or pseudo-opposite; petiole 0.5–1 cm long or distal ones more or less sessile, glabrescent; leaf blade ovate-elliptic to narrowly oblong, 3–5 cm long, 1–1.5 cm wide, glabrous on both surfaces,

abaxially sparsely whitish-scurfy, pinnatisect; segments 5–11 pairs, ovate to lanceolate-oblong, incised-pinnatifid or double-dentate. Inflorescences racemose, 5–10 cm long; bracts leaflike. Calyx 6–7 mm long, glabrous, 1/3 cleft anteriorly; lobes 3, unequal, posterior lobes acicular, lateral pair larger, toothed. Corolla white, with reddish beak, 11–13 mm long; tube erect, ca. 2 times as long as calyx; galea more or less falcate, slightly crested, not twisted; beak straight, 3–4 mm long, slightly 2-cleft at apex, not ciliate; lower lip nearly as long as galea. Filaments all glabrous. Capsule ovoid, 9–12 mm long, 5–6 mm wide. Seeds narrowly ovoid, ca. 2 mm long. Figure 45(2)–36.

Phenology: flowering from June to July.

Habitats: grassy slopes; ca. 2900 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–84]; also in other parts of Sichuan and Yunnan Provinces, China.



Map 45(2)-84: *Pedicularis macilenta* Franch. ex F. B. Forbes et Hemsl.

Notes: Type, “in humid localities on the slope of mount Yentzehay (*Delavay 1888, ex Franchet*)”, was cited in the protologue of *P. macilenta* Franch. ex F. B. Forbes et Hemsl. Two sheets of *Delavay 3698*, matching well the records, have been deposited in the herbarium P, with one here designated as lectotype.

N HENGDUAN: Dawu, Tahsiangling, 2900 m, 26 June 1934, *H. Smith 10198* (PE00134078–PE00134082). **S HENGDUAN:** Hanyuan, 1934, *Z. S. Liu 550* (PE). Meigu, Ligou, Kongmingzhai, 2800 m, 5 Aug. 1959, *Chuangjingliang (59) 1594* (PE). Yanyuan, Bailinggongshe, 3100 m, 11 Aug. 1983, *Qinghai-Xizang Exped. 12874* (KUN, PE); Yanyuan, Bailinggongshe, 3500–3600 m, 7 Aug. 1983, *Qinghai-Xizang Exped. 12720* (KUN, PE).

85. *Pedicularis hongii* Kottaim., *Ann. Bot. Fenn.* 57: 209–210. 2020. ≡ *Pedicularis multicaulis* W. B. Yu, H. Wang & D. Z. Li, *PhytoKeys* 130:

205–215. 2019, nom. illeg., non *Pedicularis multicaulis* Bonati, *Notes Roy. Bot. Gard. Edinburgh* 13: 140. 1921. Type: China. Yunnan: Weixi, Lidiping, wet meadow, 3180 m, 30 Aug. 2014, *W. B. Yu, X. L. Yang & H. Tang 2014096* [holotype: HITBC; isotypes: HITBC, KUN)].

Herbs perennial, 30–50 cm tall, glabrescent, slightly black when dry. Taproots slender and fusiform. Stems caespitose, mostly 5 to 9, ascending or partially crawling, branched, glabrescent, or with lines of hair. Basal leaves absent; cauline leaves alternate; petiole 5–10 mm or distal ones more or less sessile, glabrescent; leaf blade ovate-elliptic or oblong, 5–30 mm long, 7–15 mm wide, glabrous on both surfaces, pinnatisect; segments 2 to 5 pairs, ovate to lanceolate-oblong, incised-pinnatifid or double-dentate. Inflorescences racemose, up to 30 cm long; bracts leaflike, distal ones shorter than flowers. Pedicel 1–2.5 mm. Calyx tube ca. 5 mm long, glabrescent, 1/3 cleft anteriorly; lobes 3,

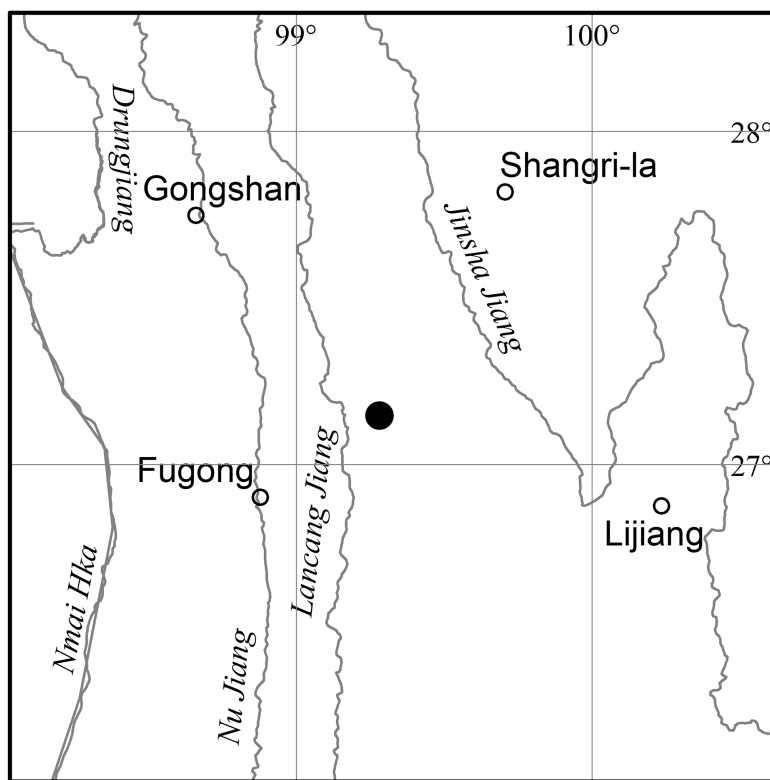
posterior one acicular, lateral pair larger, leaf-like. Corolla rose, 10–14 mm long; tube erect, 8–10 mm; galea more or less falcate, with 1 distinct reflexed marginal tooth on one side; beak straight, ca. 3 mm long, slightly 2-cleft at apex; lower lip 5–6 mm long, 6–8 mm wide, sparsely ciliate; middle lobes apex slightly cucullate. Filaments all glabrous. Capsule lanceolate-oblong, 10–15 mm long, 4–5 mm wide. Seeds narrowly ovoid, ca. 1 mm.

Phenology: flowering from June to August.

Habitats: wet meadow or the margin of wetland; 2900–3200 m.

Distribution: endemic; S Hengduan [Map 45(2)–85].

S Hengduan: Weixi, Lidiping, wet meadow, 3180 m, 27°9'16.06" N, 99°24'48.70" E, 30 Aug. 2014, *W. B. Yu, X. L. Yang & H. Tang 2014096* (KUN).



Map 45(2)–85: *Pedicularis hongii* Kottaim.

Ser. 29. Oxycarpae

Ser. Oxycarpae Prain, Ann. Roy. Bot. Gard. Calc. 3: 74. 1890.

Stems erect, branched near base or unbranched, rarely branched apically. Leaves basal and cauline, alternate or pseudo-opposite; leaf blade oblong to lanceolate, often pinnatisect. Inflorescences racemose or spicate, usually elongated. Calyx lobes 3–5. Corolla tube less than 2 times as long as calyx; galea twisted or not; beak sometimes twisted, bent downward.

About eight species; seven in the Pan-Himalaya (two endemics).

Notes: Our molecular phylogenetic results indicate that all species of the series *Oxycarpa* Prain form a moderately supported clade.

- 1a. Beak of corolla straight or slightly bent, more or less horizontal; galea not twisted.
 - 2a. Leaves pinnatisect; stems simple or branched at base; calyx 4–5 mm long; calyx lobes equal in size, entire, glabrescent86. *P. oxycarpa*
 - 2b. Leaves pinnatifid to pinnatipartite; stems single, unbranched; calyx 6–8 mm long; calyx lobes unequal in size, lateral lobes dentate, sparsely pubescent87. *P. monbeigiana*
- 1b. Beak of corolla semicircular or S-shaped; galea twisted.
 - 3a. Plants 5–8 cm tall; filaments all glabrous.
 - 4a. Stems single, densely glandular-pubescent; calyx tube barely 4 mm long, 3-lobed..... 88.*P. subulatidens*
 - 4b. Stems usually several, not glandular-pubescent; calyx tube 8–9 mm long, 5-lobed 89. *P. longicalyx*
 - 3b. Plants 15–40(–70) cm tall; filaments all pubescent.
 - 5a. Corolla 8–10 mm long, beak of galea semicircular; flowers reddish, with white spots on lower lip90. *P. tibetica*
 - 5b. Corolla 12–20 mm long, beak of galea often S-shaped; flowers without white spots.
 - 6a. Flowers yellow, with purplish beak; calyx pubescent91. *P. torta*
 - 6b. Flowers purplish-red or red throughout; calyx glabrescent92. *P. davidii*

86. *Pedicularis oxycarpa* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 540. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 249. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 169. 1998. Type: China, Yunnan, Jianchuan to Heqing, 3000 m, 13 July 1887, *J. M. Delavay 3064* [**lectotype designated here:** P(P02977344); isoelectotypes: P(P02977345), K(K000708673, K000708675)].

Herbs perennial, 20–40 cm tall, erect, sparsely pubescent, black when dry. Roots fleshy. Stems 1 or up to 10, branched at base or unbranched, with lines of hairs. Basal leaves withering early, petiolate or distal ones more or less sessile; petiole 1–2 cm long; leaf blade linear-oblong or lanceolate-oblong, 4–7(–10) cm long, 0.8–2 cm wide, adaxially sparsely pubescent or glabrescent, abaxially glabrous and whitish-scurfy, pinnatisect; segments 7–15 pairs, linear-lanceolate, margin double-dentate. Inflorescences racemose, 8–14 cm long, lax; bracts leaflike; proximal pedicels 3–6 mm long, slender. Calyx 4–5 mm long,

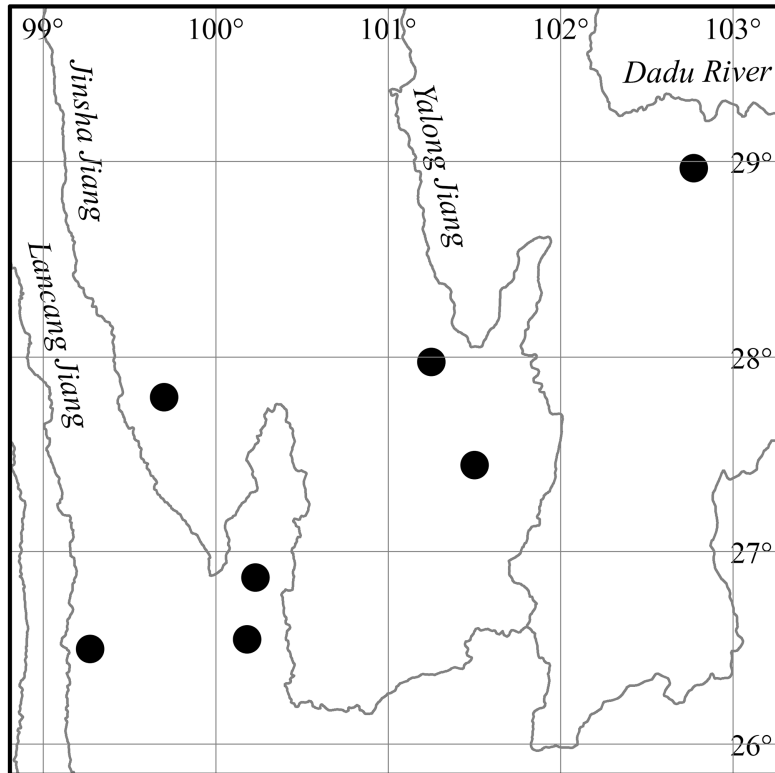
ca. 1/2 cleft anteriorly, glabrescent; lobes 3, equal in size, entire. Corolla white, with purplish beak, 14–18 mm long; tube erect, ca. 2 times as long as calyx, sparsely pubescent; galea bent at a right angle apically, distinctly crested, recurved; beak falcate, 5–7 mm long, slender, clearly crested; lower lip long ciliate. Filaments all pubescent, or 2 filaments densely pubescent, 2 sparsely pubescent. Capsule lanceolate-oblong, 10–13 mm long, 5 mm wide. Figure 45(2)–36. **Chromosomes:** $2n = 16$.

Phenology: flowering and fruiting from May to August.

Habitats: alpine meadows; 2800–4400 m.

Distribution: S Hengduan [Map 45(2)–86]; also in other parts of S Sichuan and E Yunnan, China.

Notes: In the protologue of *P. oxycarpa* Franch. ex Maxim., Maximowicz recorded “... prope Lankong, monte Hee-Chn-Men (*Delavay!* in herb. Paris)”. Based on this information, one sheet of *J. M. Delavay 3064* deposited in the



Map 45(2)-86: *Pedicularis oxycarpa* Franch. ex Maxim.

herbarium P is here designated as lectotype, and the other sheets of this collection are designated as isolectotypes. Our molecular phylogenetic results show that all individuals of *P. oxycarpa* Franch. ex Maxim. form a well-supported clade sister to *P. davidii* Franch., indicating a close relationship between the two species.

S HENGDUAN: Ganluo, Haitang, 21 July 1959, 4276 (CDBI, PE). **Heqing,** Manian Shan, 3500 m, 25 Aug. 1929, *R. C. Ching 24093* (PE). **Lanping,** 3200 m, 17 Aug. 1933, *H. T. Tsai 53779* (PE, WUK); Lanping, Xuebao Shan, 3200 m, 30 July 2010, *H. Peng Group H.-Dianlanping-E1416* (KUN). **Muli,** Tanyang, Buchang, 3600 m, 11 Sept. 1983, *Qinghai-Xizang Exped. 13904* (PE); Muli, border of Muli and Yanyuan, 3180 m, 10 Aug. 2010, *D. E. Boufford et al. 42799* (PE). **Shangri-la** (Zhongdian), Napahai, 3400 m, 23 June 1981, *Qinghai-Xizang Exped. 1398* (PE); Shangri-la (Zhongdian), Doge, 3200 m, 25 July 1937, *T. T. Yü 12436* (IBSC); Shangri-la

(Zhongdian), Pika, 3100 m, 7 July 1937, *T. T. Yü 12012* (IBSC); Shangri-la (Zhongdian), 3190 m, 26 July 2006, *D. E. Boufford et al. 35369* (PE); Shangri-la (Zhongdian), 3200 m, 24 June 1931, *K. M. Feng 1391* (PE). **Yanyuan,** 3200 m, 20 July 1983, *Qinghai-Xizang Exped. 12148* (PE). **Yulong** (Lijiang), Xuesongcun, 3000 m, 18 July 1937, *T. T. Yü 15338* (PE); Yulong (Lijiang), snow mountains, 3600–3800 m, 27 July 1981, *PE Hengduan Shan Exped. 02448* (PE); Yulong (Lijiang), Yulongxue Shan, 3100–3500 m, 18 July 1937, *T. T. Yü 15338* (PE); Yulong (Lijiang), Yushanping, 3000 m, 24 June 2001, *F. S. Yang Y003* (PE); Yulong (Lijiang), Wenhai, 3100 m, 21 June 1998, *L. S. Xie & Q. T. Zhang 98026* (KUN).

87. *Pedicularis monbeigiana* Bonati, Bull. Soc. Bot. Genève, Ser. 2, 5: 112. 1913; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 250. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 169. 1998. Type: China,

Yunnan, Weixi, Tsekou, Mongbeig, June 1912, *Monbeig* 72 [lectotype designated here: E(E00438446)].

Pedicularis laktangensis Bonati, Notes Roy. Bot. Gard. Edinb. 13: 115. 1921. **syn. nov.** Type: Upper Burma, Laktang. On steep grassy slopes facing south, 2700–3050 m, June 1919, *F. Kingdon-Ward* 3293 [holotype: E(E00273603)].

Pedicularis stenophylla H. L. Li, Taiwania 1. 88. 1948. **syn. nov.** Type: Myanmar, Mitkyina, in Jungle camp, above Hpawte, 3650 m, 13 July 1938, *M. P. Naw* 17430 (holotype: FRI); Myanmar, frontier of Tibet (China) and Myanmar, Adung Valleg, 3600 m, 29 July 1937, *F. Kingdon-Ward* 9880 (paratype: FRI).

Pedicularis monbeigiana var. *birmanica* Bonati, Notes Roy. Bot. Gard. Edinb. 13: 120. 1921. **syn. nov.** Type: Myanmar, the summit of the Sansi Gorge, Sept. 1912, *G. Forrest* 9146 [holotype: E(E00273604)].

Pedicularis lanceifolia P. C. Tsoong, Kew Bull. 9: 448. 1954. **syn. nov.** Type: Frontier of Tibet (China) and Myanmar, valley of the Seinghku, in pasture and meadows, ca. 3350 m, 29 July 1929, *F. Kingdon-Ward* 7218 [holotype: K000739102)].

Herbs perennial, 20–70(–90) cm tall, erect, pubescent, black when dry. Rootstock short, 2–4 cm long, 2 cm in diameter, several branched, branches more or less fleshy, 5–10 cm long. Stems single. Basal leaf petiole 5–10 cm long; leaf blade oblong-lanceolate to linear-lanceolate, 5–14(–20) cm long, 1.5–4 cm wide, sparsely pubescent along veins on both surfaces, pinnatifid to pinnatifid; segments 12–20 pairs, triangular-ovate to lanceolate, 1–2.2 cm long, 0.4–1 cm wide, margin double-dentate; cauline leaves 4–6, alternate, similar to basal leaves but smaller. Inflorescences racemose, 10–35 cm long, many-flowered; bracts leaflike, proximal ones longer than flowers; pedicels 1–4 cm long, elongated in fruit, slender, densely pubescent. Calyx 6–8 mm long, sparsely long-pubescent, 1/2 cleft anteriorly; lobes 3, unequal, ca. 1/4 as long as tube, posterior lobe smallest, entire, lateral lobes dentate, sparsely pubescent. Corolla white to purple-

red, 15–24 mm long; tube erect, 12–16 mm long, sparsely pubescent; galea more or less bent at a right angle apically, clearly crested; beak pointed forward and bent downward near apex, 5–8 mm long; lower lip long ciliate. Filaments all pubescent. Capsule obliquely ovoid, 8–10 mm long.

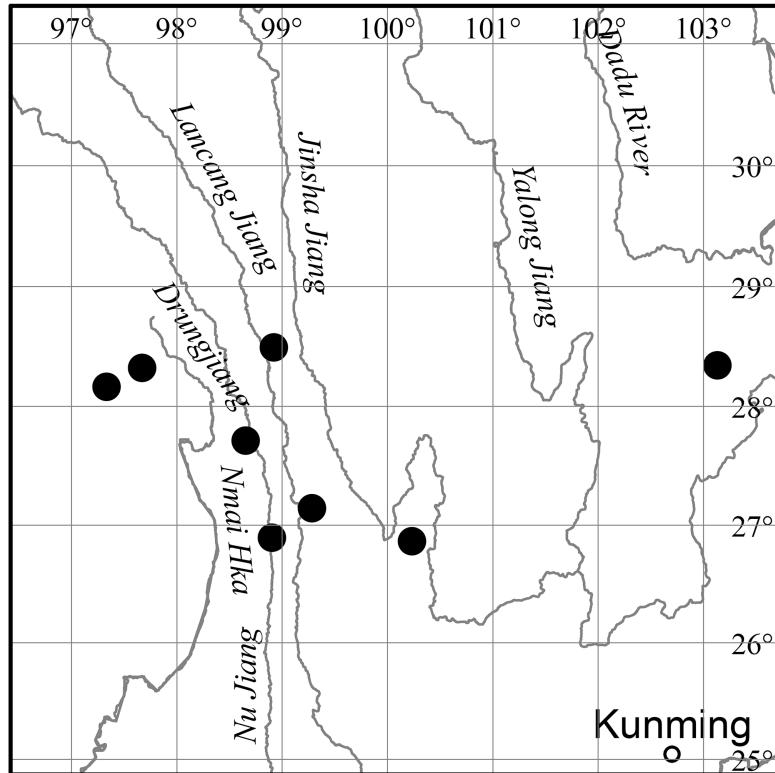
Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows; 2500–4200 m.

Distribution: S Hengduan, U Irrawaddy [Map 45(2)–87]; also in other parts of Sichuan, China.

Notes: When Bonati described *P. monbeigiana* Bonati as new, he did not cite any collections and only briefly recorded: “Yunnan occidental, region de Oui-Si (Monbeig)”. Then, four close relatives were described as new, *i.e.*, *P. laktangensis* Bonati, *P. monbeigiana* var. *birmanica* Bonati, *P. stenophylla* H. L. Li and *P. lanceifolia* P. C. Tsoong, based on several collections from the border of Upper Burma and China. After examining herbarium material, we find that some original descriptions are not accurate, and key diagnostic traits show continuous variation among these “species”. Hence, the four names are here treated as new synonyms of *P. monbeigiana* Bonati.

S HENGDUAN: Dêqên, Yongzihou Shan, 3900 m, 12 Aug. 1940, *K. M. Feng* 6545 (PE); Dêqên, Cizhongxue Shan, 3401 m, 19 Aug. 1938, *T. T. Yü* 22405 (PE); Dêqên, Jiansheju, 3000 m, July 1935, *C. W. Wang* 64818 (PE). **Fugong,** Chih-tze-lo, 3500 m, 4 Sept. 1933, *H. T. Tsai* 54148 (PE). **Gongshan,** W Gaoligongsha, 3500–3600 m, 26 July 1982, *Qinghai-Xizang Exped.* 8615 (PE); Gongshan, to Dulong direction, 2700–3200 m, 21 July 1982, *Qinghai-Xizang Exped.* 8319 (PE); Gongshan, Shawalongba, 3400 m, 27 Aug. 1938, *T. T. Yü* 22541 (PE); Gongshan, Heipu, 3300 m, 1 Nov. 1938, *T. T. Yü* 22944 (PE); Gongshan, Junzila, 3700 m, 5 Oct. 1938, *T. T. Yü* 23252 (PE); Gongshan, Qiming, 3000 m, 11 July 1937, *T. T. Yü* 22068 (PE); Gong Shan, Nacibu, 4200 m, 13 Aug. 1938, *T. T. Yü* 22323 (PE). **Meigu,** Yiguoju (Hongxi county), ~ 2500 m, 12 July 1959, collector unknown, 1048 (CDBI). **Weixi,** Yezhi, grassy slope, 3600 m, Aug. 1935, *C. W. Wang* 68531 (PE); Weixi, Biluoxue Shan, 3500–3600 m, 13 July 1981, *PE Hengduan Shan*



Map 45(2)-87: *Pedicularis monbeigiana* Bonati

Exped. 01546 (PE). **Yulong** (Lijiang), Wenhai, 3100 m, 21 June 1998, *L. S. Xie & Q. T. Zhang 98026* (KUN); Yulong (Lijiang), Yunshanping, 3000 m, 24 June 2001, *F. S. Yang Y0003* (PE). **U IRRAWADDY: Adung Valley**, near the Tibetan frontier, 3660 m, 29 July 1938, *F. Kingdon-Ward 9880* (BM). **Seinghku Valley**, the Frontier of Tibet (China) and Myanmar, ca. 3350 m, 29 July 1929, *F. Kingdon-Ward 7218* (K).

88. *Pedicularis subulatidens* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 296, 325. 1955; Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 254. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 170. 1998. Type: China, Tibet, Zayü, Ata Kang La, 3900–4300 m, 11 July 1933, *F. Kingdon-Ward 10573* [holotype: BM(BM000997955)].

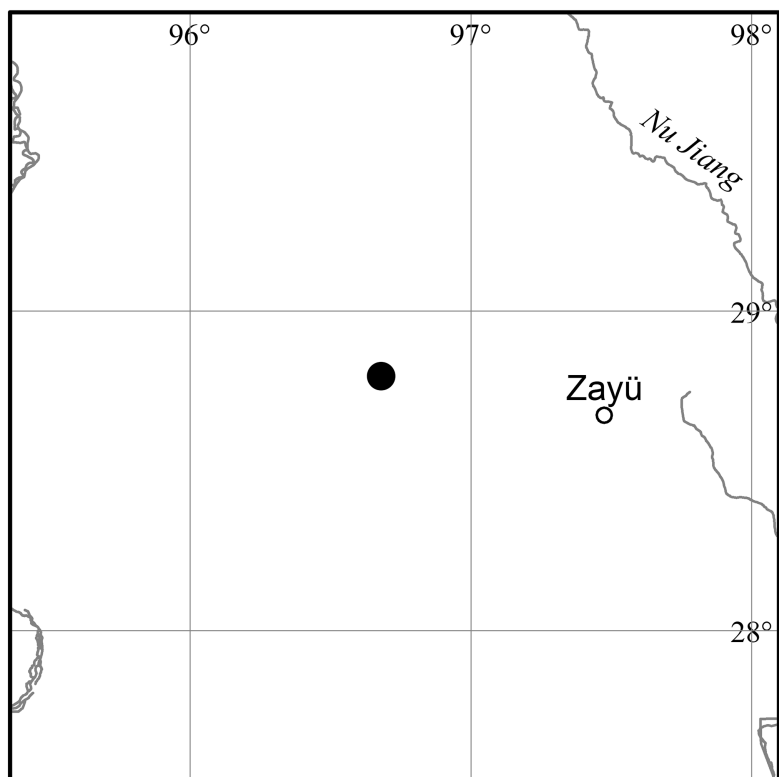
Herbs perennial, less than 7 cm tall. Roots many, 2–6 cm long, branched, with some branches more or less fusiform. Stems single, densely

glandular-pubescent. Basal leaf petiole 1–2 cm long, sparsely pubescent; leaf blade oblong-lanceolate, 1–2 cm long, 7–10 mm wide, adaxially glabrous, abaxially whitish-scurfy, pinnatisect; segments 7 or 8 pairs, ovate-oblong to ovate, incised-dentate; cauline leaves 1–3 or absent. Inflorescences subcapitate, 5–8-flowered, pedicellate or distal flowers sessile. Calyx 5–6 mm long, 1/2 cleft anteriorly; tube barely 3–4 mm long; lobes 3, unequal, posterior lobes entire and acuminate, lateral pair dentate. Corolla tube 11–14 mm long, pubescent externally; galea twisted; beak semi-circular or S-shaped, 5–6 mm long; lower lip 9–11 mm long, 10–13 mm wide. Filaments all glabrous.

Phenology: flowering from July to August.

Habitats: alpine meadows; 4300–4700 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra [Map 45(2)-88]. Known only from the collection.



Map 45(2)-88: *Pedicularis subulatidens* P. C. Tsoong

Notes: Type collections of *P. subulatidens* P. C. Tsoong have been deposited in the herbarium BM, and six individuals were mounted on one sheet, which was labelled as “type”.

Yarlung Zangbo-Brahmaputra: Zayü, Ata Kang La, 3900–4300 m, 11 July 1933, *F. Kingdon-Ward 10573* (BM).

89. *Pedicularis longicalyx* H. P. Yang, *Acta Phytotax. Sin.* 18: 243. 1980; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 170. 1998. Type: China, Tibet, Bomi, 4230 m, *T. S. Ying & D. Y. Hong 650836* [lectotype designated by Lin in 2007: PE(00033118)].

Herbs perennial, 7–10 cm tall, slightly black when dry. Roots fusiform, and fleshy. Stems usually numerous, outer ones often procumbent to ascending. Basal leaves numerous, fascicled; petiole 2–4 cm, glabrescent; leaf blade ovate-oblong, 1–2.5 cm long, pinnatisect; segments 5–7

pairs, ovate to orbicular, incised-toothed; cauline leaves few, 1 or 2. Inflorescences capitate, 6–10-flowered; bracts leaflike; pedicels 1–2 mm long. Calyx oblong, 1/2 cleft anteriorly, glabrous, usually purplish spotted; tube 8–9 mm long; lobes 5, unequal in size. Corolla pale-red, 18–20 mm long; tube barely exceeding calyx, sparsely villous; galea twisted; beak slightly S-shaped, 6–7 mm long, slender; lower lip 9–11 mm long, 11–13 mm wide. Filaments all glabrous. Figure 45(2)–37.

Phenology: flowering from July to August.

Habitats: alpine meadows; 4000–4300 m.

Distribution: endemic; L Yarlung Zangbo [Map 45(2)–89].

LYARLUNG ZANGBO: Nyingchi, 4700 m, 4 Aug. 1983, *B. S. Li & S. Z. Cheng 6092* (PE).

90. *Pedicularis tibetica* Franch., *Bull. Soc. Bot. France* 47: 24. 1900; Bonati, *Bull. Herb.*

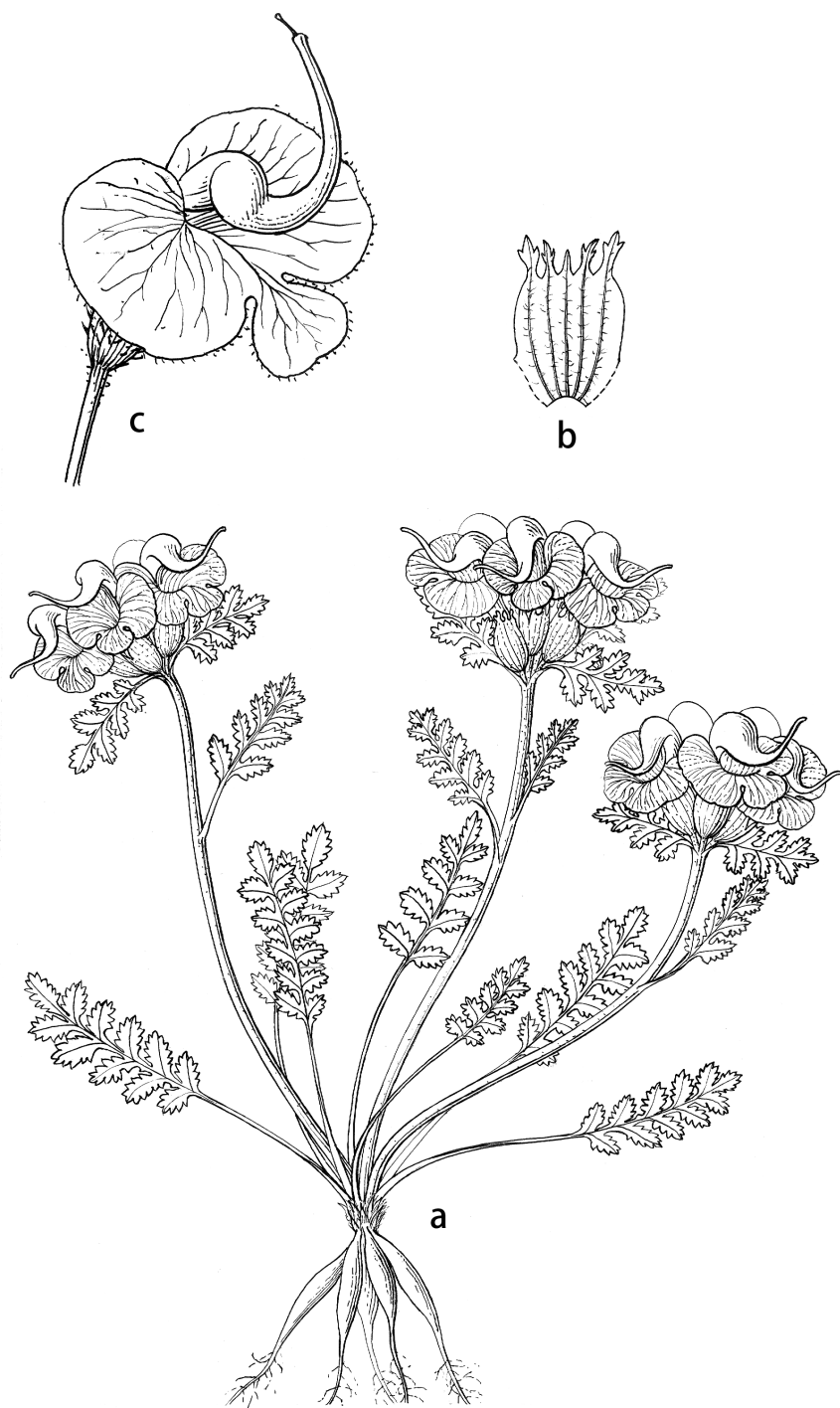
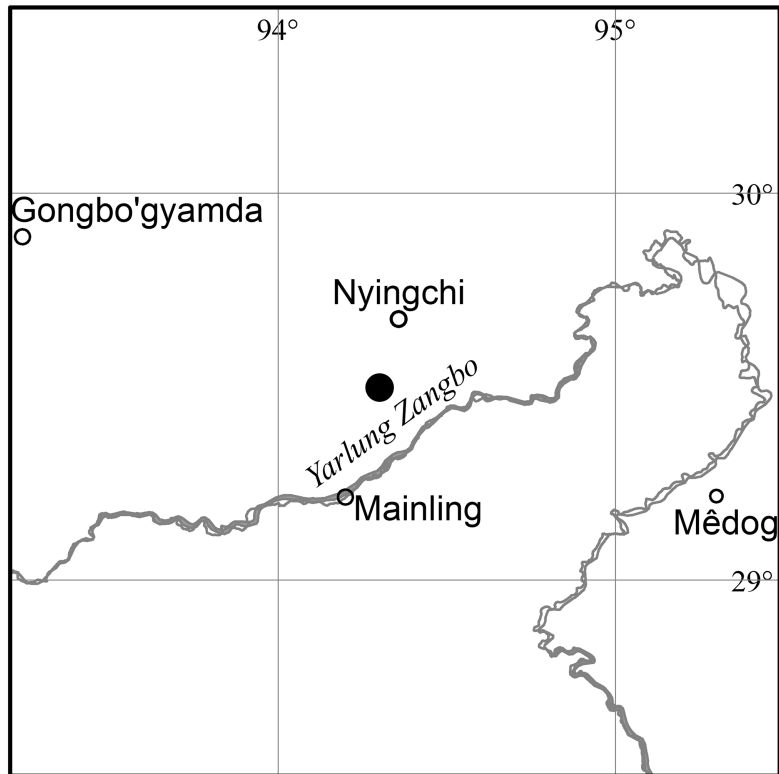


Figure 45(2)–37: *Pedicularis longicalyx* H. P. Yang. a-b: a, habit; b, calyx. Drawn by T.-L. ZHANG [*Flora Xizangica*. 4: 360, figure 361: 2-3. 1985]. *Pedicularis torta* Maxim. c, flower. C.-Z. JI modified from J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 252, figure 57: 3. 1963].



Map 45(2)-89: *Pedicularis longicalyx* H. P. Yang

Boiss. 2, 7: 542. 1907; Limpricht, Repert. Sp. Nov. Beih. 12: 483. 1922; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 253. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 169. 1998. Type: China, Kangding, Xinduqiao, *J. A. Soulié 598* [lectotype designated here: P (P02968468); isolectotype: P(P02968460)].

Herbs perennial, 15–25 cm tall, slightly black when dry. Roots 3–6 cm long, more or less fleshy. Stems usually 4–10(–15), central stem erect, outer ones often procumbent to ascending, densely gray-pubescent. Basal leaves few or withering early; petiole 1.5–4 cm long; leaf blade oblong-oblancheolate to linear-oblong, 3–5 cm long, 7–12 mm wide, adaxially sparsely long-pubescent, abaxially long-pubescent along veins, pinnatipartite to pinnatisect; segments 9–13 pairs, ovate or long ovate, dentate; cauline leaves often pseudo-opposite, alternate apically, similar

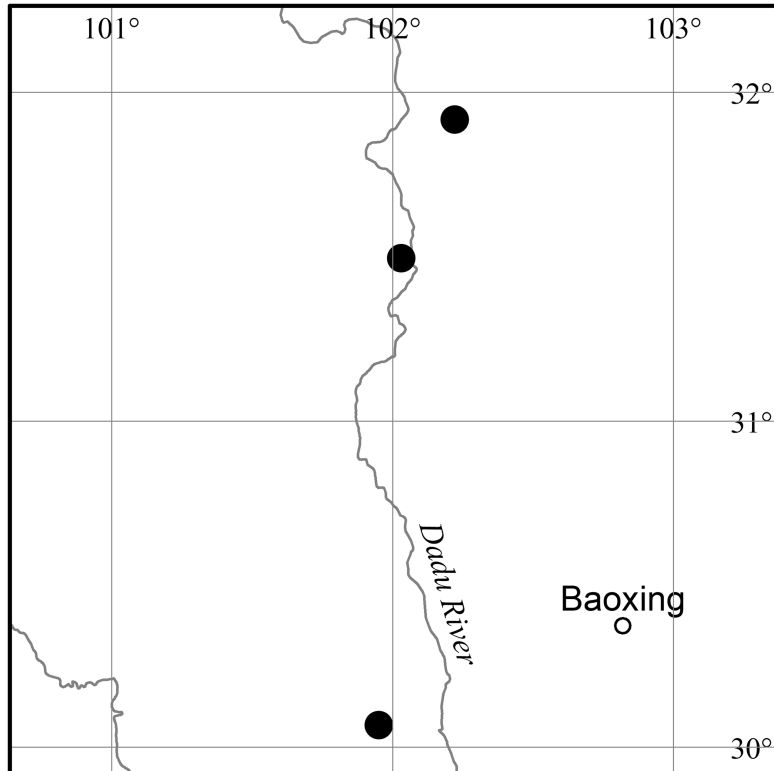
to basal leaves but smaller. Inflorescences racemose, 2–4(–10) cm long; bracts leaflike, proximal ones shorter than pedicel; pedicels 0.5–1 cm long, slender, densely pubescent. Calyx 6–7 mm long, densely pubescent, 1/2 cleft anteriorly; lobes 3 or 5, more or less equal in size. Corolla reddish, with white spots on lower lip, 9–12 mm long; tube erect, ca. as long as calyx; galea twisted; beak semicircular, 5–6 mm long. Filaments all pubescent. Capsule 6–9 mm long.

Phenology: flowering from June to July.

Habitats: alpine meadows; 4600 m.

Distribution: N Hengduan, S Hengduan [Map 45(2)–90]; also in other regions of Sichuan Province, China.

Notes: Two sheets of *Soulié 598* in the herbarium P were examined, and one of them is here designated as lectotype. Our molecular phylogenetic results show that five accessions of *P. tibetica* Franch. form a well-supported clade, which is



Map 45(2)-90: *Pedicularis tibetica* Franch.

nested in the clade consisting of *P. stewardii* H. L. Li, *P. torta* Maxim., *P. davidii* Franch., and *P. oxycarpa* Franch. ex Maxim.

N HENGDUAN: **Barkam**, Zhegu Shan, 3280 m, 20 June 1957, *X. Li 71604* (PE). **Jinchuan**, 4350 m, 30 July 1958, *The Eighth Forest Team 4961* (PE). **S HENGDUAN:** **Kangding**, Cheto La, 4200 m, 3 Aug. 1934, *H. Smith 11055* (PE); Kangding, Zheduo Shan, 4150 m, 30 July 2001, *F. S. Yang Y0091* (PE); Kangding, Tagong, 3690 m, Sept. 1979, *X. H. Hu 21084* (CDBI); Kangding, between Yajiang to Xinduqiao, 4200–4500 m, 5 Aug. 2006, *D. E. Boufford et al. 35787* (PE); Kangding, Yala village, Dapao Shan, 3768–4150 m, 16 July 2017, *Y. L. Peng et al. THP-KD-3463* (CDBI); Kangding, 4300–4500 m, 14 July 2017, *Y. D. Gao et al. THP-KD-2366* (CDBI).

91. *Pedicularis torta* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 538. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 252. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 169. 1998. Type: China, E Gansu and N Sichuan, 1885, *G. N. Potanin s.n.* (syntype: LE).

Herbs perennial, 20–40(–70) cm tall, not black when dry. Roots more or less fleshy. Stems 1 or 3(–7), erect, unbranched apically, sparsely pubescent apically. Basal leaves numerous, often withering early; cauline leaves alternate or pseudo-opposite; proximal petiole 3–5 cm long, distal ones rarely 5 mm long; leaf blade oblong-lanceolate to linear-oblong, 2–10 cm long, 0.7–2.5 cm wide, glabrous on both surfaces, pinnatisect; segments 9–16 pairs, lanceolate to linear-oblong, dentate.

Inflorescences racemose, 10–20 cm long; bracts leaflike, proximal ones longer than calyx; pedicels 1–3 mm long, slender, pubescent. Calyx 6–7 mm long, 1/2 cleft anteriorly, pubescent; lobes 3, unequal in size, posterior one more or less entire, lateral pair larger, flabellate, dentate. Corolla yellow, with purple or purple-red galea, 16–20 mm long; tube erect, ca. as long as calyx, pubescent; galea twisted; beak S-shaped, slender, 7–10 mm long; lower lip 9–12 mm long, 10–13 mm wide, long ciliate. Filaments all pubescent. Capsule ovoid, 12–16 mm long, 4–6 mm wide. Figure 45(2)–37.

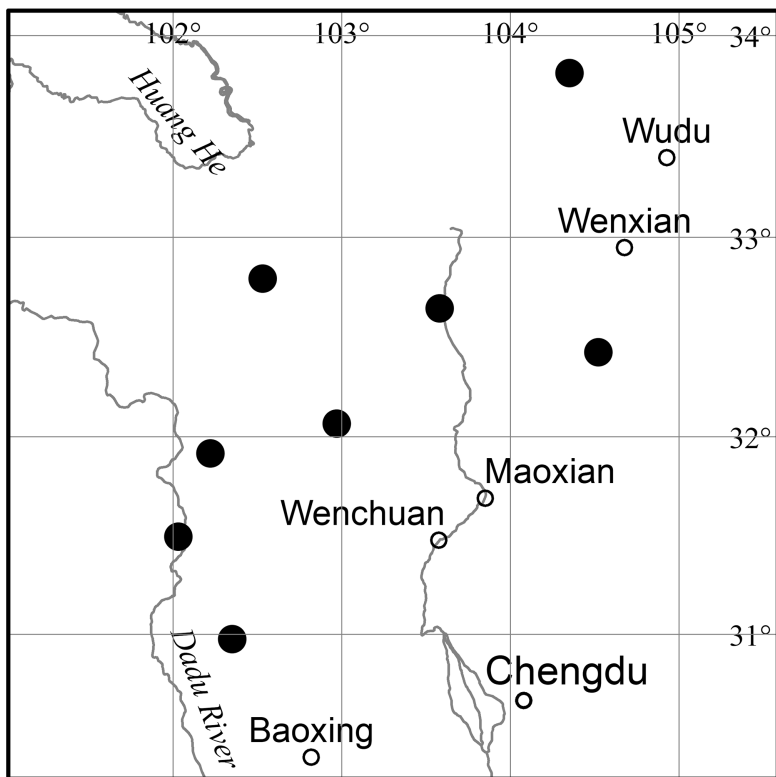
Phenology: flowering from June to August.

Habitats: alpine meadows; 2500–4400 m.

Distribution: N Hengduan [Map 45(2)–91]; also in Shaanxi, S Gansu, W Hubei, and E Sichuan of China.

Notes: Morphologically, *P. torta* Maxim. is most closely to *P. petitmenginii* Bonati, and some specimens of the latter were usually misidentified as *P. torta* Maxim. Our molecular phylogenetic results reveal that *P. torta* Maxim., *P. davidii* Franch., and *P. stewardii* H. L. Li form a monophyletic clade, in which species relationships are not resolved.

N HENGDUAN: Barkam, Mengbi Shan, 4125 m, 20 Aug. 2000, *F. S. Yang 2108* (PE); Barkam, the road to Mengbi Shan, 3750 m, 5 July 1983, *K. Y. Lang et al. 2197* (PE). **Heishui**, Luhuaqu, 2530 m, 23 June 1957, *X. Li 73757* (PE). **Hongyuan**, Shuajingsi Temple, 3250 m, 8 Aug. 1957, *23543* (KUN). **Jinchuan**, Labagou, 4400 m, 5 Aug. 1958, *X. Li 78337* (PE). **Pingwu**, *X. L. Jiang 10733* (PE). **Songpan**, 3100 m, 22 July 1922, *H. Smith 2846* (PE). **Xiaojin**, Lianghekou, 3200 m, 28 May 1958, *X. S. Zhang & Y. X. Ren*



Map 45(2)–91: *Pedicularis torta* Maxim.

6351(PE). **Zhugqu**, Wuping town, 2300 m, 26 June 1964, B. Z. Guo 5127 (HIB); Zhugqu, Shatan forest farm, 17 July 1998, 2800 m, *Bailongjiang Exped. 185* (PE).

92. *Pedicularis davidii* Franch., *Nouv. Arch. Mus. Hist. Nat.*, sér. 2, 10: 67. 1888, “*Pedicularis davidii*”; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 255. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 170. 1998. Type: China, Sichuan, Baoxing, “Mouping, in pratis humidis regionis altissimae, [David], *Fl. Juli. 1869*” [**lectotype designated here:** P(P02987317); isolectotypes: P(P02987316, P02987318); K(K000708915)].

Herbs perennial, 15–50 cm tall, densely pubescent, slightly black when dry. Rhizome 1–2 cm long, leading to several branched roots, fleshy, more or less fusiform. Stems single or usually 3 or 4, erect, few branched at base, densely rust-colored pubescent. Basal leaves usually wither early; proximal cauline leaves pseudo-opposite, distal ones alternate; proximal petiole 3–5 cm long; leaf blade ovate-oblong to lanceolate-oblong, 2–7(-13) cm long, 2–3 cm wide, adaxially glabrous or pubescent along veins, abaxially whitish-scurfy, pinnatisect; segments 9–14 pairs, linear-oblong, or ovate-oblong, pinnatifid, margin double-dentate. Inflorescences racemose, 10–20 cm long, lax; bracts leaflike; pedicels 1–3 mm long, slender, densely pubescent. Calyx 5–6 mm long, glabrescent, 1/2 cleft anteriorly; lobes 3, unequal in size, entire, or dentate. Corolla purple or red, 12–16 mm long; tube erect, ca. 2 times as long as calyx, sparsely pubescent externally; galea twisted; beak semicircular or slightly S-shaped apically, slender, 7–10 mm long; lower lip 8–11 mm long, 11–13 mm wide, ciliate. Filaments all pubescent. Capsule 8–10 mm long and 4–5 mm wide. Figure 45(2)–38.

Phenology: flowering from June to July.

Habitats: grassy slopes and flats, thickets, woods, along streams; 1700–3500 m.

Distribution: N Hengduan, S Hengduan, U Irrawaddy [Map 45(2)–92]; also in other parts of Gansu, SW Shaanxi, China.

N HENGDUAN: **Barkam**, Shuajingsi Temple, 3200 m, 1 July 2004, *P. Zhuang et al. 2000151* (WCSBG); Barkam, 3900–4150 m, 30 July 2007, *D. E. Boufford et al. 38647* (PE). **Heishui**, Yazishanyao, 4200 m, 7 July 1957, *X. Li 73010* (PE). **Hongyuan**, 4100 m, Shuajingsi Temple, 3 July 1983, *Z. X. Tang 1307* (PE). **Jiuzhaigou** (Nanping), 2400 m, 6 Aug. 1983, *K. Y. Lang et al. 1670* (PE). **Jinchuan**, Anninghong, 4200 m, 13 June 1958, *X. Li 77695* (WUK). **Lixian**, Zhegu Shan, 3340 m, 16 Aug. 2000, *F. S. Yang 2088* (PE). **Luhuo**, Renda, 3050 m, 3 Sept. 1982, *X. Z. Tang 890* (PE). **Songpan**, Huanglongsi, 3030 m, 14 June 1983, *K. Y. Lang et al. 1805* (PE); Songpan, Xuelingdou Shan, 4000 m, 23 Aug. 1989, *Z. L. Zhao 89473* (WCSBG); Songpan, Kakagou, 3400 m, 31 July 2002, *X. M. Gao M119, M 132, M133* (WCSBG). **Wenchuan**, Balang Shan, 2700 m, 19 Aug. 1982, *K. Y. Lang et al. 1179* (PE); Wenchuan, west of the city, 1800 m, 22 May 1930, *F. T. Wang 20926* (KUN). **Xiaojin**, Balang Shan, 3730 m, 27 Aug. 2000, *F. S. Yang 2123* (PE); Xiaojin, N of the city Xiaojin, 3400–3450 m, 30 July 2007, *D. E. Boufford et al. 38702* (PE); Xiaojin, 3100–3150 m, 28 July 2007, *D. E. Boufford et al. 38526* (PE). **S HENGDUAN:** **Baoxing**, 1750 m, 21 June 1933, *T. T. Yü 2034* (PE). **Kangding**, Yuling, 3780 m, 17 Aug. 2017, *W. B. Ju & C. C. Zheng THP-KD-6222* (CDBI); Kangding, Bangta village, Muozigou, 3932 m, 14 Aug. 2017, *Q. Yu THP-KD-4855* (CDBI); Kangding, Shenghang village, Songjiagou, 3507 m, 18 July 2017, *Y. L. Peng et al. THP-KD-3566* (CDBI). **Luding**, Gongga Shan, Yazigou, 3000 m, 25 June 1982, *K. Y. Lang et al. 224* (PE); Luding, Qingshiban, 2200 m, 2 June 1980, *H. Chen et al. 22136* (CDBI); Luding, Yin Shan, 1800 m, 2 May 1981, *G. H. Xu 25362* (CDBI).

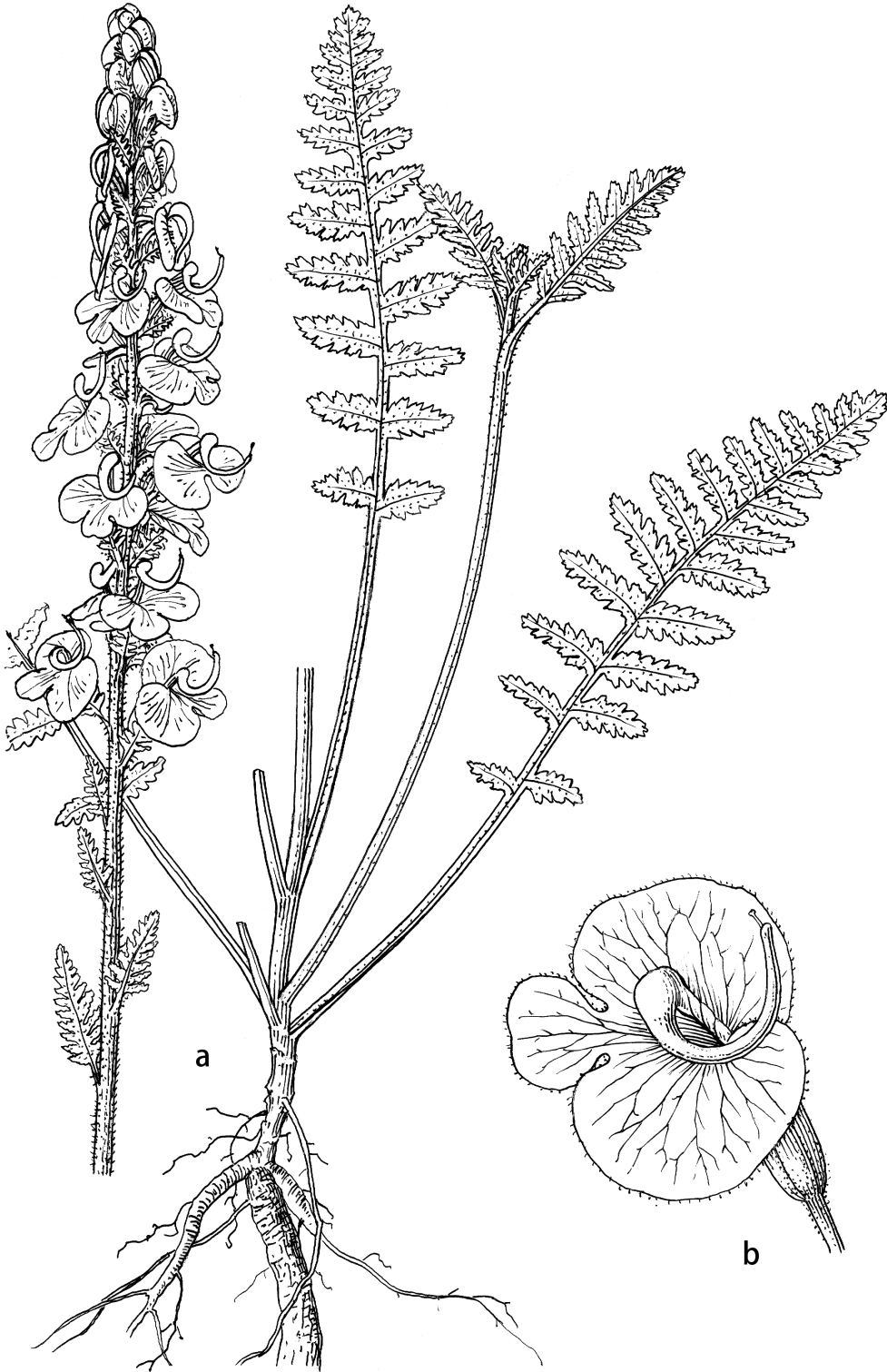
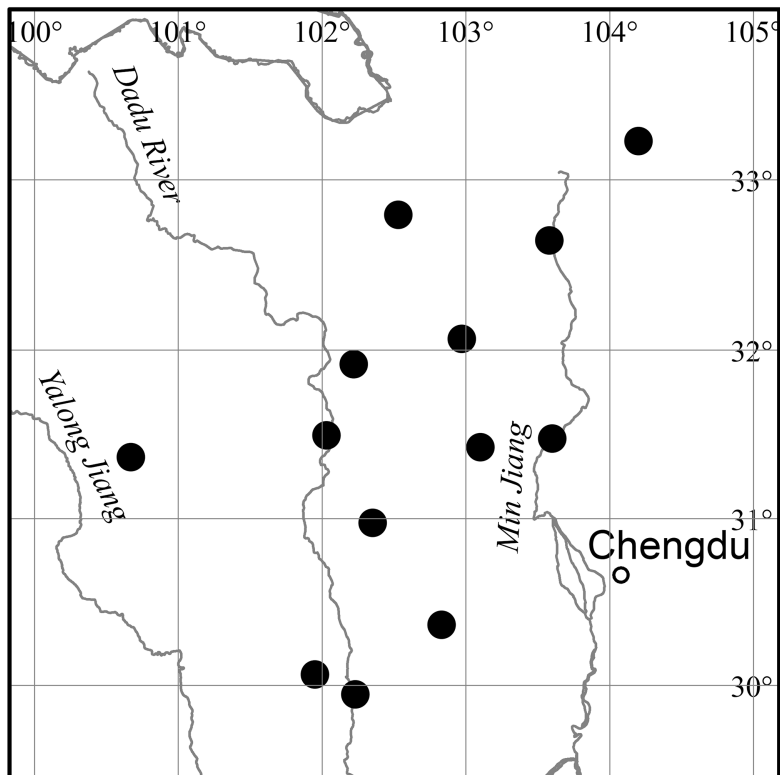


Figure 45(2)–38: *Pedicularis davidii* Franch. a, habit; b, flower. C.-Z. JI modified from J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 249, figure 57: 1-2. 1963].



Map 45(2)-92: *Pedicularis davidii* Franch.

Ser. 30. Dissectae

Ser. Dissectae H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 10. 1949.

Stems branched. Leaves alternate or proximal leaves pseudo-opposite, petiolate; leaf blade ovate-oblong, pinnatisect. Inflorescences racemose. Flowers often long-pedicellate. Calyx deeply cleft anteriorly, 3–5-lobed. Corolla often yellowish white; galea strongly twisted laterally at base; beak bent upward, S-shaped or semicircular, slender.

Four species; two in the Pan-Himalaya (one endemic).

Notes: The species of the series *Dissectae* H. L. Li share long-pedicellate axillary flowers, by which Li separated them from the series *Oxycarpae* Prain. Clearly, this series is closely related to the series *Oxycarpae*. Four species of the series *Dissectae* are quite similar morphologically.

- 1a. Calyx lobes 5; middle lobe of corolla lip neither prominently projected, nor stipitate at base 93. *P. souliei*
- 1b. Calyx lobes 3; middle lobe of corolla lip prominently projected and narrowed to a stipitate base.....94. *P. petitmenginii*

93. *Pedicularis souliei* Franch., Bull. Soc. Bot. France 47: 23. 1900; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 257. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 171. 1998. Type: China, Sichuan, Kangding, Tongolo, collected in 1893, *J. A. Soulié 385* [**lectotype designated here:** P(P02968648); isoelectotypes: K(K000708912), US(00125676)].

Herbs annual or biennial, 20–30 cm tall, slightly black when dry. Stems usually branched at base; branches 6–10, often ascending, sparsely pubescent. Proximal leaves pseudo-opposite, distal ones alternate; petiole 1.5–3 cm long; leaf blade lanceolate-oblong or ovate-oblong, 3–4 cm long, 0.8–1.5 cm wide, adaxially sparsely pubescent, abaxially sparsely pubescent along midvein or glabrous, pinnatisect; segments 9–11 pairs, long ovate or ovate-lanceolate, pinnatifid to pinnatipartite, incised-dentate. Inflorescences racemose, 1/3–1/2 as long as branches, lax; bracts leaflike; pedicels 1–2 cm long, densely pubescent. Calyx 3–5 mm long, glabrous or pubescent along veins, 1/2 cleft anteriorly; lobes 5, unequal in size, posterior lobe entire. Corolla reddish or whitish, 8–11 mm long; tube erect, longer than calyx; galea twisted; beak pointed upward, S-shaped, 6–10 mm long; lower lip ciliate, middle lobe 18–21 mm long, 13–15 mm wide. Filaments all pubescent. Capsule 5–7 mm long.

Phenology: flowering and fruiting from July to August.

Habitats: swampy places; 4000–4500 m.

Distribution: Tangut, S Hengduan [Map 45(2)–93]; also in other regions of Sichuan, China.

Notes: Franchet listed three collections in the protologue of *P. souliei* Franch, *i.e.*, *Soulié 830* collected from Ta-Tsien-lou (Kangding), *Soulié 220*, and *Soulié 385* from Tongola, Kangding, Sichuan, China. One sheet in the herbarium P is here designated as lectotype, and the others are designated as isoelectotypes.

TANGUT: **Aba**, SE of the city along highway 31, 3935 m, 10 Aug. 2007, *D. E. Boufford*

et al. 39411 (PE). **S HENGDUAN:** **Kangding**, between Yajiang and Xinduqiao, 4300–4350 m, 4 Aug. 2006, *D. E. Boufford et al. 35740A* (KUN).

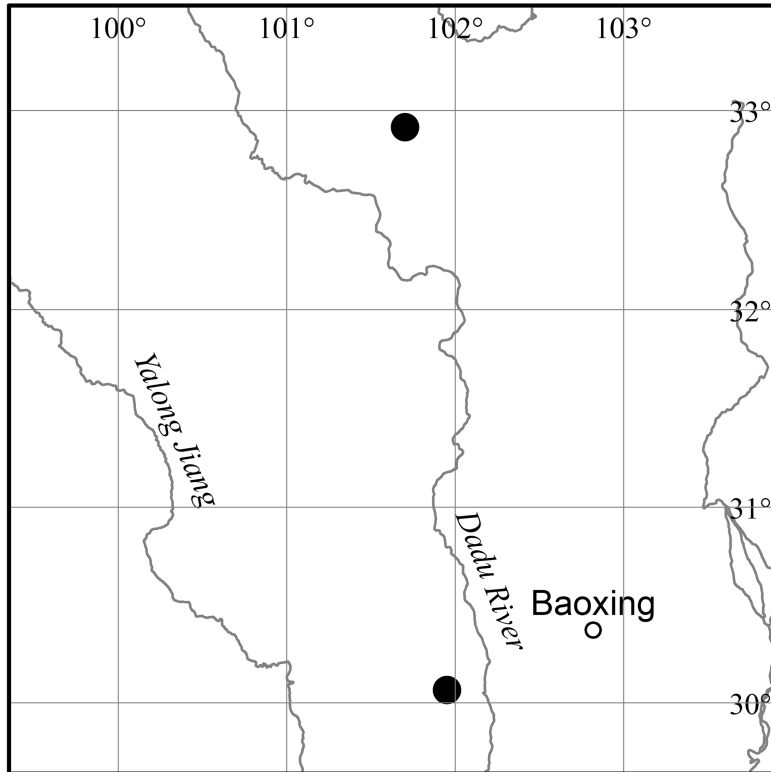
94. *Pedicularis petitmenginii* Bonati, Bull. Herb. Boiss, ser 2, 7: 542, 1907; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 260. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 171. 1998. Type: China, Sichuan, Kangding, Ta-tsien-lou, July 1893, *J. A. Soulié 122* [**lectotype designated here:** P(P02977319); isoelectotype: P(P02977321)].

Pedicularis sparsiflora Bonati, Bull. Misc. Inform. Kew 253. 1908. Type: Western China, precise location unknown, *Wilson 4257a* [holotype: K(K000708909)].

Herbs perennial, 15–60 cm tall, pubescent or glabrescent, black when dry. Stems usually 4–6, branched at base. Basal leaves withering early; cauline leaves pseudo-opposite, distal ones alternate; petiole 1.5–2.5 cm long; leaf blade ovate-oblong to linear-oblong, 3–6 cm long, 1–1.7 cm wide, adaxially sparsely pubescent or glabrescent, abaxially villous along veins, pinnatisect; segments 8–12 pairs, linear-lanceolate to narrowly-oblong, pinnatifid, serrate. Inflorescences racemose, 1/2 or 1/3 as long as stems and branches; bracts leaflike; pedicels 2–3 cm long, slender, densely pubescent. Calyx 4–5 mm long, white-villous externally, 1/2 cleft anteriorly; lobes 3, unequal in size, posterior lobe subentire, narrow, lateral pair palmatilobate. Corolla whitish or yellowish with purple or purple-red galea, 11–15 mm long; tube erect, 6–7 mm long; galea bent at a right angle apically, twisted; beak linear, S-shaped pointed upward, 5–6 mm long; lower lip ciliate, middle lobe 7–10 mm long, 9–12 mm wide, prominently projected, narrowed to a stipitate base. Filaments all villous. Capsule 8–10 mm long and 8 mm wide. Figure 45(2)–39.

Phenology: flowering and fruiting from July to August.

Habitats: forest understories, forest margins, meadows; 3100–3900 m.



Map 45(2)–93: *Pedicularis souliei* Franch.

Distribution: endemic; N Hengduan, S Hengduan [Map 45(2)–94].

Notes: Type, “Soulie, 122, Ta-tsien-lou”, is the only collection listed in the protologue of *P. petitmenginii* Bonati. Several sheets of this collection have been deposited in the herbaria K, P, and MPU. One of the collections in the herbarium P is here designated as lectotype. *Pedicularis petitmenginii* Bonati is similar to *P. torta* Maxim. and some specimens of the former were usually misidentified as the latter, and some individuals of *P. tibetica* Franch. were misidentified as *P. petitmenginii* Bonati.

N HENGDUAN: Barkam, Zhuosijia, 3600 m 18 Aug. 1958, *P. X. Li 10466* (WUK); Barkam, Shuajingsi Temple, 3150 m 27 Aug.

1957, *H. F. Zhou et al. 23547* (NAS). **Hongyuan**, Shuajingsi Temple, 3600 m, 29 July 1989, *Q. S. Zhao 0028* (PE); Hongyuan, Shuajingsi Temple, 3250 m, 11 Sept. 1989, *J. X. Zhou & X. Li 74569* (PE). **Lixian**, Zhegu Shan, *F. S. Yang 2087* (PE). **Maoxian**, Sanlong, *Z. He & Z. L. Zhou 13394* (IBK). **Xiaojin**, Lianghekou, 3500 m, 24 July 1958, *X. B. Zhang & Y. X. Zhang 6164* (PE); Xiaojin, Mengbigou, 3300 m, 27 July 1958, *X. S. Zhang & Y. X. Ren 3627* (PE). **S HENGDUAN:** **Baoxing**, Ganyanggou, 3100 m, 9 July 1933, *T. T. Yü 2242* (PE). **Kangding**, Yulingkong, 3300 m, 22 June 1934, *H. Smith 10675* (PE); Kangding, Linguan, 3950 m, 1 Aug. 1959, *N. Jiang & C. L. Jin 02565* (PE); Kangding, Yulin, 3700 m, 24 July 1951, *W. G. Hu & Z. He 10479* (WUK).

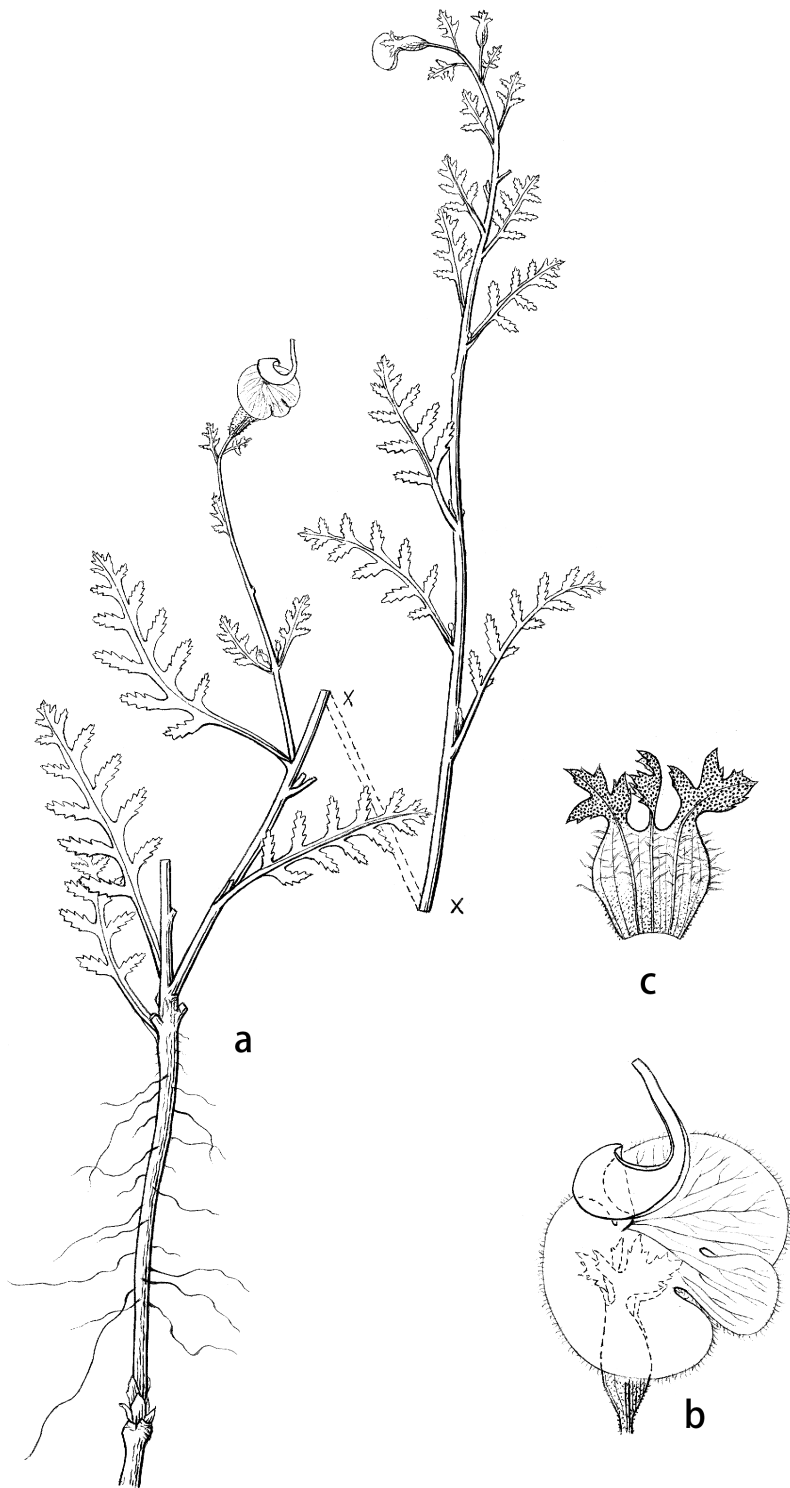
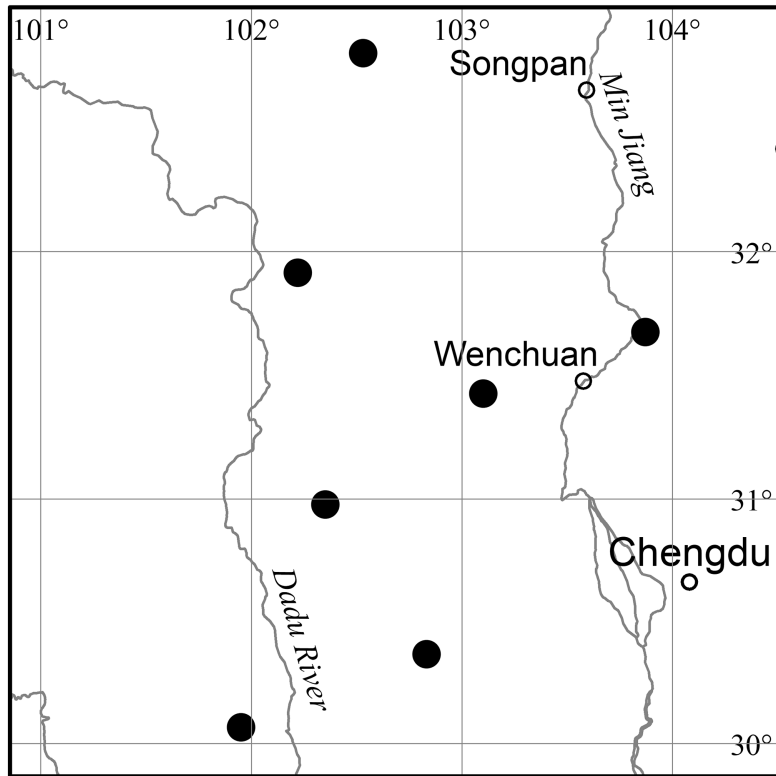


Figure 45(2)–39: **Pedicularis petitmenginii** Bonati. a, habit; b, flower; c, calyx. Drawn by Z.-H. WU [*Fl. Reipubl. Popularis Sin.* 68: 260, figure 58: 1-3. 1963].



Map 45(2)-94: *Pedicularis petitmenginii* Bonati

Ser. 31. *Rhinanthoides*

Ser. *Rhinanthoides* Prain, Ann. Roy. Bot. Gard. Calc. 3: 67. 1890.

Stems erect or spreading, branched at base or unbranched. Leaves basal and cauline. Basal leaves long-petiolate; leaf blade linear-oblong, pinnatisect; cauline leaves few, alternate. Inflorescences slightly capitate or racemose. Calyx lobes 5. Corolla purple-rose, or crimson, up to 2.8 cm long; tube ca. as long as calyx; galea bent at a right angle apically; beak semicircular or S-shaped, very long, slender.

Two species; both in the Pan-Himalaya (one endemic).

Notes: The species of the series *Rhinanthoides* Prain form a monophyletic clade, where species relationship is poorly resolved.

- 1a. Calyx 1/2 cleft anteriorly, posterior lobe entire, lateral lobes ovate, serrate; corolla galea more or less erect at base.....95. *P. rhinanthoides*
- 1b. Calyx slightly cleft anteriorly, lobes all serrate; corolla galea curving from its base.....
.....96. *P. cyclorhyncha*

95. *Pedicularis rhinanthoides* Schrenk ex Fischer & C. A. Mey., Enum. Pl. Nov. 1: 22. 1841; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 262. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 172. 1998. \equiv *Pedicularis rhinanthoides* var. *typica* Prain, Journ. As. Soc. Beng. 58, 2: 272. 1889. Type: Kazakhstan, Alatau, s.d., *Schrenk s.n.* [lectotype designated by Garg & Singh (2020: 89): BR(BR0000005430871); isolectotypes: KFTA(KFTA0001357), PH(00020174)].

Pedicularis peduncularis M. Pop., Fl. URSS. 22: 700. 1955. **syn. nov.** \equiv *Pedicularis rhinanthoides* subsp. *rotundata* Vved., Bull. Univ. Asie Centr. 11, Suppl. 25. 1925. Type: “Se rencontre sur le versant meridional de Talas-Alatau (Karshantau!, la vallee d’Angren!) et dans Pamiro-Alaj (la vallee de Zeravschn! Monts Hissar!)”, not seen.

Pedicularis rhinanthoides subsp. *angulata* Vved., Bull. Univ. Asie Centr. 11, Suppl.: 25. 1925. **syn. nov.** Type: Kazakhstan, “Prov. Syr-Darja, distr. Tschimkent (Shymkent). Ad cursum superiorem fl. Kschi-koindy in fl. Dsheboglysu influentis”, 24 Aug. 1922, *M. V. Kultiassov 173* [syntype: S(S11-3326)].

Pedicularis rhinanthoides subsp. *revoluta* Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 153. 1943. **syn. nov.** Type: India, Sikkim, Naku Chu, Llonok, 5000–5500 m, 3 Aug. 1909, *W. W. Smith & G. H. Cave 1945* [holotype: PH(00020176); isotype: UC].

Pedicularis pushpangadanii Husain & Garg, J. Jap. Bot. 78: 164. 2003. **syn. nov.** Type: India, Himachal Pradesh, Spiti, Lossar, 4100 m, 4 Aug. 2002, *T. Husain 222166* [holotype: LWG; isotype: LWG)].

Herbs perennial, 4–40 cm tall, slightly black when dry. Roots more or less fusiform, fascicled, and fleshy. Stems 1 to numerous, erect or flexuous, unbranched, glabrescent, shiny. Basal leaves usually densely fascicled; petiole 2–5 cm long; leaf blade linear-oblong, pinnatisect; segments 9–12 pairs, ovate, glabrescent, dentate; teeth callose; cauline leaves few, with shorter petiole than basal leaves. Inflorescences short-racemose, sometimes 3–8 cm long; bracts leaflike; pedicels

0.5–1(–1.5) cm long, glabrous. Calyx long ovate, 15–25 mm long, 1/2 cleft anteriorly, often with purplish dots; lobes 5, unequal in size, posterior one lanceolate and more or less entire, lateral ones ovate and serrate. Corolla rose to violet-purple, 1.5–2.5(–3) cm long, ca. 2 times longer than calyx, pubescent; tube erect; galea erect at base, more or less bent at a right angle apically; beak S-shaped to semicircular, 7–10 mm long; lower lip 14–28 mm wide, ciliate or not. Filaments 2 pubescent, 2 glabrous. Capsule lanceolate-ovoid, 10–19 mm long, 6 mm wide. **Chromosomes:** $2n = 16$.

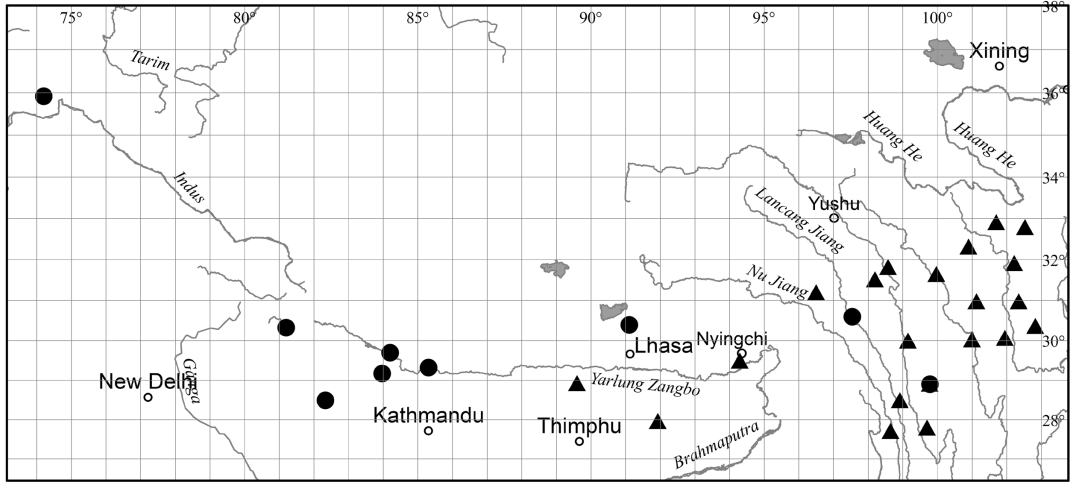
Phenology: flowering and fruiting from May to September.

Habitats: moist alpine meadows, boggy places along streams, among *Rhododendron* and other shrubs in moist locations on open hillsides; 2300–5000 m.

Distribution: N Pakistan, Jammu & Kashmir, U Ganga & Indus, U Yarlung Zangbo, W Nepal, C Nepal, Bhutan, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S Hengduan [Map 45(2)–95]; also in N China, Kazakstan, Kyrgyzstan, Mongolia, Russia, and Tajikistan.

Notes: *Pedicularis rhinanthoides* Schrenk ex Fischeri & C. A. Mey. is widely distributed in the Pan-Himalaya, Central Asia, N China to Siberia. A statistical analysis of morphological traits reveals that this species includes two subspecies, i.e., *P. rhinanthoides* subsp. *rhinanthoides* and *P. rhinanthoides* subsp. *labellata* (Jacq.) Pennell. The latter is higher than the former and the corolla beak is also longer. *Pedicularis rhinanthoides* Schrenk ex Fischeri & C. A. Mey. is closely related to the next species *P. cyclorhyncha* H. L. Li. Our molecular phylogenetic results indicate that all accessions of *P. rhinanthoides* Schrenk ex Fischeri & C. A. Mey. are clustered in a well-supported clade.

- 1a. Beak of corolla 5–7 mm, usually semicircular; corolla lip 14–17 mm wide..... 95a. subsp. *rhinanthoides*
- 1b. Beak of corolla 8–10 mm, usually S-shaped; corolla lip 25–28 mm wide 95b. subsp. *labellata*



Map 45(2)–95: *Pedicularis rhinanthoides* Schrenk ex Fischer & C. A. Mey.
 ● subsp. *rhinanthoides* ▲ subsp. *labellata*

95a. *Pedicularis rhinanthoides* subsp. *rhinanthoides*

Bracts and upper petiole glabrous to slightly ciliate. Corolla beak usually semicircular, 5–7 mm long; lower lip 14–17 mm wide, more or less ciliate.

Phenology: flowering and fruiting from May to September.

Habitats: moist alpine meadows, boggy places along streams; 3000–5000 m.

Distribution: N Pakistan, U Ganga & Indus, U Yarlung Zangbu, W Nepal, C Nepal, M Yarlung Zangbo, Tangut, S Hengduan; [Map 45(2)–95]; also in Xinjiang (China), India, Kazakstan, Kyrgyzstan, Mongolia, and Russia.

Notes: Examinations of herbarium material reveal that *P. peduncularis* M. Pop., *P. rhinanthoides* subsp. *angulata* Vved., *P. rhinanthoides* subsp. *revoluta* Pennell, and *P. pushpangadanii* Husain & Garg should be treated as new synonyms of *P. rhinanthoides* subsp. *rhinanthoides*.

N PAKISTAN: Gilgit, Dada to Nazbar-Pass, 3800 m, 10 Aug. 1957, *K. Hongda* 235 (KYO). **U Ganga & Indus:** Burang, 4800 m, 19 July 1975, *Qinghai-Xizang Exped.* 76-8537

(PE); Burang, Longgong, 4333 m, 5 June 1938, *F. Ludlow, G. Sherriff & G. Tavior* 3966 (PE). **U Yarlung Zangbu:** Saga, 5000 m, 16 Aug. 1975, *Qinghai-Xizang Exped.* 7281 (PE). **Zhongba,** 5350 m, 9 Aug. 1975, *Qinghai-Xizang Exped.* 6730 (PE). **W NEPAL:** Rapti, Rukum, 4000 m, 8 July 1980, *P. R. Shakya & B. Roy* 6106 (KATH). **C NEPAL:** Dhawalagiri, Mustang, 4020 m, 19 Aug. 2002, *M. N. Subedi* 141/2002 (KATH). **M YARLUNG ZANGBO:** Damxung, Reting, 5333 m, 28 July 1942, *F. Ludlow & G. Sherriff* 8938 (PE). **TANGUT:** Zhag'yab, Jitangyou, 3600 m, 8 July 1976, *Qinghai-Xizang Exped.* 12330 (HNWP). **S HENGDUAN:** Xiangcheng, Wuming Shan, 4150 m, 24 July 2001, *F. S. Yang* Y0062 (PE).

95b. *Pedicularis rhinanthoides* subsp. *labellata* (Jacq.) Pennell, *Monogr. Acad. Nat. Sci. Philad.* 5: 152. 1943; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 263; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 172. 1998. ≡ *Pedicularis labellata* Jacq., *Voy. Dans l'inde. Bot.* 118. 1844; *P. rhinanthoides* subsp. *labellata* (Jacq.) P. C. Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 263. Type: China,

Tibet, “In humidis ab Yurpo ad Lamoutché, Gatang-Ghauti; 18,300 ped. angl.”, collected between 1828–1832, *Jacquemout s.n.* [isotypes: K (000739101), PH (00027104)].

Pedicularis biondiana Diels, Bot. Jahrb. Syst. 29(3-4): 571. 1900; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 172. 1998. Type: China, Shaanxi, Taibai Shan, *Giraldi 1210*, not seen.

Pedicularis rhinanthoides auct. non Schrenk: Botani, in Herb, Bioss. Ser. 27: 542: 1907.

Pedicularis rhinanthoides subsp. *tibetica* (Bonati) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 263. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 172. 1998. **syn. nov.** Type: China, Yunnan, Tse-Kou, *R. P. Monbeig 107* [holotype PH; isotype: K(K000708914)].

Pedicularis rhinanthoides subsp. *speciosa* Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 152. 1943. **syn. nov.** Type: China, W Himalaya from Ladak to Rupshu, Tsakzhum Tso, Ladak, Damp meadow, 4500 m, 29 July 1931, *W. N. Koelz A30* [holotype: PH(00020175)].

Pedicularis elephantiflora T. Yamaz., J. Jap. Bot. 78: 77. 2003. **syn. nov.** Type: Bhutan, Gasa Distr. Tsorim (Gophu La W side), Swamps around glacial lakes, 5340 m, 8 Sept. 2000, *G. Miehe & S. Miehe 00-358-02* [holotype designated by Yamazaki (2003: 77): TI].

Bracts and upper petiole glabrous to slightly villous. Corolla beak usually S-shaped, 8–10 mm long; lower lip 25–28 mm wide, not ciliate. Figure 45(2)–40.

Phenology: flowering and fruiting from June to September.

Habitats: alpine moist meadows and boggy places along streams, among small *Rhododendron* and other shrubs in moist locations on open hillsides; 3000–4500 m.

Distribution: Jammu & Kashmir, Bhutan, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S

Hengduan [Map 45(2)–95]; also in other regions of Yunnan and Sichuan Provinces, China.

Notes: *Pedicularis rhinanthoides* subsp. *speciosa* Pennell was described as new based on flower color and shape of lamina segments, and Pennell also described *P. rhinanthoides* subsp. *revoluta* as new based on plant height and shape of lamina segments when he compared it with the typical *P. rhinanthoides* Schrenk ex Fischeri & C. A. Mey. Two subspecies are distributed at higher altitudes of W Himalaya, and flower color and lamina shape vary within or among populations. Tsoong elevated *P. rhinanthoides* var. *tibetica* Bonati as *P. rhinanthoides* subsp. *tibetica* (Bonati) P. C. Tsoong based on more pubescence of calyx and obvious ciliate of lower lips. After a range-wide field investigation, we find that the pubescence and hair are quite variable within the population. Moreover, Yamazaki described *P. elephantiflora* T. Yamaz. as new, and he stated that “it resembles *P. rhinanthoides* subsp. *labellata* (Jacq.) P. C. Tsoong but differs in narrower leaves with smaller segments, calyx with few hairs and corolla with shorter galea and marginally glabrous lower lips”. A comparison of morphological characters between *P. elephantiflora* T. Yamaz. and *P. rhinanthoides* find that there are no morphological gaps between these two “species”. Hence, these “species” are here treated as new synonyms of *P. rhinanthoides* subsp. *labellata* (Jacq.) Pennell. Type of *P. rhinanthoides* subsp. *labellata* (Jacq.) Pennell was not designated in the original reference, and possible isotypes listed here are inferred by later taxonomists.

Jammu & Kashmir: Ladak, Tsakzhum Tso, Ladak, Damp meadow, 4500 m, 29 July 1931, *W. N. Koelz A30* (PH). **BHUTAN:** Gasa, Tsorim, Swamps around glacial lakes, 5340 m, 8 Sept. 2000, *G. Miehe & S. Miehe 00-358-02* (TI). **M YARLUNG ZANGBO:** Gyangzê, 4440 m, 19 July 1960, *G. X. Fu 00867* (PE). **L YARLUNG ZANGBO:** Nyingchi, Sejila Shan, 4460 m, 4 Aug. 1975, *Qinghai-Xizang Suppl. Exped. 751254* (PE). **YARLUNG ZANGBO-BRAHMAPUTRA:** Cona, near the county, 4360 m, 1974, *Qinghai-Xizang Exped. 2916* (PE). **TANGUT:** Aba, Zegeria-Dengzhake swamp, 3914 m, 4 Aug. 1937, *D. C. Zhang et al.*

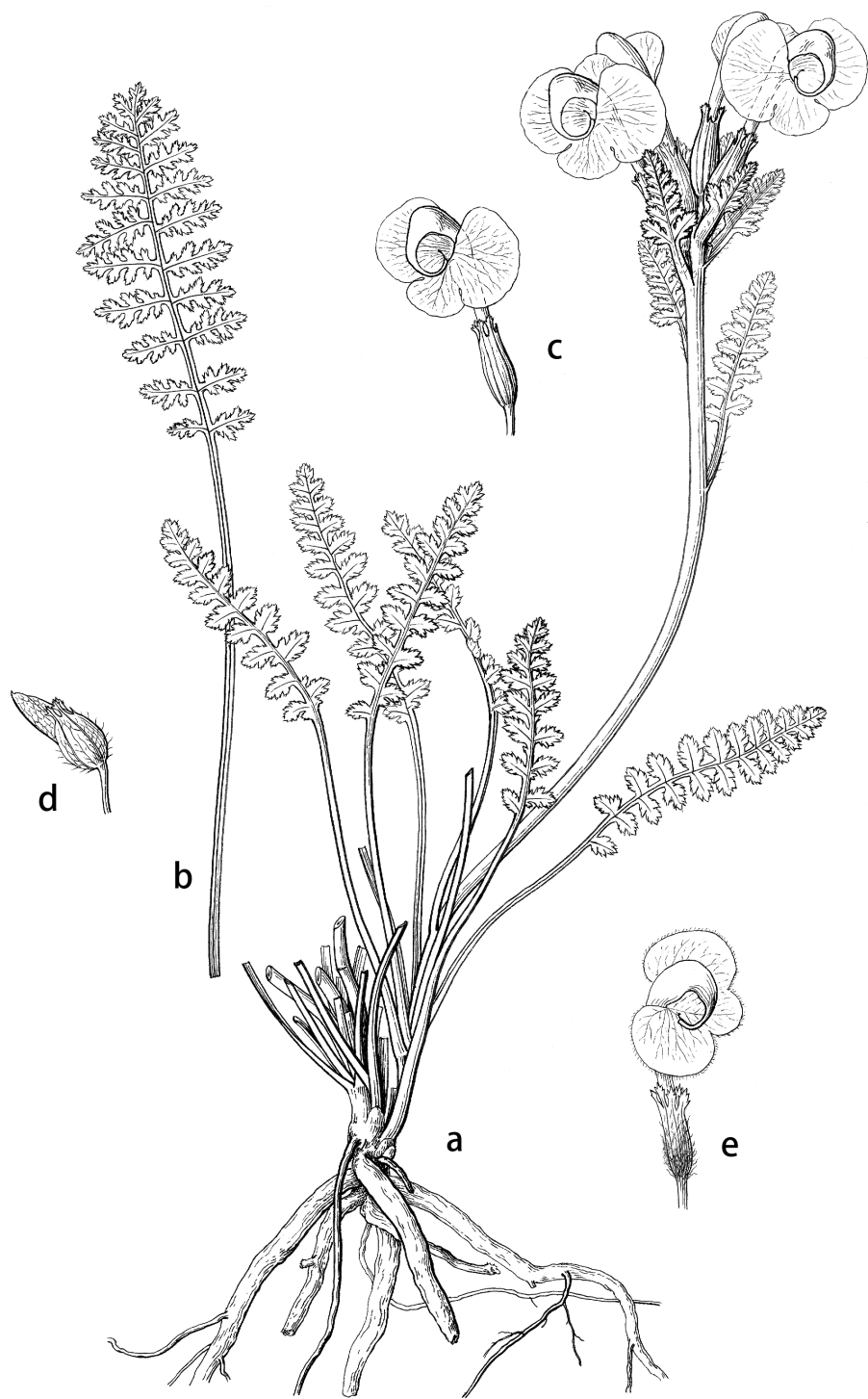


Figure 45(2)–40: *Pedicularis rhinanthoides* subsp. *labellata* (Jacq.) P. C. Tsoong. a-d: a, habit; b, leaf; c, flower; d, capsule. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 262, figure 59: 1-4. 1963]. *Pedicularis cyclorhyncha* H. L. Li. e, flower. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 264, figure 59: 5. 1963].

ZGRA-1-2-8, ZGRA-1-2-10 (IGA). **Dêgê**, Queer Shan, 4900 m, 9 Aug. 2001, *F. S. Yang 2066* (PE). **Garzê**, Jiabula Shan, 4470 m, 31 July 2001, *F. S. Yang Y0103* (PE); Garzê, Luoguoliangzi, 3750 m, 3 Aug. 2001, *F. S. Yang Y0136* (PE); Garzê, 3860–3890 m, 12 Aug. 2006, *D. E. Boufford et al. 36343* (PE). **Jomda**, 3600 m, 26 July 1976, *Qinghai-Xizang Exped. 12426* (PE). **Riwoqê**, 3800 m, 18 Aug. 1976, *Qinghai-Xizang Exped. 12842* (PE). **Zamtang**, NW of the city of Zamtang, 3050–3100 m, 5 Aug. 2007, *D. E. Boufford et al. 39031* (PE). **S HENGDUAN: Barkam**, 3 July 1958, *Z. L. Wu 32546* (PE). **Batang**, Zhongza 3400 m, 24 July 1983, *K. Y. Lang & L. Q. Li 2334* (PE). **Dawu**, SE of the city of Danba along the road to Dawu and Kangding, 3550–3600 m, 25 July 2007, *D. E. Boufford et al. 38115* (PE). **Hongyuan**, Rangkou, 3300 m, 28 July 1989, *Q. S. Zhao 0166* (PE). **Xiaojin**, 4230–4350 m, 29 July 2007, *D. E. Boufford et al. 38585* (PE). **Yajiang**, Jianziwan Shan, 3950 m, 6 Aug. 1983, *K. Y. Lang & L. Q. Li 2879* (PE). **S HENGDUAN: Baoxing**, Lianghekou, 3720 m, 16 July 1922, *T. H. Tu 4437* (PE). **Dêqên**, Baimaxue Shan, 3970 m, 30 June 2001, *F. S. Yang Y0006* (PE). **Gongshan**, Tse-Kou, ca. 3800 m, 1908, *P. Mongeig 107* (K); Gongshan, Changputong, 3500 m, 9 Oct. 1940, *K. M. Feng 7694* (PE). **Kangding**, Zheduo Shan, 3860 m, 16 July 2008, *Y. L. Peng Gaoxf0219* (CDBI); Kangding, Zheduo Shan, 4150 m, 30 July 2001, *F. S. Yang Y0093* (PE); Kangding, Zheduoatang, 3470 m, 26 July 2000, *F. S. Yang 2132* (PE); Kangding, between the cities of Yajiang, 4200–4250 m, 4 Aug. 2006, *D. E. Boufford et al. 35769* (PE); Kangding, Yulingkong, 2900 m, 21 July 1934, *H. Smith 10770* (PE). **Shangri-la** (Zhongdian), Geza, 4320 m, 22 Aug. 2011, *J. Cai et al. 11CS3291* (KUN). **Xiangcheng**, Wuming Shan, 4150 m, 24 July 2001, *F. S. Yang Y0062* (PE); Xiangcheng, 3900 m, 9 Aug. 1981, *Qinghai-Xizang Exped. 3960* (PE).

96. *Pedicularis cyclorhyncha* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 128. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 264. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18:

173. 1998. Type: China, Yunnan, Lijiang, Ah-s-chi, on open moist pasture, 29 June 1939, *R. C. Zhao 20951* [holotype: A(00303999); isotype: KUN(0396435)].

Herbs 25–40 cm tall, glabrescent except for inflorescences, black when dry. Stems single, erect, or slightly flexuous, usually branched at base. Leaves mostly basal, short-petiolate or sessile; proximal petiole 5–7 cm long, slender; leaf blade linear-lanceolate, 2–6 cm long, 7–9 mm wide, pinnatisect; segments 10–14 pairs, ovate, pinnatifid and double-dentate. Inflorescences racemose, 5–10 cm long, lax at base; bracts leaf-like, longer than calyx; pedicels erect, 3–5 mm long. Calyx 10–12 mm long, sparsely pubescent, shallowly cleft anteriorly; lobes 5, unequal in size, all serrate, lateral ones often deeply divided. Corolla crimson, 22–28 mm long; tube erect, ca. 2 times as long as calyx, sparsely pubescent; galea curved from base, more or less in a circle; beak linear, 6–8 mm long, curved, forming a complete circle with galea; lower lip 9–12 mm long, 18–21 mm wide, slightly ciliate. Filaments 2 pubescent apically, 2 glabrous throughout. Figure 45(2)–40.

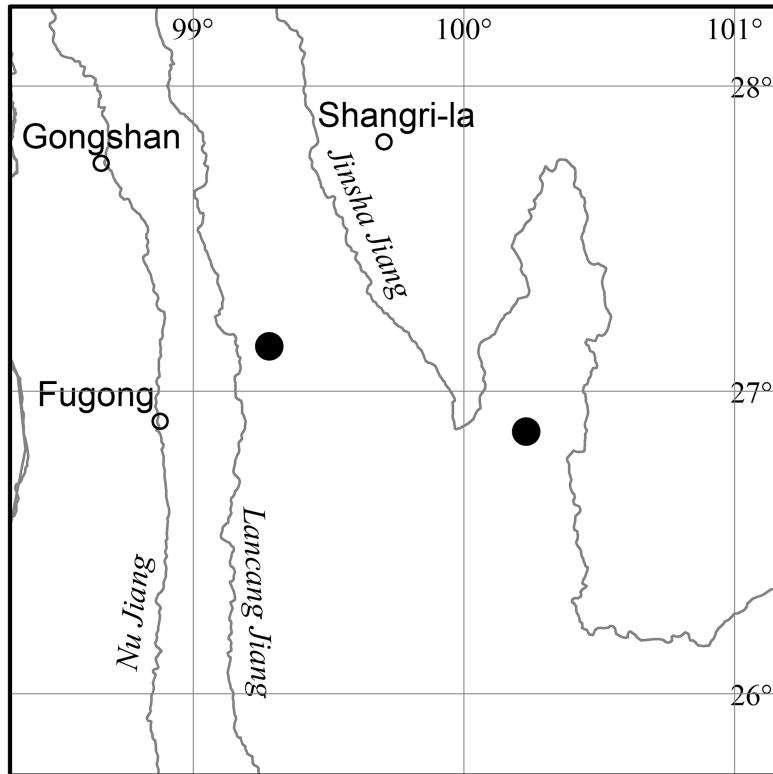
Phenology: flowering from June to July.

Habitats: moist meadows; 3000–4000 m.

Distribution: endemic; S Hengduan [Map 45(2)–96].

Notes: *Pedicularis cyclorhyncha* H. L. Li is morphologically similar to *P. rhinanthoides* Schrenk ex Fischeri et C. A. Mey. but differs in galea being curved at base and strongly incurved beak formed a complete circle. Hence, we retain the species status of *P. cyclorhyncha*, although our molecular phylogenetic results show that the relationship of *P. cyclorhyncha* and *P. rhinanthoides* Schrenk ex Fischeri et C. A. Mey. is not resolved.

S HENGDUAN: Weixi, Kangpuyunling Shan, 3800 m, 20 Aug. 1987, *Z. D. Fang 0363* (SABG). **Yulong** (Lijiang), Ah-s-chi, on open moist pasture, 29 June 1939, *R. C. Zhao 20951* (PE).



Map 45(2)-96: *Pedicularis cyclorhyncha* H. L. Li

Ser. 32. Roseae

Ser. Roseae Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 525. 1888.

Herbs low, more or less scapose. Leaves alternate. Inflorescences short and capitate, or flowers few, not distinctly centrifugal. Calyx slightly cleft anteriorly, 5-lobed. Corolla tube bent apically, toothless; galea beakless; lower lip spreading. Capsule oblique.

Two species; both endemic to the Pan-Himalaya.

Notes: *Pedicularis orthocoryne* H. L. Li is here transferred to the series *Roseae* Maxim. from the series *Flammeae* Prain (Tsoong's classification system) or from the series *Hissutae* (Li's classification system). Molecular phylogenetic results show that all individuals of *P. orthocoryne* H. L. Li and *P. muscoides* H. L. Li form a well-supported monophyletic clade, supporting a re-define of the series *Roseae*.

1a. Plant 6–15 cm tall; leaves 3–4.5 cm long; corolla 1.4–1.6 cm long 97. *P. orthocoryne*

1b. Plant 1–5 cm tall; leaves 1–1.5 cm long; corolla 1.8–2.3 cm long 98. *P. muscoides*

97. *Pedicularis orthocoryne* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 89. 1949; Tsoong

in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 334. 1963; Yang, Holmgren & Mill in

Wu & Raven (eds.), Fl. China 18: 196. 1998.
 ≡ *Pedicularis oederi* Vahl var. *bracteosa*
 Bonati, Notes Roy. Bot. Gard. Edinb. 8: 42.
 1913. Type: China, Yunnan, Lijiang, “Alpine
 meadows on the eastern flank of the Lichiang
 range”, 4260–4570 m, June 1910, *G. Forrest*
 6097 [holotype: E(E00438454)].

Pedicularis angustiflora auct. non Limpricht
 (1922): Bonati, Notes Bot. Gard. Edinb. 15:
 147. 1926.

Herbs perennial, less than 10 cm tall,
 black when dry. Roots numerous, fleshy. Stems
 unbranched, puberulent. Basal leaf petiole
 1–1.5 cm long, slender, puberulent; leaf blade
 oblong-lanceolate, 1.5–3 cm long, 6–9 mm wide,
 puberulent to glabrescent, pinnatisect to pinnati-
 partite; segments 8–10 pairs, dentate. Inflores-
 cences 2–3 cm long, few-flowered; distal bracts
 rhombic-ovate to broadly ovate, crenate-serrate;

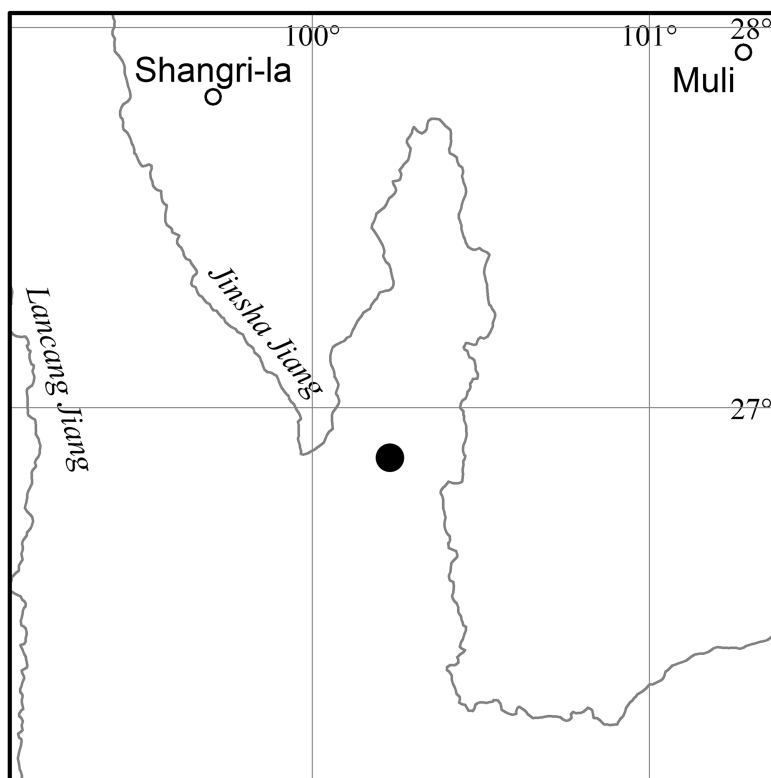
pedicels 2–3 mm long. Calyx 6–8 mm long,
 3–4 mm wide; lobes 5, unequal, posterior one
 triangular and entire, lateral lobes larger, ovate,
 serrate. Corolla yellow throughout, 15–20 mm
 long; tube 9–11 mm long. Galea straight, round-
 ed apically; lower lip 6–9 mm long, erose, middle
 lobe smaller than lateral pair, projected. Anterior
 2 filaments villous apically. Capsule oblong-
 ovoid, 9–11 mm long, 5 mm wide.

Phenology: flowering from June to July.

Habitats: grassy slopes; 4000–5300 m.

Distribution: endemic; S Hengduan [Map
 45(2)–97].

Notes: *Pedicularis oederi* var. *bracteosa*
 Bonati was described as new by Bonati based
 on a collection from Yulong, Yunnan Province,
 China. Li thought that this variety is very distinct
 and should be separated from *P. oederi* Vahl.



Map 45(2)–97: *Pedicularis orthocoryne* H. L. Li

Because the epithet “bracteosa” had been preoccupied, Li named it *P. orthocoryne* H. L. Li and placed it together with *P. oederi* Vahl in the series *Hissutae* Maxim. Tsoong recognized that *P. orthocoryne* H. L. Li is closely related to *P. oederi* Vahl but it is different from members of the series *Hissutae*, and he placed *P. orthocoryne* and *P. oederi* in the series *Flammeae* Prain.

Results of molecular data indicate that *P. orthocoryne* H. L. Li is most closely related to *P. muscoides* H. L. Li rather than to *P. oederi* Vahl. These three species are similar morphologically, but the leaves of *P. oederi* are larger than those of the other two species. *Pedicularis oederi* Vahl is widely distributed through alpine and arctic Europe, northern Asia, and arctic North America, while *P. muscoides* Vahl and *P. orthocoryne* H. L. Li are narrowly distributed in several mountains in the Qinghai-Tibet Plateau.

S HENGDUAN: Yulong (Lijiang), alpine meadows on the eastern flank of the Lichiang range, 4260–4570 m, June 1910, *G. Forrest 6097* (E); Yulong (Lijiang), Yulongxue Shan, growing on scree, 4420 m, June-Aug. 1932, *J. F. Rock 24887* (K).

98. *Pedicularis muscoides* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 91. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 309. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 187. 1998. ≡ *Pedicularis muscoides* H. L. Li var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 91. 1949. Type: China, Sichuan, Kangding, Gongkaling, 3960–5335 m, June 1928, *J. F. Rock 16343* [holotype: PH(00020121); isotype BM(BM000521615)].

Pedicularis muscoides subsp. *himalayca* T. Yamaz., J. Jap. Bot. 61: 298. 1986. **syn. nov.** Type: Nepal, Dolpa, Ccharka-Sangdah Pass, 83°30' E, 28°50' N, 5029 m, 23 July 1966, *Stainton 5573* [holotype: TI; isotype: BM)].

Perennial herbs 2–5 cm tall, black when dry. Roots straight, simple or sparsely branched, fleshy, descending from membranous scales. Stems scapelike, erect, only 1–3 cm tall. Basal leaf petiole 0.5–1.5 cm long, slender, pubescent; leaf blade oblong-lanceolate, 1–2 cm long, 2–3 mm

wide, pinnatisect or pinnatipartite; segments 5–12 pairs, ovate, glabrescent, dentate. Flowers 1 to 5; bracts leaflike, 1–1.2 cm long; pedicels 2–3 mm long. Calyx oblong-ovate, 6–9 mm long, 3–4 mm wide, pubescent; lobes 5, subequal in size, narrowly triangular, 2–3 mm long, more or less entire or dentate. Corolla cream colored or bright-rose, 12–23 mm long; tube slightly bent and expanded apically, 10–12 mm long; galea more or less bent, 8–12 mm long, apex more or less acute; lower lip shorter than galea, 5–8 mm long, 7–10 mm wide, glabrous on margins, 3-lobed, middle lobe orbicular. Filaments 2 pubescent apically, 2 glabrous throughout. Capsule oblong-ovoid, compressed, 9–11 mm long, 4 mm wide, slightly oblique, apex acute. Figure 45(2)–41.

Phenology: flowering and fruiting from June to August.

Habitats: moist alpine meadows; 3900–5300 m.

Distribution: endemic; U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, M Yarlung Zangbo, S Hengduan [Map 45(2)–98].

Notes: In the protologue of *P. muscoides* subsp. *himalayca* T. Yamaz., Yamazaki stated that “in the original description of *P. muscoides* H. L. Li, it was reported that the calyx is glabrous, but the plants of Nepal and Southeast Tibet have the calyx densely covered with short glandular hairs,, so that the plants of Nepal and Southeast Tibet are separated as a local variation”. However, Li did describe the calyx as pubescent: “calyce oblong-ovoideo, circiter 8 mm, longo, 3–4 mm, lato, puberula, 5-costato, ...” (1949. Proc. Acad. Nat. Sci. Philad. 101: 91). Apparently, *P. muscoides* subsp. *himalayca* T. Yamaz. should be typical *P. muscoides* H. L. Li. Examinations of types and figures (Li, 1949. plate 8, figure 151) confirm that *P. muscoides* H. L. Li has pubescent calyx. Hence, *P. muscoides* subsp. *himalayca* T. Yamaz. is here treated as a synonym of *P. muscoides* H. L. Li.

Yamazaki (2003. J. Jap. Bot. 78: 71) described *P. bhutanomuscoides* T. Yamaz. as new, and he stated that “This species resembles *P. muscoides* Li subsp. *himalayca* T. Yamaz., but

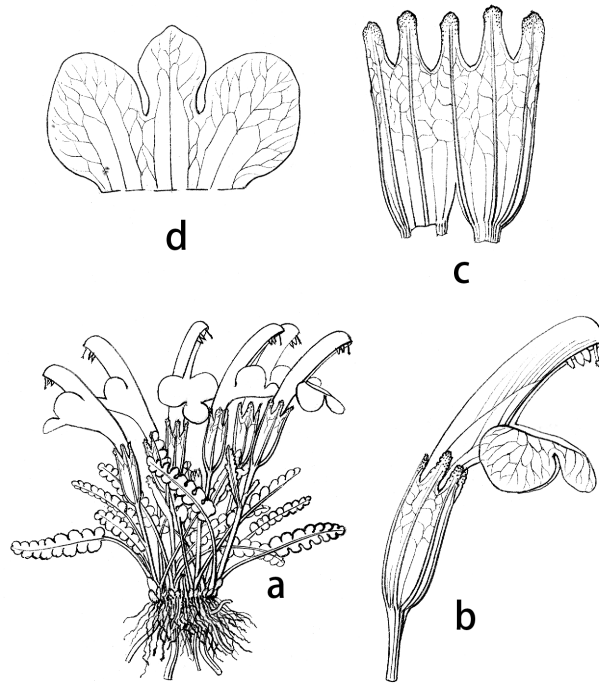
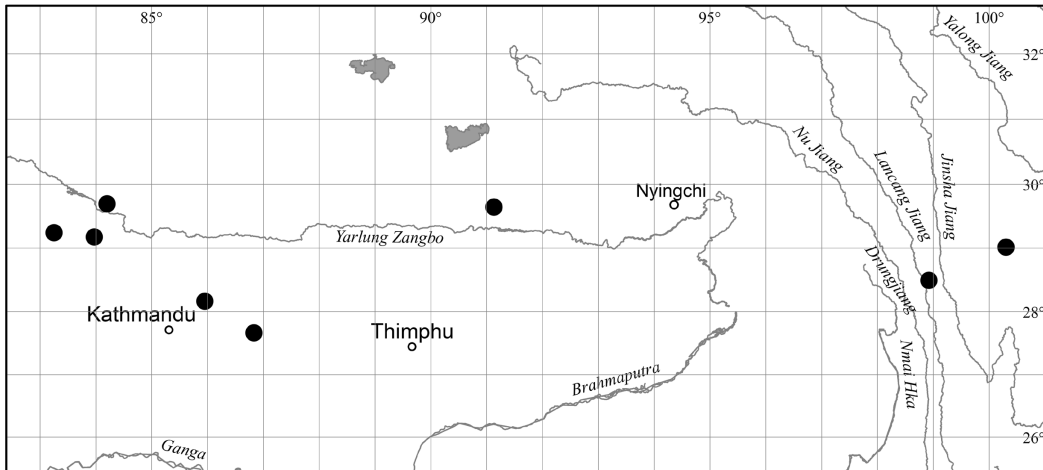


Figure 45(2)–41: *Pedicularis muscoides* H. L. Li. a, habit; b, flower; c, calyx; d, corolla lip. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 309, figure 69: 1-4. 1963].



Map 45(2)–98: *Pedicularis muscoides* H. L. Li

differs by the larger and more serrate leaves and larger flowers”. However, types of *P. bhutanomuscoides* T. Yamaz. are characterized by fish-gill-shaped laminas, very short lower lips of corolla, and much small middle lip. All these characters indicate that it should be most closely

related to *P. flammea* subsp. *oederi* (Vahl) F. S. Yang, a member of the series *Flammeae* Prain.

U YARLUNG ZANGBO: Nyalam, 5200 m, 15 June 1966, *Y. T. Zhang & K. Y. Lang* 4068 (PE); Nyalam, near the city, 4750 m, 25 June 1975, *Qinghai-Xizang Exped.* 5880 (PE,

HNWP). **Zhongba**, Longger, 5100 m, 4 Aug. 1975, *Qinghai-Xizang Exped. 6572* (PE, HNWP). **W NEPAL: Karnali**, Dolpa, Ccharka-Sangduh Pass, 83°30' E, 28°50' N, 5030 m, 1966, *J. D. A. Stainton 5573* (BM). **C NEPAL: Dhawalagiri**, Mustang, Namdo, 5030 m, June-Aug. 1954, *J. D. A. Stainton et al. 2274* (BM). **E NEPAL: Sagarmatha**, Khumbu, June 1964, *S. A. Bowes-Lyon 2129* (BM). **M YARLUNG ZANGBO: Lhasa**, Hills S of Lhasa, 4830, 31 May 1943, *F. Ludlow & G. Sherriff 9549* (PE). **S HENGDUAN: Daocheng**, Wuming Shan, 4650 m, 2 June 1982, *X. H. Hu 28124* (CDBI). **Dêqên**, Maimaxue Shan, 4600 m, 6 July 1983, *Hengduan Shan Veg. Exped. 4433* (PE); Dêqên, Baimaxue Shan, *G. Forrest 14411* (E).

Ser. 33. *Merrillianae*

Ser. *Merrillianae* P. C. Tsoong ex H. P. Yang, *Acta Phytotax. Sin.* 33: 248. 1995.

Herbs low, more or less stemless. Leaves alternate, mostly basal, in a rosette, withered leaf persistent. Inflorescences short-spicate or capitate, few-flowered. Calyx 5-lobed. Corolla tube erect; galea with 1 marginal tooth on each side, with a beaklike apex.

One species; endemic to the Pan-Himalaya.

Notes: Molecular phylogenetic results indicate that the series *Merrillianae* P. C. Tsoong ex H. P. Yang is most closely related to the series *Asplenifoliae* Prain.

99. *Pedicularis merrilliana* H. L. Li, *Proc. Acad. Nat. Sci. Philad.* 101: 96. 1949; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 309. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 187. 1998. Type: China, Sichuan, Kangding, 4900 m, June-July 1929, *J. F. Rock 177707* [holotype: PH (00020115); isotype: E(E00386161)].

Herbs perennial, 4–8 cm tall, black when dry. Roots more or less fleshy and branched. Stems several, unbranched, shiny, with membranous scales at base. Leaves mostly basal; petiole 1.5–3 cm long, slender, glabrescent; leaf blade oblong, 1–1.7 cm long, 3–5 mm wide, adaxially glabrous, abaxially rust-colored pubescent, pinnatisect; segments 8–12 pairs, oblong to ovate-oblong, dentate. Inflorescences ca. 3-flowered; bracts leaflike, 0.8–1.5 cm long; pedicels 2–4(–7) mm long, slender, sparsely villous. Calyx 8–10 mm long, 2–3 mm wide, slightly cleft anteriorly, pubescent; lobes 5, unequal in size, serrate. Corolla purple-red, 20–25 mm long; tube more or less erect, 8–12 mm long; galea slightly falcate, with a short, wide beaklike apex, truncate, with 1 distinct subapical, marginal tooth on each side; lower lip 6–10 mm long, 10–15 mm

wide, glabrous. Filaments glabrous, or 2 anterior filaments exceedingly, sparsely short-pilose. Capsule oblong-ovoid, 11–13 mm long, slightly oblique, apex acute.

Phenology: flowering from June to July.

Habitats: alpine meadows; 3200–4900 m.

Distribution: Bhutan, N Hengduan [Map 45(2)–99]; also in SW Gansu, China.

1a. No ciliation on the margin of lower lip; filaments all glabrous 99a. subsp. *merrilliana*

1b. With ciliations on the margin of lower lip; filaments 2 sparsely short-pilose, 2 glabrous...
..... 99b. subsp. *yarilaica*

99a. *Pedicularis merrilliana* subsp. *merrilliana*

Herbs perennial, 5–8 cm tall. Stems 1–5, unbranched, shiny, with membranous scales at base. Inflorescences ca. 3-flowered; bracts leaflike, 0.8–1.5 cm long; pedicels 2–4(–7) mm, slender, sparsely villous. Corolla purple-red, 18–23 mm long; tube more or less erect, 9–12 mm long; lower lip 6–8 mm long, glabrous. Filaments all glabrous. Capsule oblong-ovoid, 11–13 mm long, slightly oblique, apex acute. Figure 45(2)–42.

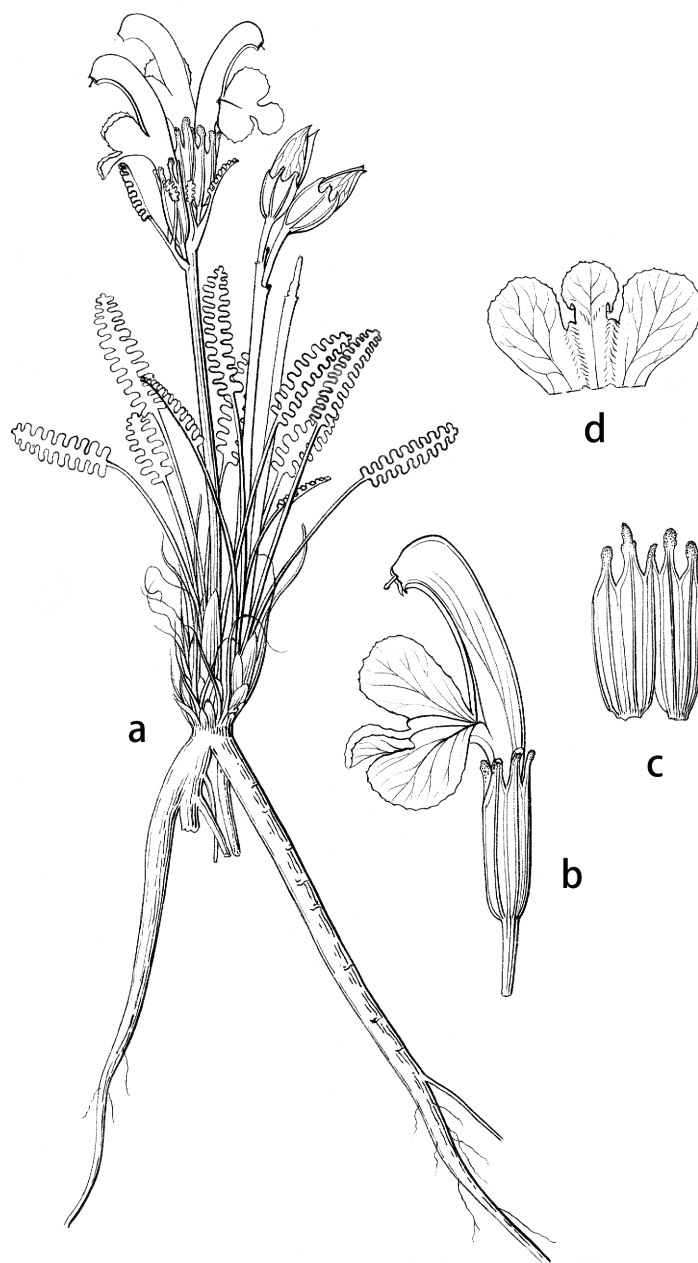


Figure 45(2)-42: *Pedicularis merrilliana* subsp. *merrilliana* H. L. Li. a, habit; b, flower; c, calyx; d, corolla lip. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 309, figure 69: 5-8. 1963].

Phenology: flowering from June to July.

Habitats: alpine meadows; 3200–4900 m.

Distribution: N Hengduan [Map 45(2)–99]; also in other regions of Gansu, China.

N HENGDUAN: **Barkam**, Dongrergo (Barkam to Kangding), 4300 m, 20 July 1922, *H. Smith 3811* (PE). **Heishui**, river division, 4320 m, 1 July 1959, *S. Jiang & C. L. Jin* (*South-to-North Water Divers. Proj.*

Exped.) 01475 (PE). **Maoxian**, 1952, *Z. He & Z. L. Zhou 12858* (PE). **S HENGDUAN: Kangding**, Gongga Shan, Zimeiliangzi, 4000 m, 2 June 1980, *Z. Y. Chen, G. Hu, Z. J. Zhao et al. 112411* (SZ).

99b. *Pedicularis merrilliana* subsp. *yarilaica* (R. R. Mill) F. S. Yang, **comb. et stat. nov.** \equiv *Pedicularis yarilaica* R. R. Mill, *Edinb. J. Bot.* 58: 77. 2001. **syn. nov.** Type: Bhutan, Upper Mo Chu district, Yari La, between Chumiten and Tseya Gyethang, calyx pale green, corolla purplish pink, damp hill slopes, 4265 m, 4 June 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 16422* [holotype: BM(BM000885893)].

Stems 1–6 cm tall, minutely pubescent with 2 rows of hairs. Leaves mainly in a basal tuft; petiole 4–18 mm long, sub-glabrous. Leaves mainly in a basal tuft, alternate; petiole 4–18 mm long, subglabrous; leaf blade ovate-oblong, 6–13 mm long, 2.5–6 mm wide; segments 5–10 pairs, triangular-oblong, subentire lateral with broad, rounded, decurved tips. Inflorescences of 2(–3), terminal flowers very close together; bracts

8–10 mm long, with short-broad petiole and deeply 3-fid lamina. Corolla purplish-pink, 22–25 mm long; lower lip 9–11 mm long, 11–15 mm wide, more or less glabrous on margins. Filaments anterior 2 sparsely short-pilose in upper 2/3, posterior 2 glabrous.

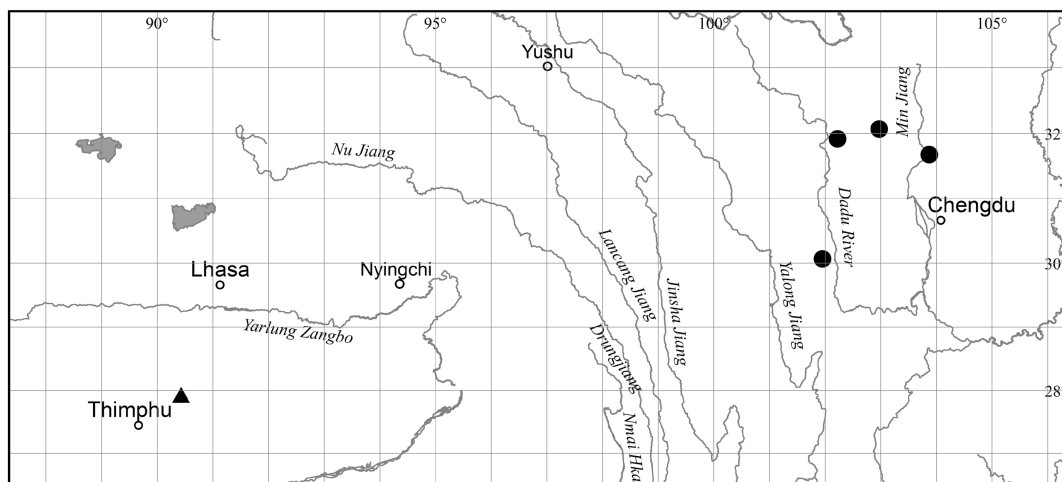
Phenology: flowering from June to July.

Habitats: damp hill slopes; 3960–4265 m.

Distribution: endemic; Bhutan [Map 45(2)–99].

Notes: Mill described *P. yarilaica* R. R. Mill as new based on two collections from Bhutan and S Tibet, China. It differs from *P. merrilliana* H. L. Li (distributed in NW Sichuan) in sparse hairs on the margin of low lips and 2 anterior filaments exceedingly sparsely short-pilose in upper 2/3 (all glabrous in *P. merrilliana*), and it is here treated as a subspecies of *P. merrilliana* H. L. Li.

BHUTAN: Upper Mo Chu, Yari La, between Chumiten and Tseya Gyethang, damp hill slopes, 4265 m, 4 June 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 16422* (E, PE).



Map 45(2)–99: *Pedicularis merrilliana* H. L. Li
 ● subsp. *merrilliana* ▲ subsp. *yarilaica*

Ser. 34. *Asplenifoliae*

Ser. *Asplenifoliae* Prain, Ann. Roy. Bot. Gard. Calc. 3: 79. 1890.

Herbs low, without a distinct main stem. Leaves numerous, almost all basal, persistent. Inflorescences short-spicate or subcapitate, few-flowered, long-pedicellate. Calyx 5-lobed. Corolla tube less than 2 times as long as calyx; beak straight or bent slightly downward.

Six species; all endemic to the Pan-Himalaya.

Notes: Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 97–100) described *P. umbelliformia* H. L. Li as new and he placed it in the series *Paucifoliatae* Prain. *Pedicularis umbelliformia* is characterized by branched linear roots, which are quite different from fascicled and filiform roots of the series *Paucifoliatae* Prain. Hence, we transfer *P. umbelliformia* H. L. Li to the series *Asplenifoliae* Prain, which are morphologically similar and characterized by branched linear roots. This taxonomic treatment is supported by our results of molecular phylogenetic analysis.

Tsoong (1955. Acta Phytotax. Sin. 3: 321) described *P. longipedicellata* P. C. Tsoong as new based on several collections from Bhutan and he placed it in the series *Asplenifoliae*. However, *P. longipedicellata* P. C. Tsoong is characterized by considerably larger and wider flowers than those of the series *Asplenifoliae*, and the length of corolla tubes is more than two times than that of calyx. All these characters indicate that *P. longipedicellata* should be a member of the series *Albiflorae* P. C. Tsoong ex H. P. Yang. Our molecular phylogenetic results reveal that the series *Asplenifoliae* is most closely related to the series *Mychophilae* and *Paucifoliatae*.

1a. Stems with lines of rust-colored hairs; corolla 12–16 mm long.

2a. Leaf blade pinnatisect, gap between segments wider than segments.....100. *P. mayana*

2b. Leaf blade pinnatifid to pinnatipartite, gap between segments narrower than segments.....
.....101. *P. umbelliformis*

1b. Stems glabrescent; corolla 18–30 mm long.

3a. Beak almost straight; filaments all glabrous102. *P. albiflora*

3b. Beak bent slightly downward; filaments pubescent.

4a. Stems 3–7 cm tall; corolla tube 12–14 mm103. *P. yui*

4b. Stems less than 2 cm tall; corolla tube 16–20 mm long.

5a. Petiole usually 1.5–2 cm long; segments 4–5 pairs; corolla beak 3 mm long
.....104. *P. hicksii*

5b. Petiole usually 2–4 cm long; segments 5–8 pairs; corolla beak 5 mm long
.....105. *P. petrophila*

100. *Pedicularis mayana* Hand.-Mazz., Symb. Sin. 7: 858. 1936; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 311. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 188. 1998. Type: China, NW Yunnan, “In regione alpina montis Maya inter fluvios Landsang-djiang (Mekong) et Lu-djiang (Salween), 28°4', in cespite.”, 4300–4575 m,

3 Aug. 1916, H. R. E. von Handel-Mazzetti 9641 [holotype: WU].

Pedicularis rhizomatosa P. C. Tsoong, Acta Phytotax. Sin. 3: 281. 1955; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 326. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 193. 1998. **syn.**

nov. Type: China, Tibet, Mainling, Tamnyen La, 3657 m, 22 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 4944* [holotype: BM(BM00885895)].

Herbs perennial, 4–10 cm tall, marcescent leaves with petiole and scales persistent at base, black when dry. Stems usually 3–7, erect or ascending, slender, with lines of rust-colored hairs. Leaves alternate; basal leaves in a rosette; petiole 4–5 cm long, slender, sparsely villous; leaf blade ovate-lanceolate to ovate-oblong, 0.8–1.5 cm long, 4–5 mm wide, abaxially sparsely pubescent, scurfy, adaxially glabrous, pinnatisect; segments 6–12 pairs, lanceolate, crenate. Inflorescences subcapitate, usually 4–8-flowered; bracts leaflike. Calyx 7–9 mm, slightly cleft anteriorly, rust-colored villous; lobes 5, unequal in size, oblanceolate, crenate. Corolla purple, 14–16 mm long; tube erect, 9–12 mm long, glabrous; galea falcate apically, usually slightly crested; beak 3–4 mm long, slender; lower lip 6–9 mm long, distinctly praemorse, glabrous. Filaments all glabrous. Capsule lanceolate-oblong, 1.3–1.4 cm long, ca. 5 mm wide, slightly oblique, apex acute. Figure 45(2)–43.

Phenology: flowering and fruiting from May to September.

Habitats: alpine meadows; 3700–4600 m.

Distribution: endemic; L Yarlung Zangbo, S Hengduan [Map 45(2)–100].

Notes: Tsoong described *P. rhizomatosa* P. C. Tsoong as new and placed it in the series *Asplenifoliae* Prain, but in *Fl. Reipubl. Popularis Sin.* he transferred this species to the series *Albiflorae* P. C. Tsoong, a new series established by himself. A statistic of morphological characters reveals that there are no morphological gaps between *P. rhizomatosa* P. C. Tsoong and *P. mayana* Hand.-Mazz. Hence, the former is treated as a new synonym of the latter, which is supported by our results of molecular data, where one individual of *P. mayana* Hand.-Mazz. and two of *P. rhizomatosa* P. C. Tsoong form a monophyletic clade sister to *P. umbelliformis* H. L. Li.

L Yarlung Zangbo: Nangxian, Langong, 4420 m, 4 July 1938, *F. Ludlow & G. Sherriff 3959* (PE). **S HENGDUAN: Dêqên**, Cizhong,

3700 m, 12 July 1940, *K. M. Feng 5348* (PE). **Fugong**, Zhiziluo, Biluoxue Shan, 4000 m, 26 Aug. 1934, *H. T. Tsai 58201* (NAS, PE, WUK).

101. *Pedicularis umbelliformis* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 100. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 314. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 189. 1998. Type: China, Yunnan, Shangri-la (Zhongdian), “Kongsinshu”, 3450 m, 24 June 1937, *T. T. Yü 11746* [holotype: A; isotypes: PE(00032970, PE00032974)].

Herbs perennial, 6–15 cm tall, marcescent leaves with petiole and scales persistent at base, more or less black when dry. Roots numerous, linear. Stems 2 or 3(–6), unbranched, minutely pubescent. Leaves almost all basal, 5 or 6(–8); petiole 2–3.5 cm long, slender, pubescent; leaf blade ovate-elliptic to oblong-lanceolate, 1.5–2.5 cm long, 7–8 mm wide, adaxially glabrous, abaxially sparsely pubescent, scurfy, pinnatisect or pinnatipartite; segments 5–7 pairs, ovate, pinnatifid, dentate. Inflorescences short-racemose or umbelliform, 5–10-flowered; bracts leaflike, ca. as long as calyx; pedicels 2–3 mm long. Calyx 5–8 mm long, sparsely pubescent; lobes 5, more or less equal in size, dentate. Corolla red-purple, 13–20 mm long; tube erect, 6–10 mm long; galea bent at a right angle apically; beak 4–6 mm long; lower lip 8–10 mm long, 8–9 mm wide, sparsely ciliate, middle lobe smaller than lateral pair, lateral lobes nearly fully projected. Filaments 2 pubescent, 2 glabrous. Figure 45(2)–44. **Chromosomes:** $2n = 16$.

Phenology: flowering from May to June.

Habitats: grassy slopes; 3400 m.

Distribution: endemic; S Hengduan [Map 45(2)–101].

Notes: Li stated that *P. umbelliformis* H. L. Li is closely related to *P. praeurptorum* Bonati and *P. tsarungensis* H. L. Li. However, our molecular phylogenetic results reveal that three accessions of *P. umbelliformis* H. L. Li form a monophyletic clade sister to *P. mayana* Hand.-Mazz., indicating the most close relationship between *P. umbelliformis* H. L. Li and *P. mayana* Hand.-Mazz.

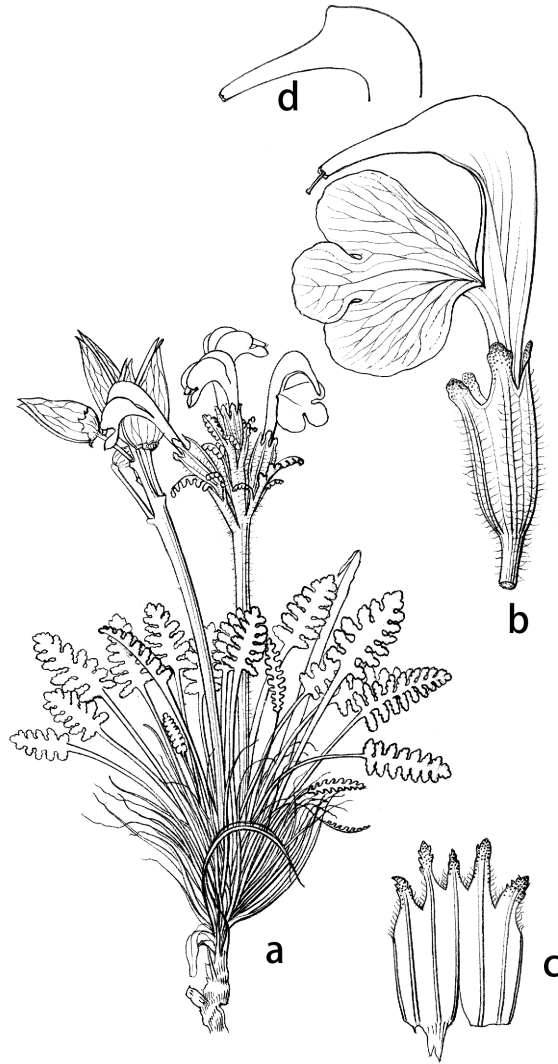


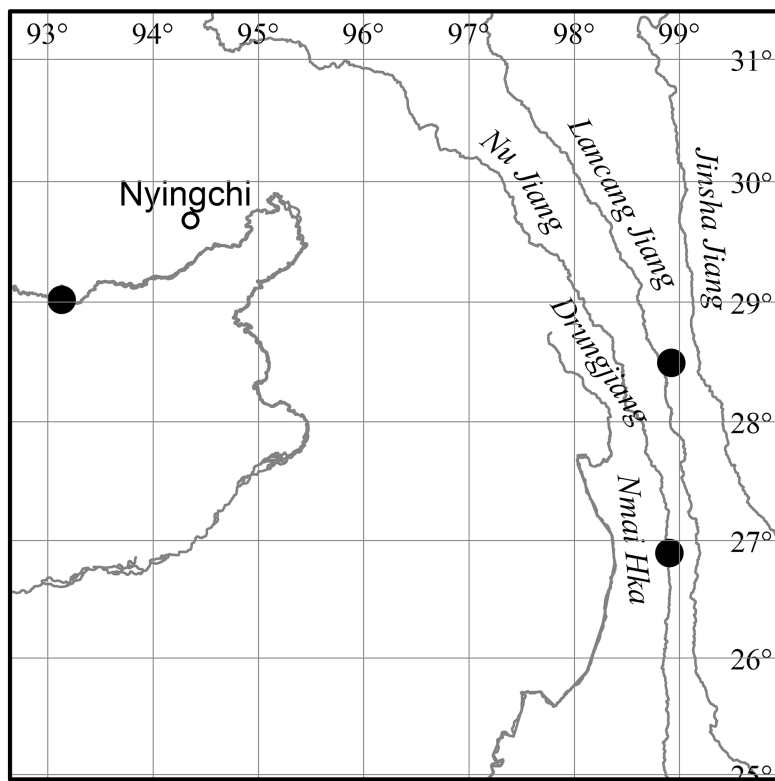
Figure 45(2)–43: *Pedicularis mayana* Hand.-Mazz. a, habit; b, flower; c, calyx; d, galea. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 311, figure 69: 9-12. 1963].

S HENGDUAN: Shangri-la (Zhongdian), “Kongsinshu”, 3450 m, 24 June 1937, *T. T. Yü* 11746 (KUN, PE).

102. *Pedicularis albiflora* (Hook. f.) Prain, *J. Asiat. Soc. Bengal* 58: 273. 1889; *Ann. Bot. Gard. Calc.* 3: 156. 1890; Limpricht, *Rep. Sp. Nov. Veget.* 20: 236. 1924; Yamazaki in Hara *et al.*, *Enum. Fl. Pl. Nepal* 3: 122. 1982. ≡ *Pedicularis asplenifolia* var. *albiflora* Hook. f., *Fl. Brit. India* 4: 315. 1884. Type: India, Sikkim, Kankola, 3962 m, 22 Aug. 1849,

(*Pedicularis n. 20*) Hook. f. s.n. [lectotype designated by Garg & Singh (2020: 61): K(K000739108)].

Perennial herbs, 3–8 cm tall. Roots several, fleshy, covered by several ovate scales, membranous. Stems branched at base, simple, erect, pubescent. Leaves mostly radical; petiole slender, 1–4 cm long, glabrous; leaf blade linear or linear-lanceolate, 1–2 cm long, 5–10 mm wide, glabrous above, sparsely pubescent beneath, pinnatifid; segments 4–8-paired, oblong



Map 45(2)-100: *Pedicularis mayana* Hand.-Mazz.

to oblong-ovate, acute at apex, acute-serrate. Inflorescences racemes, 2–5-flowered; pedicels 2–10 mm long, sparsely pilose. Calyx tubular-campanulate, 7–8 mm long, 3 mm wide, sparsely pilose, 5-lobed, posterior lobe small oblanceolate, serrate, lateral lobes narrowly obovate, dilated above, acute-serrate. Corolla light-yellow with galea purple-tipped, 16–20 mm long; tube straight, 13–15 mm long, 1.5–2 times as long as calyx; galea decurved at middle, punctate, gradually narrowed into a beak, 2–3 mm long, truncate and dentate at apex; lower lip broad, 6–8 mm long, 12–15 mm wide, pilose on margins, middle lobe broadly orbicular. Filaments all glabrous. Capsule oblong, acute at apex, 10–12 mm long, 4–5 mm wide.

Phenology: flowering and fruiting from June to August.

Habitats: among grasses on open slopes, in short turfs near a stream; 4000–4500 m.

Distribution: endemic; E Nepal, L Yarlung Zangbo [Map 45(2)-102].

E NEPAL: **Kosi,** Sankhuwasabha, Lumbasumba Himal, 3962 m, 24 July 1971, *L. W. Beer*; *C. R. Lancaster & D. Morris 9445* (BM); Kosi, Sankhuwasabha, Jaljale Himal, 4030–4170 m, 22 July 1991, *H. Ohba, S. Akiyama, H. Ikeda et al. 9120155* (TI); Kosi, Sankhuwasabha, Thudam Pass, 4325 m, 11 July 1978, *H. Tabata, K. R. Rajbhandari & Y. Shimizu 11447* (TI). **Mechi,** Taplejung, 4267 m, 1971, *Beerno 8278* (BM); Taplejung, Arun-Tamur, 4267 m, 1956, *J. D. A. Stainton 859* (BM, TI). **L Yarlung Zangbo:** **GongBo'gyamda,** Deyang La, 4115 m, 9 Aug. 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 14290* (PE00094876).

103. Pedicularis yui H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 102. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 312.

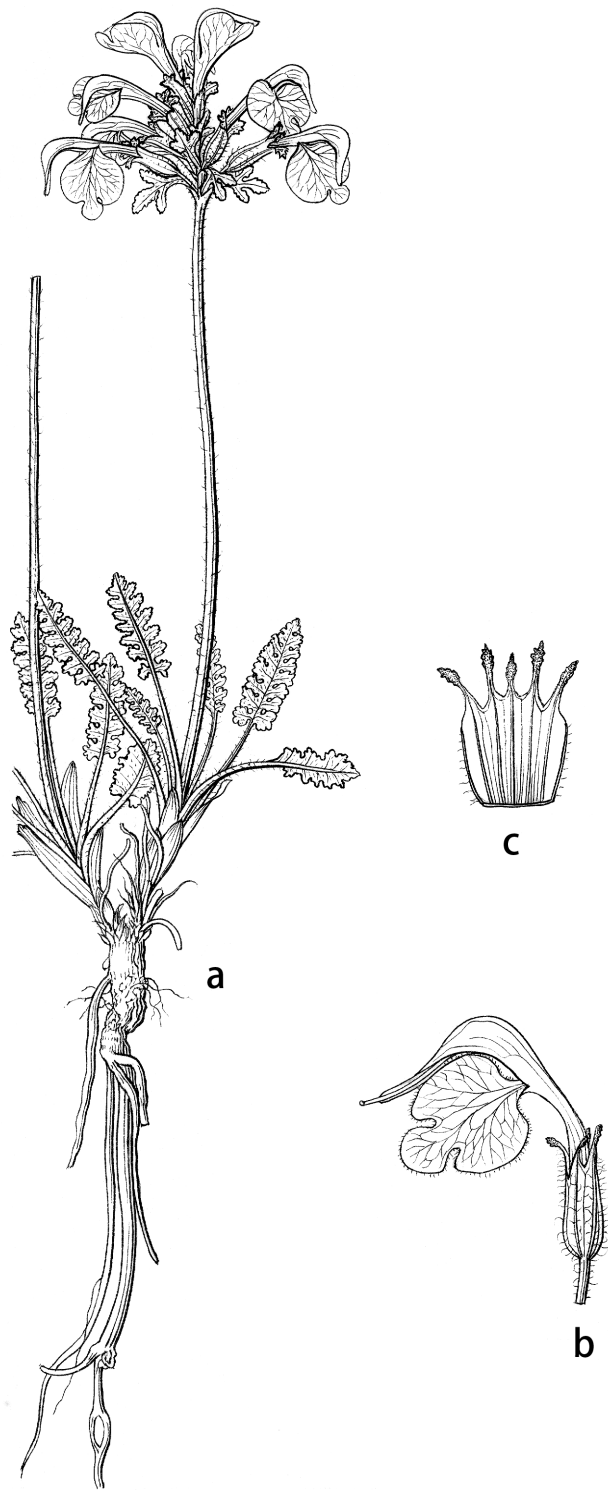
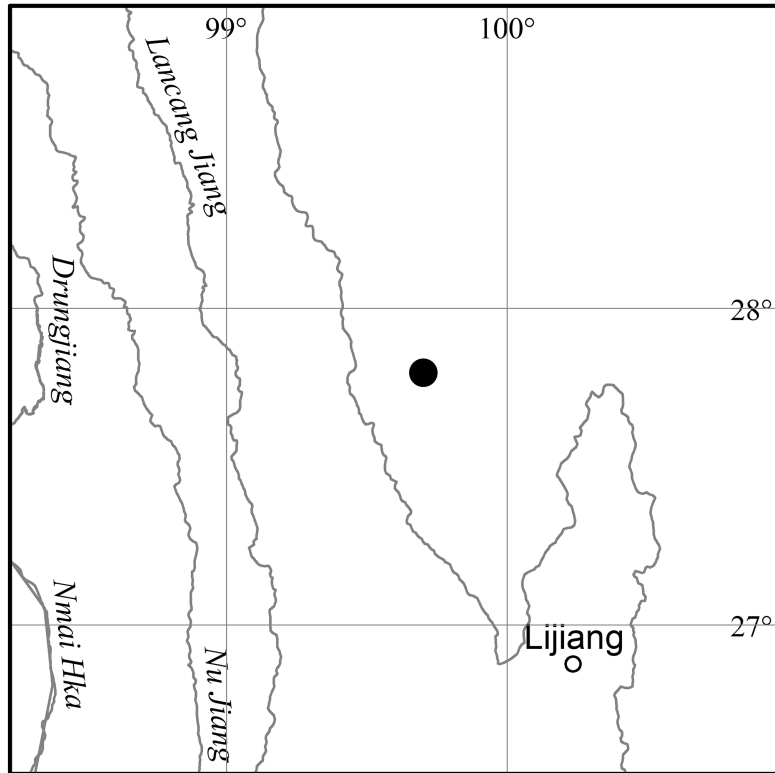


Figure 45(2)–44: *Pedicularis umbelliformis* H. L. Li. a, habit; b, flower; c, calyx. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 314, figure 71: 1-3. 1963].



Map 45(2)-101: *Pedicularis umbelliformis* H. L. Li

1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 188. 1998. Type: China, NW Yunnan, “in alpine swamp at an altitude of 4100 m, Tsukuei, Salween-Kiukiang divide, Yunnan”, 14 July 1938, *T. T. Yü 19382* [holotype: A(00097297)].

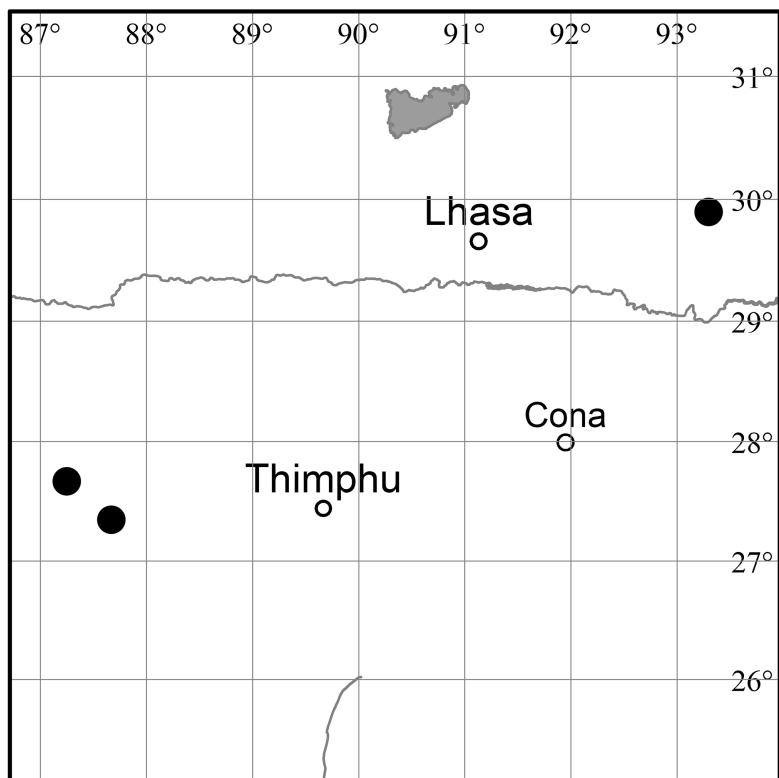
Pedicularis tenacifolia P. C. Tsoong, in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 416. 1963; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 311. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 188. 1998. **syn. nov.** Type: China, SE Tibet, Nangxian, “Takpo Province, Chianang, Langong”, 4420 m, 4 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 3959* [holotype: PE(00032941); isotypes: PE(00032942), BM(BM000997954), E(E00284043)].

Pedicularis roseialba T. Yamaz., *J. Jap. Bot.* 78: 71. 2003. **syn. nov.** Type: Bhutan, Paro Distr. Bonte La, open low *Rhododendron* dwarf-

scrub with fragments on upper N-facing slope, 4930 m, 10 July 2000, *G. Miehe & S. Miehe 00-184-24* (holotype: TI).

Pedicularis yui var. *ciliata* P. C. Tsoong, in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 313. 1963. **syn. nov.** Type: Yunnan, Upper Kiukiang Valley, Clulung, S Lungtsahmura, alpine grassland, 4000 m, 10 Aug. 1938, *T. T. Yü 19863* [holotype: PE(00032310); isotypes: E(E00284023), PE(00032309)].

Herbs 6–10 cm tall, glabrescent, black when dry. Stems usually single, erect, unbranched, slender, with marcescent leaves and petiole of the preceding year and lanceolate scales persistent at base. Leaves alternate, mostly basal; petiole 1.5–3 cm long; leaf blade long-ovate to ovate-oblong, 5–10 mm long, 3–5 mm wide, adaxially glabrous, abaxially usually white-villous along midvein, pinnatisect; segments 4 or 5 pairs, short-ovate, minutely crenulate. Inflorescences racemose or



Map 45(2)-102: *Pedicularis albiflora* (Hook. f.) Prain

subcapitate, 4–6-flowered; bracts leaflike; pedicels 3–6(–11) mm long, filiform. Calyx 8–10 mm long, sparsely long-pubescent or glabrous, slightly cleft anteriorly; lobes 5, unequal in size, ovate, serrate. Corolla purple, 18–20 mm long; tube erect, ca. 2 times longer than calyx; galea bent at a right angle apically; beak bent slightly downward, straight, 4–5 mm long; lower lip 9–11 mm long, glabrous or ciliate, minutely crenulate. Filaments all glabrous, or 2 pubescent 2 glabrous. Figure 45(2)–45.

Phenology: flowering from June to July.

Habitats: alpine swamps; 4000–5000 m.

Distribution: endemic; Bhutan, L Yarlung Zangbo, S Hengduan [Map 45(2)–103].

Notes: Tsoong in *Fl. Reipubl. Popularis Sin.* described *P. tenacifolia* P. C. Tsoong as new (misidentified as *P. umbelliformis*), and he stated that *P. tenacifolia* differs from *P. mayana* Hand.-Mazz. in having few lamina segments

(5–6 vs. 6–12 for each side) and obvious hairs on the margin of lower lips. We examined the type collection and find that *P. tenacifolia* is similar to *P. yui* H. L. Li, and a further statistic of morphological traits reveals that morphological variation of *P. tenacifolia* falls into the range of *P. yui* H. L. Li. Hence, *P. tenacifolia* is here treated as a new synonym of *P. yui* H. L. Li, which is supported by our results of molecular data, because the nrDNA ITS sequences of two “species” are identical.

Tsoong described *P. yui* var. *ciliata* P. C. Tsoong as new based on a collection (*T. T. Yü 19863*) from NW Yunnan, which was misidentified as *P. praeruptorum* Bonati by H. L. Li. It differs from typical *P. yui* in the margin of the corolla lip with hairs and in anterior filaments with pubescence. However, these variations fall into the range of *P. yui*, and the former is here merged into the latter. Moreover, Yamazaki described *P. roseialba* T. Yamaz. as new based

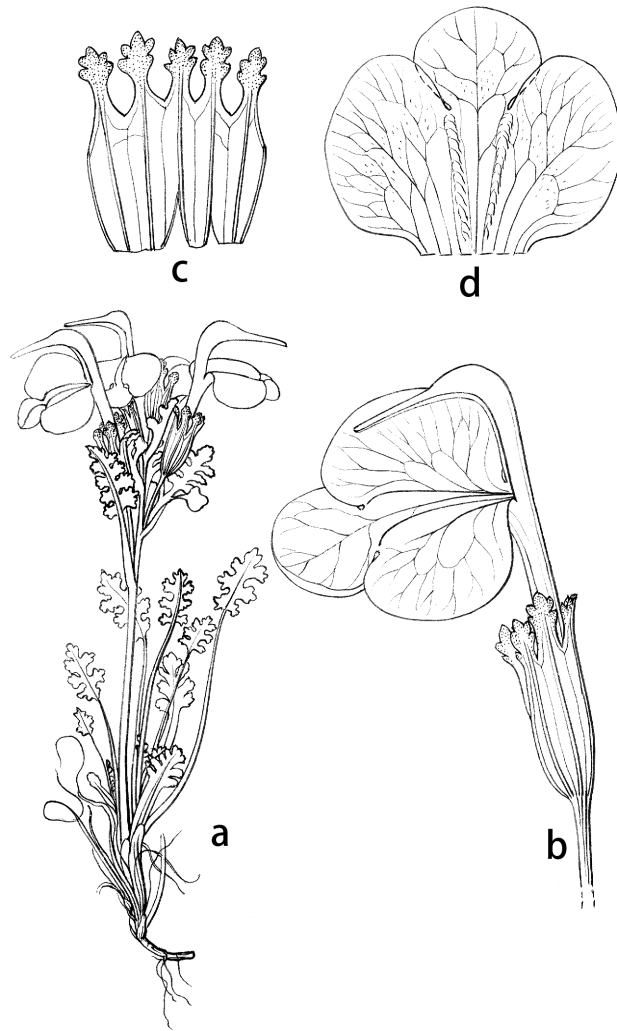
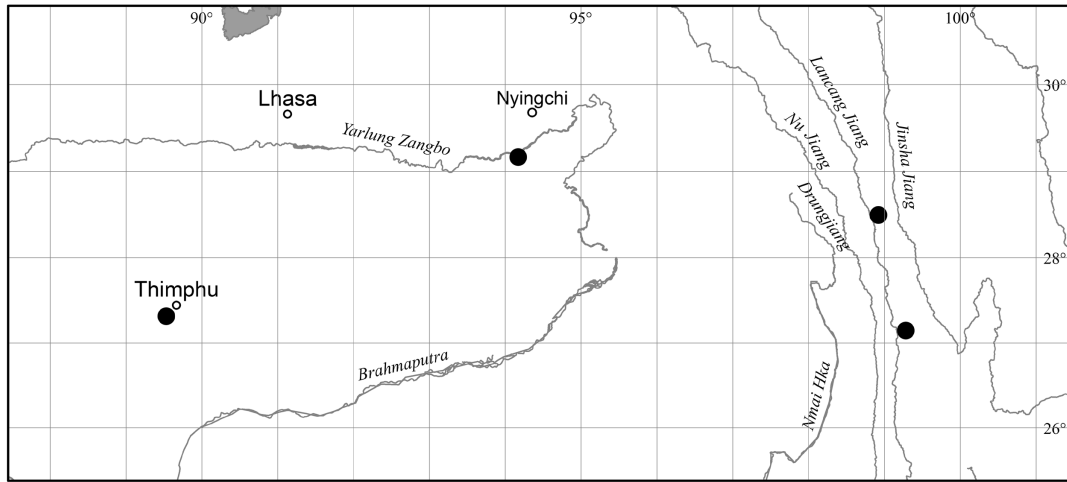


Figure 45(2)–45: *Pedicularis yui* H. L. Li. a, habit; b, flower; c, calyx; d, corolla lip. Drawn by C.-Y. LIU [Fl. Reipubl. Popularis Sin. 68: 312, figure 70: 1-4. 1963].

on a collection from Bhutan. He stated that it resembles *P. albiflora* Prain but differs in lineari-oblong and pinnatifid leaves, glabrous calyx, and margin of corolla lip. Examinations of herbarium specimens confirm that *P. roseialba* is similar to typical *P. yui* rather than to *P. albiflora* (Ser. *Albiflorae*), and *P. roseialba* is here treated as a synonym of *P. yui*. It should be recognized that the morphological variation of *P. yui* H. L. Li is quite complex and further

studies are necessary to clarify infraspecific classification units in this species. The results of our molecular phylogenetic analysis reveal that *P. yui* H. L. Li and *P. tenacifolia* P. C. Tsoong form a clade nested within a clade including *P. umbelliformis* H. L. Li, *P. mayana* Hand.-Mazz., and *P. merrilliana* H. L. Li.

BHUTAN: **Paro**, Bonte La, open low *Rhododendron* dwarf-scrub with fragments on upper N-facing slope, 4930 m, 10 July



Map 45(2)-103: *Pedicularis yui* H. L. Li

2000, *G. Miehe & S. Miehe 00-184-24* (TI). **L YARLUNG ZANGBO: Mainling**, Tamnyen La, Lat. 29°20' N, 94°43' E, 3650 m (12000 ft), 22 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 4944* (BM). **S HENGDUAN: Dêqên**, Upper Kiukiang Valley, 4000 m, 10 Aug. 1938, *T. T. Yü 19863* (KUN, PE). **Weixi**, Salween-Kiukiang divide, alpine swamp, 4100 m, 14 July 1938, *T. T. Yü 19382* (PE, KUN).

104. *Pedicularis hicksii* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 283, 322. 1955; *Bull. Brit. Mus. (Nat. Hist.) Bot.* 2: 10. 1955. Type: Bhutan, Shingbe (Me La), 4420 m, 24 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 21099* [holotype: BM(BM000885907)].

Perennial herbs, 3–8 cm tall. Roots several, fleshy, covered by several ovate scales, membranous. Stems branched at base, simple, erect, pubescent. Leaves mostly radical; petiole slender, 1–4 cm long, glabrous; leaf blade linear or linear-lanceolate, 1–2 cm long, 5–10 mm wide, glabrous above, sparsely pubescent beneath, pinnatifid; segments 4–8-paired, oblong to oblong-ovate, acute at apex, acute-serrate. Inflorescences racemes, 2–5-flowered; pedicels 2–10 mm long, sparsely pilose. Calyx tubular-campanulate, 7–8 mm long, 3 mm wide, sparsely pilose, 5-lobed,

posterior lobe small oblanceolate, serrate, lateral lobes narrowly obovate, dilated above, 3 mm long, acute-serrate. Corolla light-yellow with galea purple-tipped, 20–30 mm long; tube straight, 13–15 mm long, 1.5–2 times as long as calyx; galea decurved at middle, punctate, gradually narrowed into a beak, 2–3 mm long, truncate and dentate at apex; lower lip broad, 6–8 mm long, 12–15 mm wide, pilose on margins, middle lobe broadly orbicular. Filaments all glabrous. Capsule oblong, acute at apex, 10–12 mm long, 4–5 mm wide.

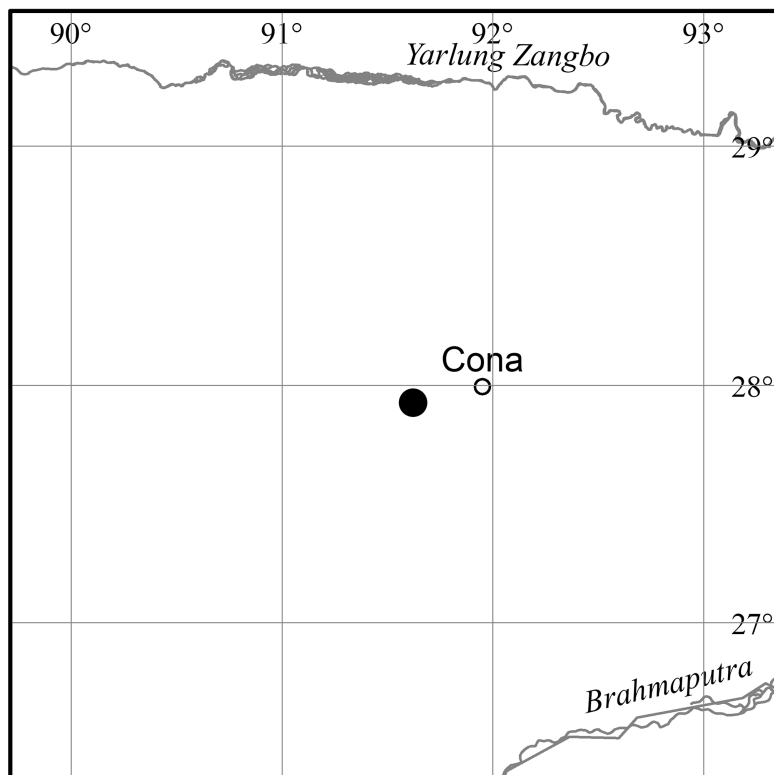
Phenology: flowering from June to August.

Habitats: alpine meadows, among grasses on open slopes, 4000–4500 m.

Distribution: endemic; Bhutan [Map 45(2)-104].

Bhutan: Shingbe, 4420 m, 24 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 21099* (E00273614).

105. *Pedicularis petrophila* H. L. Li, *Taiwania* 1: 87. 1948. Type: Myanmar, Adung Valley, near the Tibetan frontier, 4270 m, 26 July 1931, *F. Kingdon-Ward 9858* [holotype: F(F730638)].



Map 45(2)-104: *Pedicularis hicksii* P. C. Tsoong

Perennial herbs, only 7 cm tall. Roots single or sometimes branched, more or less fleshy. Stems single to several and clustered. Leaves mostly radical, dense; petiole slender, 1.5–4 cm long, glabrous or sparsely pubescent; leaf blade linear or linear-lanceolate, 7–25 mm long, 4–7 mm wide, glabrous, pinnatifid to pinnatisectis; segments 5–8-paired, oblong-ovate, acute at apex, serrate. Inflorescences short-racemose, 2–10 flowers; pedicels 15–20 mm long, sparsely pilose. Calyx tubular-campanulate, 5–6 mm long, sparsely pilose, reticulate near apex, 5-lobed, posterior lobe smallest, oblanceolate, serrate, lateral lobes stipitate, dilated above, 3-lobed, serrate. Corolla purple, 18–25 mm long; tube straight, 15–18 mm long, pubescent externally; galea falcate, with vertical part 5–7 mm

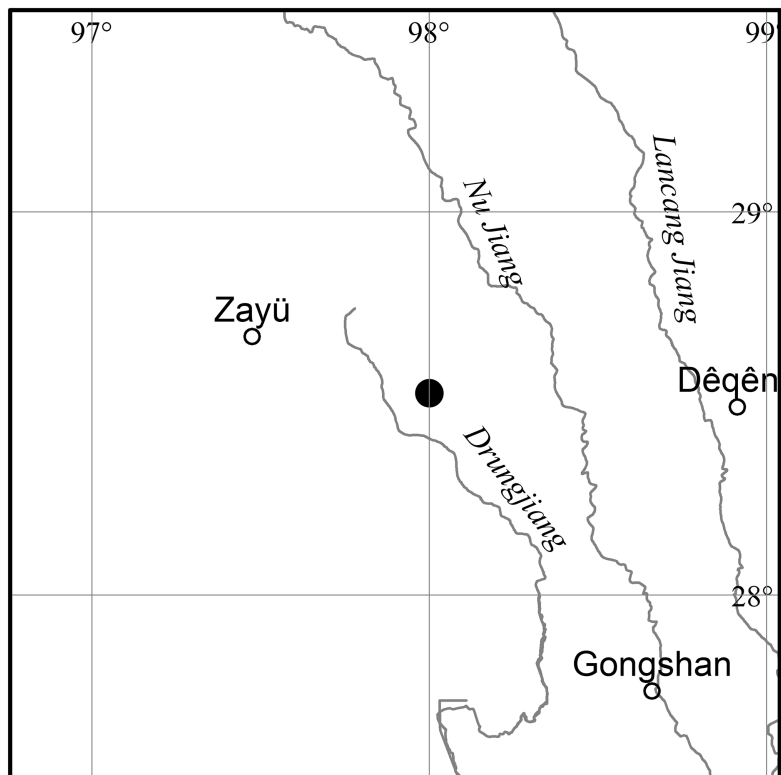
long, horizontal part 5–7 mm long, gradually narrowed into a beak, 4–6 mm long, bent downward; lower lip ca. as long as galea, lobes more or less equal, pilose on margins. Filaments all pubescent. Capsule oblong, acute at apex, 10–12 mm long, 4–5 mm wide.

Phenology: flowering from June to August.

Habitats: steep alpine slopes, 4000–4300 m.

Distribution: endemic; U Irrawaddy [Map 45(2)–105].

U Irrawaddy: Adung Valley, near the Tibetan frontier, 4270 m, 26 July 1931, *F. Kingdon-Ward* 9858 (BM).



Map 45(2)-105: *Pedicularis petrophila* H. L. Li

Ser. 35. Odontophorae

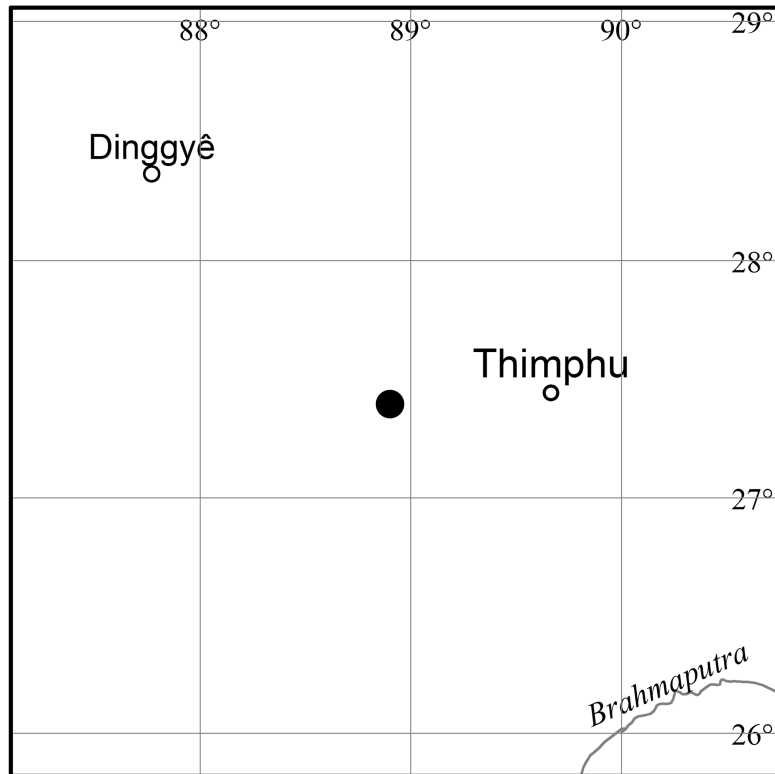
Ser. Odontophorae P. C. Tsoong ex H. P. Yang, *Acta Phytotax. Sin.* 33: 249. 1995.

Herbs perennial, low. Leaves few, alternate; leaf blade pinnatipartite or pinnatisect. Flowers few, axillary. Calyx 5-lobed. Corolla tube ca. 2 times as long as calyx; galea falcate, with marginal teeth, beaked.

One species; endemic to the Pan-Himalaya.

106. *Pedicularis odontophora* Prain, *J. Asiat. Soc. Bengal*, Pt. 2, *Nat. Hist.* 58: 275. 1889; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 313. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 189. 1998. Type: China, Tibet, Na-tong, Phari, Dotoh, 24 Aug. 1878, (King's collector) *Dungboo s.n.* [lectotype designated by Garg & Singh (2020: 87): CAL (CAL0000018952); isolectotype: K(K000739124)].

Herbs 3–10 cm tall. Rhizomes creeping, 5–7 cm long. Stems minutely pubescent. Basal leaves withering early; petiole 2.5–3 cm long; cauline leaf petiole 5–10 mm long; leaf blade ovate, 2–3 cm long, 2–2.5 cm wide, pinnatipartite or pinnatisect; segments 3–5 pairs, pinnatifid, dentate. Flowers axillary; pedicels 2–4 mm long. Calyx cylindrical-campanulate, 7–9 mm long, slightly cleft anteriorly; lobes 5, unequal in size, entire. Corolla tube 11–14 mm long, slightly expanded apically; galea falcate, 7–9 mm long, with 1 pair of



Map 45(2)-106: *Pedicularis odontophora* Prain

triangular marginal teeth; beak straight, 3–4 mm long, slender; lower lip 9–11 mm long, lobes ovate, middle lobe ca. 1/2 as long as lateral lobes. Filaments all pubescent, anterior 2 more densely.

Phenology: flowering in August.

Habitats: alpine swamps, 4200–4500 m.

Distribution: endemic; M Yarlung Zangbo [Map 45(2)-106].

M Yarlung Zangbo: Yadong, Chumbi, 4 July 1878, *Dongboo* 308? (CAL0000018961).

Ser. 36. *Mychophilae*

Ser. *Mychophilae* P. C. Tsoong ex H. P. Yang, *Acta Phytotax. Sin.* 33: 249. 1995.

Herbs more or less stemless. Roots few. Stems weak, flexuous. Leaves mostly or all basal; cauline leaves when present, few, alternate, or often pseudo-opposite throughout. Flowers few, often pseudo-opposite; long-pedicellate. Calyx slightly cleft anteriorly or not, 5-lobed. Corolla tube longer than calyx; beak usually straight, slender.

Notes: The series *Mychophilae* and *Albiflorae* were illegally established by Tsoong and then were further described by Yang (1995, *Acta Phytotax. Sin.* 33: 249), with the former including one species *P. mychophila* C. Marquand & Airy Shaw and the latter including three species of China, *i.e.*, *P. rhizomatososa* P. C. Tsoong, *P. tayloriana* P. C. Tsoong, and *P. tapaoensis* P. C. Tsoong. In addition, Tsoong

(1954. Kew Bull. 9: 450) described *P. cooperi* P. C. Tsoong as new based on a collection from Sikkim, and described *P. longipedicellata* P. C. Tsoong as new based on several collections from Bhutan (1955. Acta Phytotax. Sin. 3: 321). These two species outside China are placed in the series *Mychophilae*. *Pedicularis rhizomatosa* is returned to the series *Asplenifoliae* because it is treated as a variety of *P. mayana* Hand.-Mazz. (see notes in the series *Asplenifoliae* Prain).

Yang (1989. Acta Phytotax. Sin. 27: 224) published *P. yanyuanensis* H. P. Yang based on one collection from SW Sichuan, China. She stated that it resembles *P. wilsonii* Bonati (Ser. *Wilsoniae*) but differs in longer corolla tube, smaller lower lip, and slightly emarginate middle lobe. We find that *P. wilsonii* has several fusiform and fleshy roots, and thus is very different from lignified roots of *P. yanyuanensis*. Actually, *P. yanyuanensis* is most closely related to the series *Mychophilae* on account of its low and stemless plant, short and pinnatipartite to pinnatisect leaf blade, and shape of the corolla. Here, *P. yanyuanensis* is treated as a member of the series *Mychophilae*. Zhang *et al.* (2006. Novon. 16: 286–290) described *P. yaoshanensis* H. Wang as new based on a collection from NW Yunnan and placed in the series *Longiflorae* Prain. However, typical members of the series *Longiflorae* are characterized by coiled or twisted galea. Apparently, the slight curved galea of *P. yaoshanensis* shows that it should be kicked out of the series *Longiflorae* and transferred to the series *Mychophilae*.

Six species; all in the Pan-Himalaya (5 endemics).

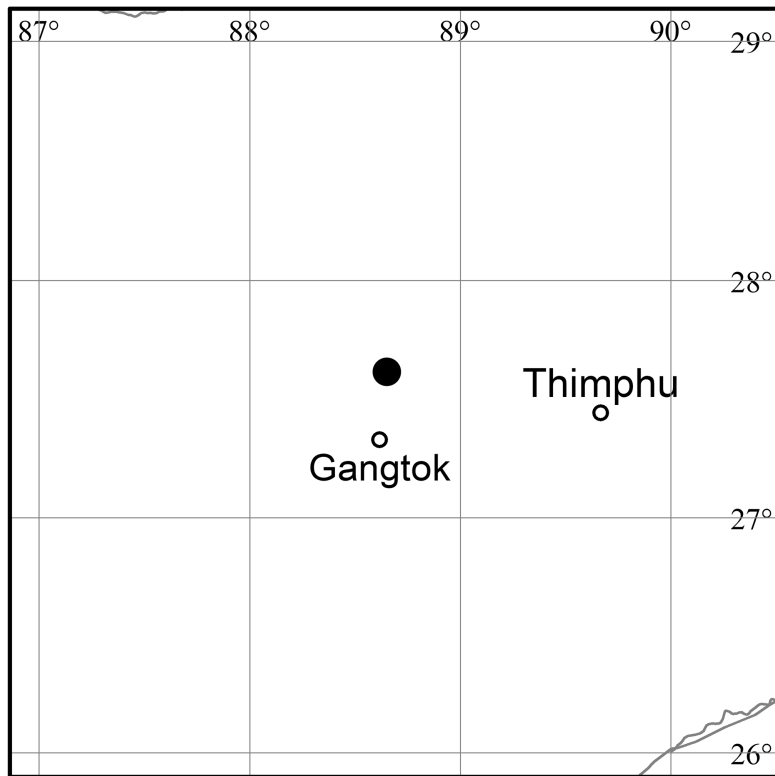
- 1a. Laminas 4–6 mm long; filaments glabrous107. *P. cooperi*
- 1b. Laminas 8–35 mm long; filaments pubescent.
 - 2a. Flower pedicels 16–65 mm long; corolla tube 3 times longer than calyx 108. *P. longipedicellata*
 - 2b. Flower pedicels 0.5–1.5 mm long; corolla tube less than 2.5 times longer than calyx.
 - 3a. Leaves mostly basal, cauline leaves when present, alternate or often pseudo-opposite; leaf blade 5–13 pairs 109. *P. mychophila*
 - 3b. Leaves basal; leaf blade 4–7 pairs.
 - 4a. Corolla tube 22–25 mm long; filaments all pubescent 110. *P. tayloriana*
 - 4b. Corolla tube 30–50 mm long; filaments pubescent, or filaments 2 pubescent and 2 glabrous.
 - 5a. Corolla tube 40–50 mm long; filaments 2 pubescent and 2 glabrous 111. *P. yanyuanensis*
 - 5b. Corolla tube 30–35 mm long; filaments all pubescent 112. *P. pseudoregeliana*

107. *Pedicularis cooperi* P. C. Tsoong, Kew Bull. 9: 450. 1954. Type: India, Sikkim, Chola Pass, 16 Sept. 1913, *R. E. Cooper* 884 [holotype: E(E00273631); isotype: E(E00273632)].

Herbs perennial, 2–6 cm tall, black when dry. Roots slender, several. Basal leaves numerous, dense; petiole 6–13 mm long, glabrous; leaf blade 4–6 mm long, 2–3 mm wide, oblong; cauline leaves small, 5–20 mm long. Inflorescences fasciculate; flowers bracteate; bracts 4–6 mm long, ovate, opposite, leaflike; pedicels gla-

brous. Calyx cylindric, glabrous; tube 4–5 mm long, 5-dentate, subequal in size. Corolla tube 17–22 mm long, about five times as long as the calyx, glabrous; galea shortly beaked, basal part erect, 4–5 mm long, anther pouch horizontal, 3–4 mm long, apex 5 mm long, dentate; lower lip 9–11 mm long, 11–13 mm wide, 3-lobed. Stamens inserted below the middle of corolla tube in lower part; filaments all glabrous.

Phenology: flowering and fruiting from August to September.



Map 45(2)-107: *Pedicularis cooperi* P. C. Tsoong

Habitats: on moss ground; 4270 m.

Distribution: endemic; Sikkim & Darjeeling [Map 45(2)-107].

Sikkim & Darjeeling: Sikkim, Lachung, Chola Pass, 16 Sept. 1913 (no more detailed information), *R. E. Cooper 884* (PE).

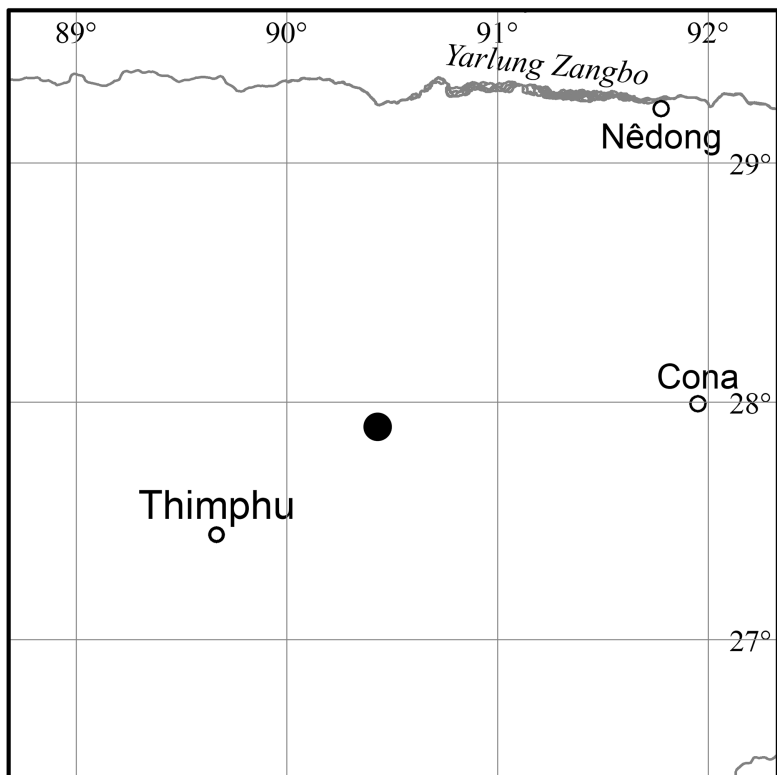
108. *Pedicularis longipedicellata* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 280, 321. 1955; *Bull. Brit. Mus. (Nat. Hist.), Bot.* 2: 8. 1955. Type: Bhutan, Kantanang, Tsampa, 4270 m, 10 June 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 19093* [holotype: BM(BM000997985)].

Herbs perennial, 5–10 cm tall, black when dry. Roots fleshy, branched, fusiform, 8–15 cm long. Leaves all basal, numerous, dense; petiole 1.8–3 cm long, glabrous; leaf blade ovate-

oblong to oblong-lanceolate, 2–4 cm long, 5–7 mm wide, abaxially sparsely pubescent along veins, adaxially glabrous, pinnatipartite to pinnatisect; segments 7–13 pairs, triangular-ovate to ovate-oblong, pinnatifid to pinnatisect. Inflorescences fasciculate; pedicels 1.5–6.5 cm long. Calyx 10–14 mm long, sparsely long-pubescent; tube 6–8 mm long; lobes 5, more or less equal, posterior one smallest. Corolla bright-crimson (sometimes white), 25–28 mm long; tube 14–18 mm long; galea more or less bent at a right angle apically, 8–10 mm long, 4–5 mm wide, slightly crested; beak straight or more or less curved downward, 2–5 mm long; lower lip 15–17 mm long, 18–20 mm wide, margin dentate. Filaments all densely pubescent. Capsule ovoid-lanceolate, 10–12 mm long, short-apiculate.

Phenology: flowering from June to July.

Habitats: on moss ground; 4300–4500 m.



Map 45(2)-108: *Pedicularis longipedicellata* P. C. Tsoong

Distribution: endemic; Bhutan [Map 45(2)-108].

BHUTAN: Upper Mangde Chu, 4724 m, 14 July 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 16385* (BM).

109. *Pedicularis mychophila* C. Marquand & Airy Shaw, *J. Linn. Soc. Bot.* 48: 212. 1929; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 319. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 190. 1998. Type: China, Tibet, Nam La, 4260–4570 m, 24 July 1924, *F. Kingdon-Ward 6043* [holotype: K(K000739116)].

Herbs perennial, 5–15 cm tall, densely gray-tomentose, more or less black when dry. Roots 1–5, fusiform, fleshy, 10–20 cm long. Stems usually 2–4, slender, ascending, glandular-pubescent, with brown hairs. Leaves mostly or

all basal; petiole 2–5.5 cm long, with densely rust-colored pubescence; leaf blade ovate-oblong to lanceolate-oblong, 0.7–4 cm long, 3–13 mm wide, densely pubescent on both surfaces, pinnatisect; segments 5–13 pairs, triangular-ovate to oblong, incised-crenate. Flowers axillary or pseudo-opposite; proximal bracts leaflike, others very small, densely tomentose; pedicels usually curved, 1.1–1.3 cm long, densely tomentose. Calyx 8–10 mm long, slightly cleft anteriorly or not, densely tomentose; lobes 5, unequal in size, dentate. Corolla purplish-red, 18–22 mm long; tube erect, 11–13 mm long, glabrous; galea bent at a right angle apically; beak straight or more or less curved downward, 4–5 mm long; lower lip 12–15 mm long, 15–20 mm wide, glabrous but praemorse-dentate. Filaments 2 slightly pubescent, 2 glabrous. Capsule ovoid, ca. 10 mm long, 4–5 mm wide, short-mucronate. Figure 45(2)-46.

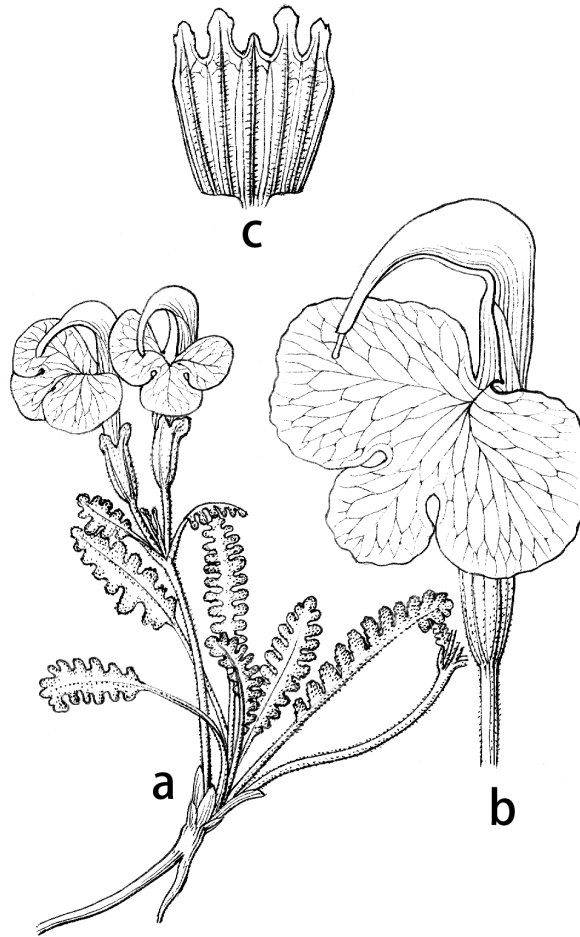


Figure 45(2)–46: *Pedicularis mychophila* C. Marquand & Airy Shaw. a, habit; b, flower; c, calyx. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 319, figure 72: 4-6. 1963].

Phenology: flowering from June to July.

Habitats: moss-covered rocks; 4000–4500 m.

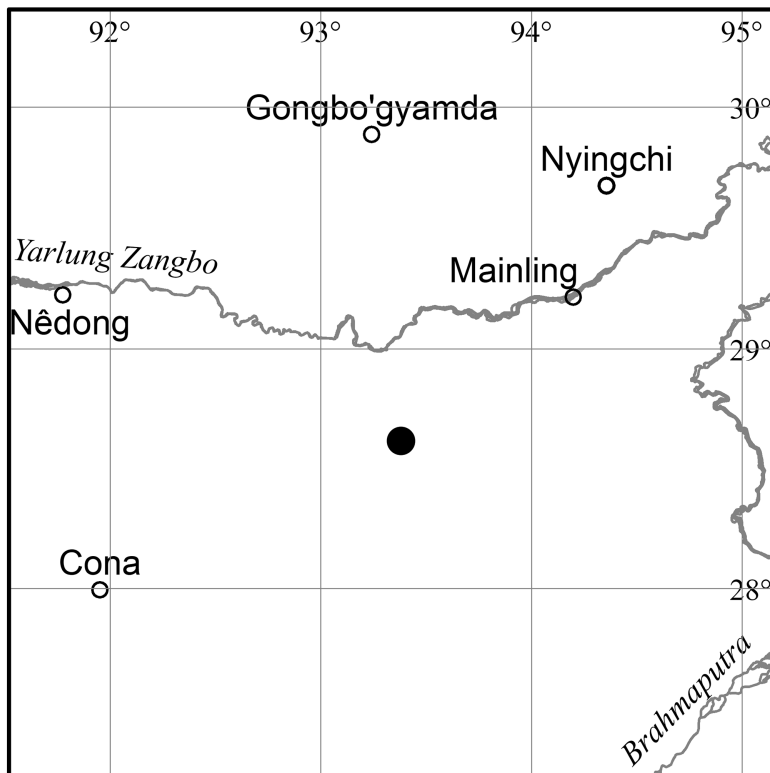
Distribution: endemic; Yarlung Zangbo-Brahmaputra [Map 45(2)–109].

Notes: Our molecular phylogenetic results show that *P. mychophila* C. Marquand & Airy Shaw and *P. tayloriana* P. C. Tsoong form a moderately supported clade, indicating a close phylogenetic relationship between the two species.

YARLUNG ZANGBO-BRAHMAPUTRA: Tsari (Migyutin), Nyima La, 4876 m, 4 July 1938, *F. Ludlow, G. Sherriff & G. Taylor 5119* (BM, PE).

110. *Pedicularis tayloriana* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 283. 1955; Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 327. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 193. 1998. \equiv *Pedicularis taylorii* P. C. Tsoong, *Bull. Brit. Mus. (Nat. Hist.), Bot.* 2: 10. 1955, nom. illeg. Type: China, Tibet, “Tsari Sama, Langong”, 4110 m, 28°45' N, 94°0' E, 16 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 5578* [holotype: BM (BM000885894)].

Pedicularis perpusilla P. C. Tsoong, *Bull. Brit. Mus. (Nat. Hist.), Bot.* 2: 9. 1955. **syn. nov.** Type: Bhutan, Pung La (E. Bhutan), 3650 m, 9 July 1949, *F. Ludlow, G. Sherriff & J. H.*



Map 45(2)-109: *Pedicularis mychophila* C. Marquand & Airy Shaw

Hicks 20906 [holotype: BM(BM000885926); isotype: PE(00033060)].

Pedicularis yalungensis T. Yamaz., J. Jap. Bot. 61: 77. 1986. **syn. nov.** Type: Nepal, C Nepal, Yalung, Kharka-Yalung La-Pam Lhang, 4300–5300 m, 8 Sept. 1983, *H. Ohba, M. Wakabayashi, M. Suzuki et al. 8331339-a* (holotype: TI).

Herbs perennial, less than 7 cm tall, shiny, barely glabrous throughout, dark black or not. Rootstock short. Stems barely stemless 2–4 cm tall. Leaves almost basal; petiole 1–1.5 cm long, membranously winged; leaf blade 5–10 mm long, 2.5–4.5 mm wide, pinatipartite to pinnatisect; segments 5 or 6 pairs, ovate, incised-dentate. Flowers 1–4, single or pseudo-opposite; bracts leaflike, small; pedicels 4–10 mm long, with 2 lines of hairs. Calyx 6–8 mm long, usually glandular-pubescent at base, more than 1/2 cleft anteriorly; lobes 3–5,

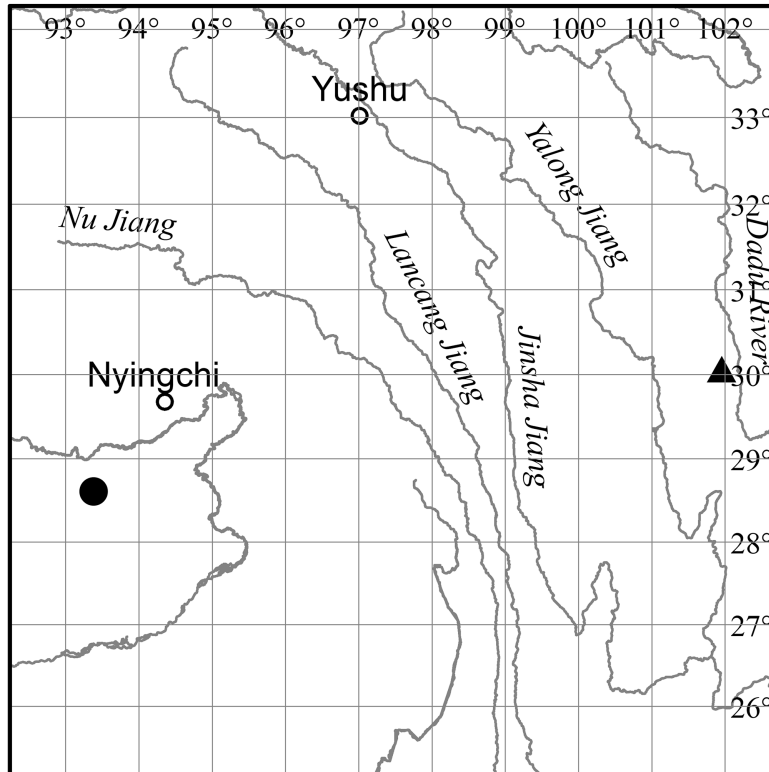
unequal, posterior one small, linear and entire, sometimes absent, lateral lobes distinctly serrate apically. Corolla red, with white dots on throat; tube 20–30 mm long, pubescent; galea bent at a right angle; beak 4–6 mm long; lower lip 8–10 mm long, 13–16 mm wide, ciliate. Filaments all pubescent.

Phenology: flowering from June to July.

Habitats: Open grassy hillsides; 3500–4500 m.

Distribution: endemic; Bhutan, Yalung Zangbo-Brahmaputra, S Hengduan [Map 45(2)-110].

Notes: *Pedicularis tayloriana* P. C. Tsoong and *P. tapaoensis* P. C. Tsoong are known only from the type collection. Tsoong stated that they could be distinguished by black or not when dry, and galea with or without 2-auriculate marginal protuberance. But Yang, Holmgren & Mill in



Map 45(2)-110: *Pedicularis tayloriana* P. C. Tsoong
 ● subsp. *tayloriana* ▲ subsp. *tapaoensis*

Fl. China (1998. 18: 193) discriminated against them for the length of their beaks (4: 5–5.5). Tsoong recognized the two species might be distinguished based on their geographic distributions, with *P. tayloriana* distributed in SE Tibet and *P. tapaoensis* in SW Sichuan, China. Here, the two species are treated as subspecies based on subtle morphological difference and non-overlap distribution.

- 1a. Galea not 2-auriculate protuberant; plants dark black when dry..... 110a. subsp. *tayloriana*
- 1b. Galea 2-auriculate protuberant; plants not black when dry.....110b. subsp. *tapaoensis*

110a. *P. tayloriana* subsp. *tayloriana*

Herbs perennial, less than 7 cm tall, shiny, barely glabrous throughout, dark black when dry.

Stems usually 2–4 cm long; galea not 2-auriculate protuberant, beak 4–5.5 mm long.

Phenology: flowering from June to July.

Habitats: open grassy hillsides, open alpine meadows; 3500–4700 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra [Map 45(2)-110].

Notes: Yamazaki described *P. yalungensis* T. Yamaz. as new based on a collection from Central Nepal, and he stated that “*Pedicularis yalungensis* is near to *P. taylaiana* P. C. Tsoong of SE Tibet, but differs in leaves with 6–8 segments in each side, pedicels with sparsely and spreadingly pilose all over not bifariously, and calyx with eglandular and long-pilise hairs.” However, Tsoong never described the species “*P. taylaiana* P. C. Tsoong” and *P. yalungensis* is very similar to *P. tayloriana* P. C. Tsoong. After examination of

the type and other collections of the two species, we find that *P. yalungensis* should be treated as a new synonym of *P. tayloriana* subsp. *tayloriana*.

Yarlung Zangbo-Brahmaputra: Tsari (Migyutin), Tsari Sama, Langong, 4110 m, 16 June 1938, *F. Ludlow, G. Sherriff & G. Taylor* 5578 (PE).

110b. *P. tayloriana* subsp. *tapaoensis* (P. C. Tsoong) F. S. Yang **comb. et stat. nov.** ≡ *Pedicularis tapaoensis* P. C. Tsoong, in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 328, 417. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 193. 1998. **syn. nov.** Type: China, Sichuan, Kangding, Tapao Shan, 4700 m, 22 Aug. 1934, *H. Smith 11460* [holotype: PE(00032947); isotype PE(00123518)].

Herbs perennial, 5–7 cm tall, not black when dry. Stems caespitose, less than 1 cm or barely stemless. Leaves densely tufted; petiole 0.8–2.2 cm long, broadly winged, glabrous; leaf blade elliptic-ovate to oblong, 8–10 mm long, 4–8 mm wide, glabrous on both surfaces, pinnatifid or coarsely dentate. Flowers solitary in leaf axils. Corolla purple-red; tube 25–30 mm long, sparsely pubescent; galea more or less bent at a right angle, with 2-auriculate protuberances; beak straight or bent slightly downward, ca. 4 mm long.

Phenology: flowering from June to July.

Habitats: open alpine meadows; 4700 m.

Distribution: endemic; S Hengduan [Map 45(2)–110].

S HENGDUAN: **Kangding**, Tapao Shan, 4700 m, 22 Aug. 1934, *H. Smith 11460* (PE).

111. *Pedicularis yanyuanensis* H. P. Yang, *Acta Phytotax. Sin.* 27: 224. 1989; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 194. 1998. Type: China, Sichuan, Yanyuan, 3900 m, 9 Aug. 1983, *Qinghai-Xizang Exped. 12786* [holotype: PE(00032303)].

Pedicularis yaoshanensis H. Wang, *Novon.* 16: 286–290. 2006. **syn. nov.** Type: China, Yunnan, Qiaojia, Yao Shan, 3600–3700 m, 17

Aug. 2004, *H. Wang & S. D. Zhang 03-0857* (holotype, KUN).

Herbs perennial, 5–8 cm tall, pubescent, slightly black when dry. Roots more or less lignified, long-conical, branched, 5–7 cm long, brown when dry. Stems usually 3–5, short or more or less absent, spreading to ascending. Leaves mostly basal; petiole 1–2 cm long, pubescent; leaf blade lanceolate-oblong, 1–3 cm long, pubescent along veins, pinnatisect; segments 5–8 pairs, ovate to oblong, margin double-dentate; cauline leaves usually pseudo-opposite, smaller than basal leaves. Flower pedicels 1–2 mm long. Calyx oblong, 1/3 cleft anteriorly, densely white-villous; lobes 3, unequal in size. Corolla red, with purple-red galea, 5–6 cm long; tube 4–5 cm long, villous with multicellular hairs; galea nearly falcate, much expanded, 5–7 mm long; beak more or less incurved, 5–7 mm long; lower lip 8–10 mm long, 10–13 mm wide, ciliate, middle lobe smaller than lateral lobes, emarginate. Anterior 2 filaments pubescent.

Phenology: flowering in August.

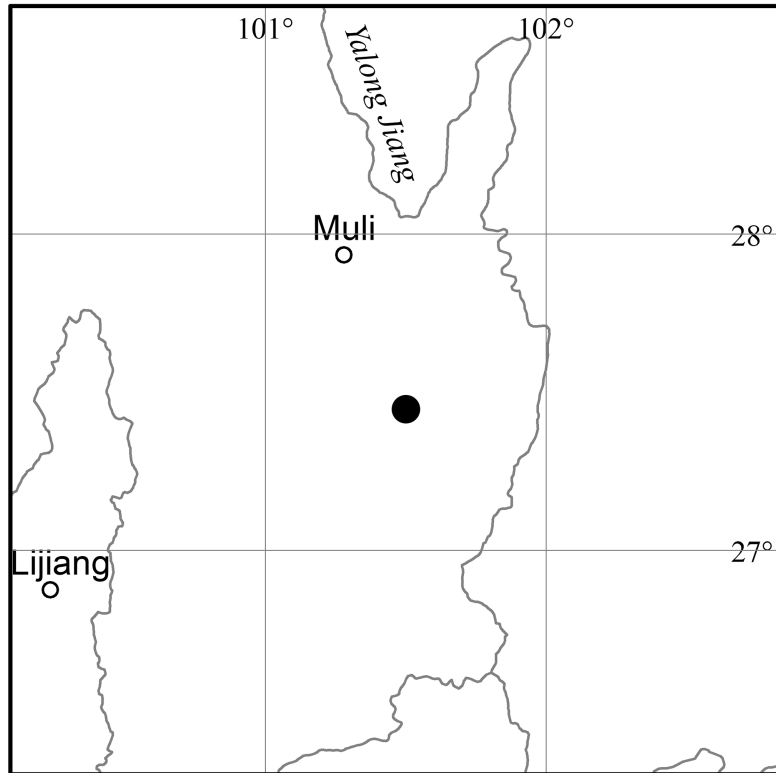
Habitats: *Abies fabri* forests on slopes; 3900 m.

Distribution: S Hengduan [Map 45(2)–111]; and also in other parts of Yunnan Province, China.

S Hengduan: **Yanyuan**, 3900 m, 9 Aug. 1983, *Qinghai-Xizang Exped. 12786* (NAS).

112. *Pedicularis pseudoregeliana* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 284, 322. 1955. Type: Nepal, Dhudkund, 6 miles of E of Timure, 4724 m, *O. V. Polunin 831* [holotype: BM (BM0010521617)].

Perennial herbs, 5–7 cm tall. Roots several, fleshy, covered by membranous scales. Leaves mostly radical clustered; petiole 3–15 mm long, sparsely pilose; leaf blade linear to linear-oblong, obtuse at apex, 5–15 mm long, 1–4 mm wide, glabrous on both surfaces, pinnatisect, 4–7-paired, ovate, acuminate incised-serrate. Flowers solitary and axillary or 2–3 in a raceme; pedicels slender, 1–3 mm long, glabrous. Calyx urceolate-tubular, 6–8 mm long, 2–3 mm wide, glabrous, lobes



Map 45(2)-111: *Pedicularis yanyuanensis* H. P. Yang

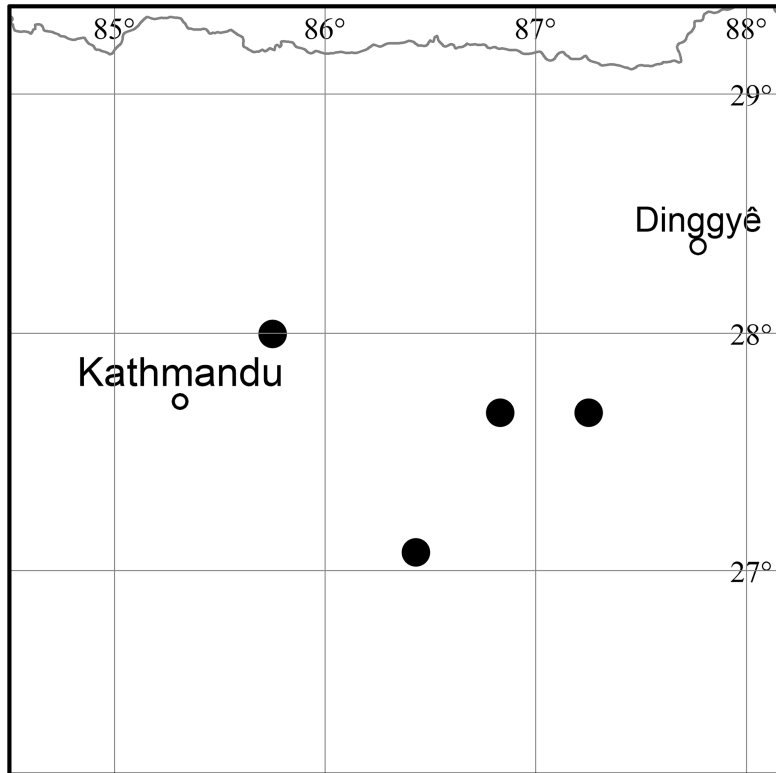
orbicular, stipitate, ca. 2 mm long and wide, acutely incised-serrate, rarely 5-lobed. Corolla reddish-purple, 30–45 mm long; tube slender, 25–35 mm long, 1.5–2 mm wide, 3–4 times as long as calyx, sparsely pilose; galea decurved at middle, erect part 4–5 mm long, with 2 teeth on ventral margins; beak 3–4 mm long, truncately acute and shallowly bilobed at apex; lower lip broad, subequal or slightly longer than galea, 8–11 mm long, 12–15 mm wide, middle lobe broadly orbicular, emarginate. Two anterior filaments pilose, and 2 posterior ones glabrous. Capsule oblong, acute at apex, 8–10 mm long, 4 mm wide.

Phenology: flowering from July to August.

Habitats: in alpine pastures; 4000–4600 m.

Distribution: endemic; C Nepal, E Nepal [Map 45(2)-112].

C NEPAL: Bagmati, Rasuwa, Dhudkund, 6 miles of E of Timure, 4724 m, 5 July 1949, *O. V. Polunin 831* (E); Bagmati, Sindhupalchok, Bhote Koshi River, 4267 m, 8 July 1964, *S. A. Bowes-Lyon 2201* (BM). **E NEPAL:** Kosi, Sankhuwasabha, Ishwa Khola, 4110 m, 13 Sept. 1975, *L. W. Beer 25456* (BM). **Sagarmatha,** Solukhumbu, Dudh Kosi Valley, 4267 m, 7 July 1964, *J. D. A. Stainton 4603* (BM).



Map 45(2)-112: *Pedicularis pseudoregeliana* P. C. Tsoong

Ser. 37. *Neolatitubae*

Ser. *Neolatitubae* P. C. Tsoong ex H. P. Yang, Acta Phytotax. Sin. 33: 249. 1995.

Herbs less than 10 cm tall. Stems scarcely present, weak, curved. Leaves mostly basal. Flowers axillary, pedicel up to 4 cm long. Calyx deeply cleft anteriorly, 2–3-lobed. Corolla red-purple; galea circinate-incurved at base; beak semicircular.

One species; endemic to the Pan-Himalaya.

Notes: Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 330) established the series *Neolatitubae* when he described *P. neolatituba* P. C. Tsoong as new based on one collection from Western Sichuan, China. Yu (2018. PLoS ONE 13: e0200372) reduced *P. neolatituba* as a new synonymy of *P. delavayi* Franch. ex Maxim. We recover the status of *P. neolatituba* P. C. Tsoong and the series *Neolatitubae*, because *P. neolatituba* P. C. Tsoong is indeed different from *P. latituba* Bonati and species of the series *Longiflorae* by axillary flowers with very long pedicel, and deeply cleft calyx.

113. *Pedicularis neolatituba* P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 330, 418. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 195. 1998. Type: China, Songpan, “Dongrergo, in

prato alpino, terroso”, 4700 m, 9 Aug. 1922, H. Smith 3162 [holotype: PE(00033070)].

Herbs perennial, usually less than 10 cm tall, more or less black when dry. Roots fleshy. Stems scarcely present, glabrous. Basal leaves

numerous; petiole 2–3 cm long; leaf blade lanceolate-oblong to narrowly lanceolate, 1–2 cm long, 3.5–7 mm wide, long-pubescent along mid-vein when young, glabrescent, pinnatisect; segments 6–8 pairs, ovate to oblong, margin double-dentate; cauline leaves usually pseudo-opposite, slightly smaller than basal leaves. Flowers few, axillary, pseudo-opposite or from basal leaves; pedicels black, 3–4 cm long, glandular-pubescent. Calyx 7–9 mm long, 3/4 cleft anteriorly; lobes 3, unequal, posterior one spinescent and entire, lateral pair larger, incised-serrate. Corolla reddish-purple; tube 30–50 mm long, pale-purple pubescent; galea with auriculate protuberance near margin; beak semicircular, 6–7 mm long;

lower lip 18–20 mm long, 20–24 mm wide. Filaments all pubescent. Figure 45(2)–47.

Phenology: flowering from July to August.

Habitats: alpine meadows; 4700 m.

Distribution: endemic; N Hengduan [Map 45(2)–113].

Notes: Tsoong described *P. neolatituba* P. C. Tsoong as new based on a collection (*H. Smith 3162*) from Donggrergo, Songpan, Sichuan Province, China. He stated that the special plant looks like species of the series *Mychophilae* C. Marquand & Airy Shaw, but its calyx tube is deeply cleft and intumescent, which is similar to that of

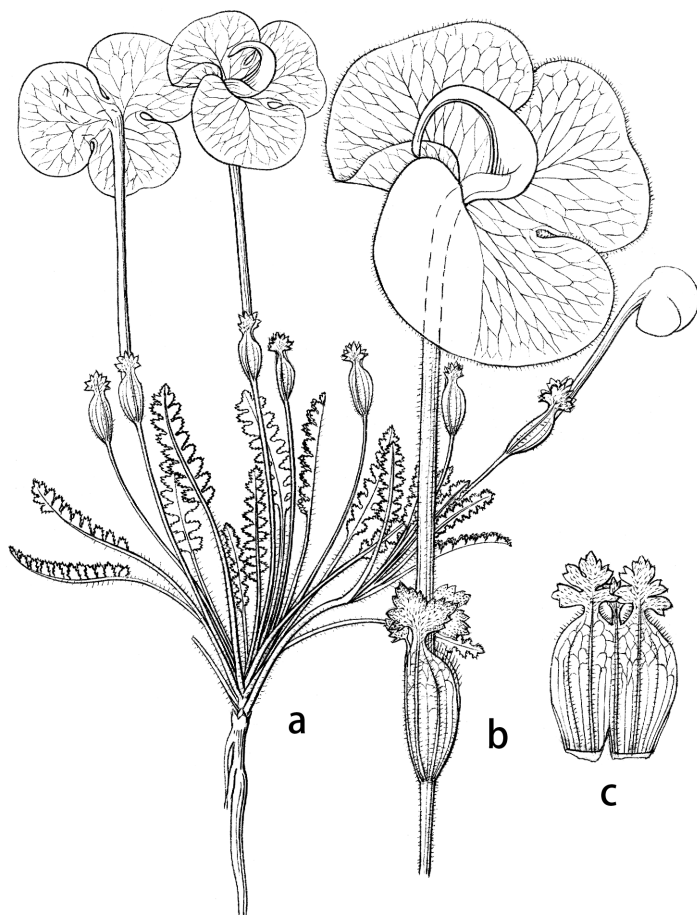
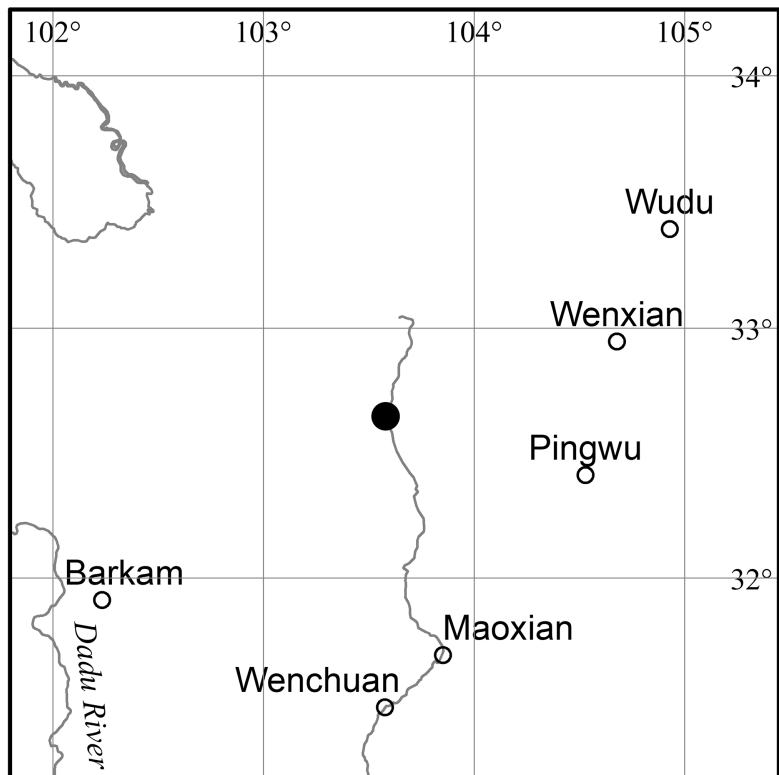


Figure 45(2)–47: *Pedicularis neolatituba* P. C. Tsoong. a, habit; b, flower; c, calyx. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 330, figure 72: 1-3. 1963].



Map 45(2)-113: *Pedicularis neolatituba* P. C. Tsong

P. mussotii Franch. of the series *Franchetianae* Maxim. However, the strongly twisted corolla tube and galea indicate that it is different from the species of the two series.

N Hengduan: Songpan, “Dongrergo, in prato alpino, terroso”, 4700 m, 9 Aug. 1922, *H. Smith 3162* (PE).

Ser. 38. *Franchetianae*

Ser. *Franchetianae* Prain, *Ann. Roy. Bot. Gard. Calc.* 3: 70. 1890.

Leaves alternate or often pseudo-opposite throughout. Flowers axillary; pedicels 2–8 cm long. Calyx deeply cleft anteriorly, 2–3-lobed. Corolla tube slightly longer than calyx or not; galea usually crested; beak curved, slender.

Two species; both endemic to the Pan-Himalaya.

- 1a. Stems branched; beak of corolla pendant, parallel to calyx, curved apically114. *P. franchetiana*
- 1b. Stems unbranched; beak of corolla semicircular115. *P. mussotii*

114. *Pedicularis franchetiana* Maxim., *Bull. Acad. Imp. Sci. Saint-Pétersb.* 32: 553. 1888; Tsong in Chien & Chun, *Fl. Reipubl. Popu-*

laris Sin. 68: 320. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 191. 1998. Type: China, Sichuan, Baoxing,

no more detailed information, 1870, *M. I. David* s.n. [lectotype designated here: P(P02985309)].

Stems branched, sparsely long-pubescent. Leaves alternate or pseudo-opposite; petiole 2–3 cm long; leaf blade 1.0–4.3 cm long, 0.8–1.2 cm wide, pinnatipartite to pinnatisect; segments ovate, dentate, 7 to 14 pairs, triangular-ovate to oblong-ovate, 4–9 mm long, 2–5 mm wide, margin dentate, sparsely long-pubescent. Basal flower pedicels 4–5.5 cm long, apically only 5–10 mm, exceeding leaves, finely pubescent. Inflorescences racemose, and lower flowers axillary. Calyx 5–6 mm long, membranous, sparsely scabrous-pubescent, reticulate near apex, 2-lobed, 3-cleft, and incised-dentate. Corolla purple, 10–12 mm long; tube not exceeding calyx and shorter than galea, pubescent; galea falcate, usually crested; beak pendant, parallel to calyx, curved apically; lower lip 10–13 mm long, 14–16 mm wide, long ciliate, middle lobe

rounded, scarcely exerted. Filaments long-pubescent, or 2 glabrous.

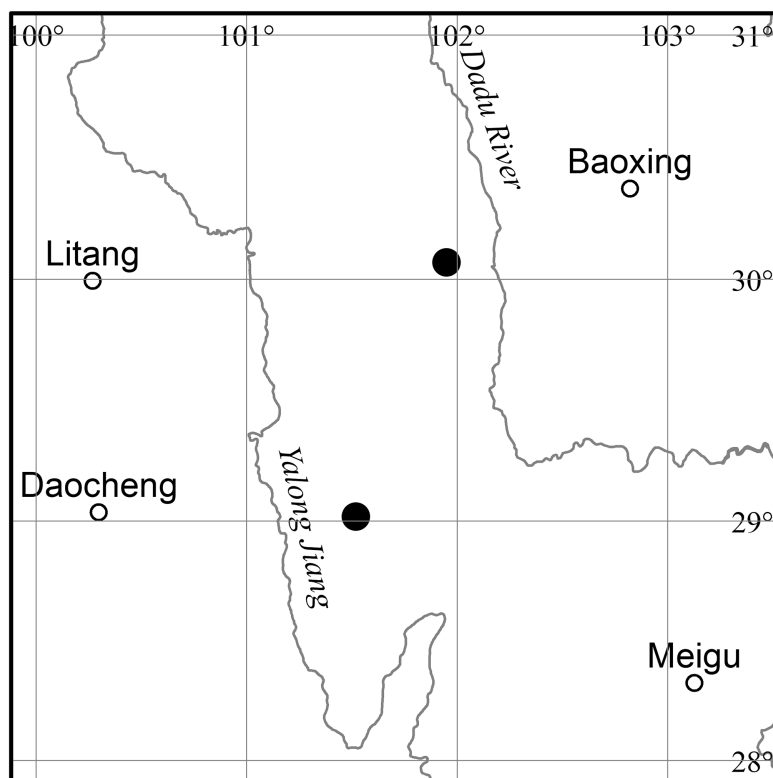
Phenology: flowering from July to August.

Habitats: alpine meadows; 4700 m.

Distribution: endemic; S Hengduan [Map 45(2)–114].

Notes: *Pedicularis franchetiana* Maxim. was described as new in 1888, with brief information “China, Azetschuan occidental, regione Mou-pine (*David!* In hb. Paris, *P. siphonantha admixta*)”. Based on this information, one sheet of collection *M. I. David* (collected in 1870) is here designated as lectotype.

S HENGDUAN: Jiulong, Tanggu, Dege Pass to Tongkai, 4200 m, 2 Aug. 1980, *Z. A. Liu* 22959 (CDBI). Kangding, Dong-e-Yakou, *South-to-North Water Divers. Proj. Exped. 02572* (PE); Kangding, Zimei, 4200 m, 2 July 1979, *X. H. Hu* 20897 (CDBI).



Map 45(2)–114: *Pedicularis franchetiana* Maxim.

115. *Pedicularis mussozii* Franch., Bull. Soc. Bot. France 47: 24. 1900, “*Pedicularis mussozii*”; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 321. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 191. 1998. ≡ *Pedicularis mussozii* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 179. 1949. Type: China, Sichuan, Kangding, 1893, *J. A. Soulié 81* [**lectotype designated here:** K(K000708714); isolectotype: US(00125651)].

Pedicularis obliquigaleata W. B. Yu & H. Wang, Novon 20: 512–518. 2010. **syn. nov.** Type: China, Yunnan, Shangri-la (Zhongdian), Daxue Shan, 4294 m, 25 July 2007, *W. Yu 643* [holotype: KUN(0888324)].

Pedicularis lophocentra Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 59: 251. 1922. Type: China, Sichuan, Muli, “Prov. Setschwan austro-occid.: In montis Saganai supra monasterium Muli ad septentr. pagi Yunnanensis Yungning”, 4300–4375 m, 30 July 1915, *H. R. E. von Handel-Mazzetti 7144* [holotype: WU; isotypes: E(E00386155), HUH(00097235)].

Herbs perennial, 10–15 cm tall, slightly black when dry. Roots slender, several, fusiform, more or less fleshy. Stems usually 4 or 5, often procumbent or ascending, unbranched, densely fine-pubescent, and striate. Leaves mostly basal; petiole 2.5–10 cm long, narrowly winged, sparsely pubescent; leaf blade 2–10.5 cm long, 0.5–2.5 cm wide, adaxially glabrous or sparsely pubescent and finely pubescent along midvein, abaxially sparsely pubescent along veins, pinnatifid to nearly pinnatisect; segments 6–13 pairs, triangular-ovate to ovate, margin double-dentate or pinnatifid; cauline leaves usually pseudo-opposite. Flower pedicels 3–12 cm long, usually curved, finely pubescent. Calyx tube 5–10 mm long, 2- or 3(-5)-lobed; posterior one smallest, entire or dentate, lateral lobes incised-dentate. Corolla red; tube 7–10 mm long, pubescent externally; galea more or less bent at a right angle, with or without auriculate protrusion; beak semicircular, 7–11 mm long; lower lip 8–15 mm long, 16–26 mm wide, long ciliate, middle lobe emarginate. Filaments pubescent. Capsule semi-globose, 10–12 mm long, 6–7 mm wide. Figure 45(2)–48.

Phenology: flowering from July to August.

Habitats: alpine meadows; 3600–4900 m.

Distribution: endemic; N Hengduan, S Hengduan [Map 45(2)–115].

Notes: Franchet listed seven collections sampled from Kangding (Sichuan Province), *i.e.*, *Soulié 81, 234, 283*, and *Musso 276, 284, 286, 291*. One sheet of *Soulié 81* in the herbarium P is here selected as lectotype of *P. mussozii* Franch. Handel-Mazzetti in the protologue of *P. lophocentra* cited one collection *Handel-Mazzetti 7144*, one sheet deposited in the Herbarium WU should be holotype, and isotypes in the herbaria E and HUH were also examined.

Yu *et al.* described *P. obliquigaleata* W. B. Yu & H. Wang as new based on collections from NW Yunnan, and they placed it in the series *Dissectae* H. L. Li according to the classification systems of Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 1–214) and Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 1–378). They stated that the new taxon is similar to *P. souliei* Franch. but differs in densely gray-pubescent stems, pinnatifid leaf with segments that are triangular-ovate to oblong-ovate with dentate margins, two calyx lobes, bent galea, semicircular beak, and purple or rose-red corolla lip with a subtruncate middle lobe. However, the great difference means that the two species with which they compared should belong to different series or sections. Our molecular phylogenetic results reveal that *P. obliquigaleata* W. B. Yu & H. Wang is nested in a clade composed of nine individuals of *P. mussozii* Franch. (Ser. *Franchetianae* Prain). After examining types and other herbarium specimens of these three “species”, we find that the morphological variation of *P. obliquigaleata* falls into the range of *P. mussozii* Franch. Hence, *P. obliquigaleata* W. B. Yu & H. Wang is here removed from the series *Franchetianae* Prain and treated as a synonym of *P. mussozii* Franch.

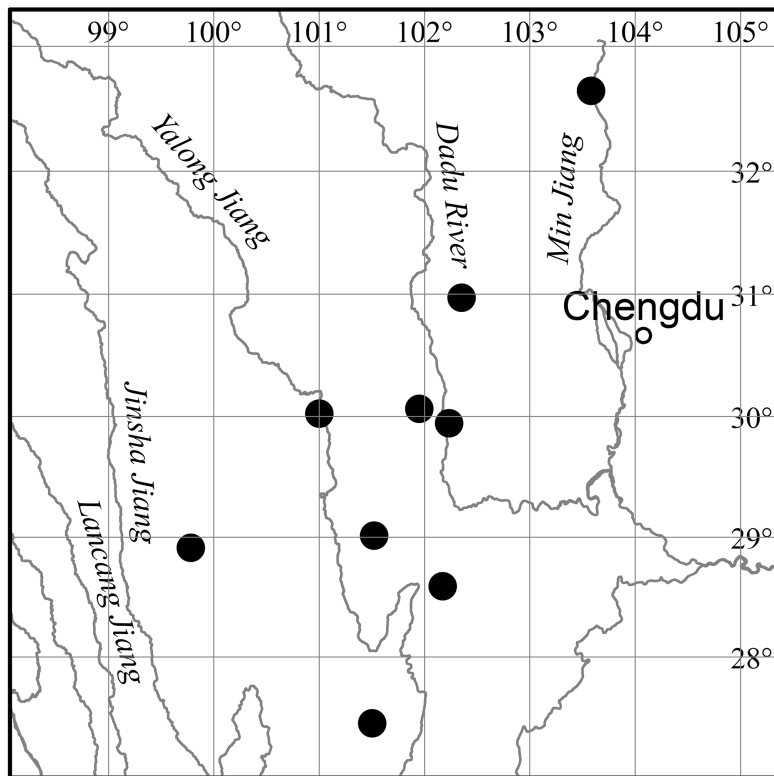
N HENGDUAN: Songpan, Konkaling, 4000 m, 30 Aug. 1937, *T. T. Yü 13040* (PE). **Xiaojin**, Balang Shan, 4523 m, 27 Aug. 2000, *F. S. Yang 2119* (PE). **Yajiang**, road (highway 318) from Yajiang to Litang, 4550–4670 m, 29 July 2010, *D. E. Boufford et al. 42392* (PE).



Figure 45(2)–48: *Pedicularis mussotii* Franch. a, habit; b, flower; c, calyx. Drawn by C.-Y. LIU for *P. mussotii* var. *lophocentra* (Hand.-Mazz.) H. L. Li [*Fl. Reipubl. Popularis Sin.* 68: 330, figure 72: 7-9. 1963].

S HENGDUAN: Jiulong, Jichou Shan, S side of Pass and E side of highway 218, 4365 m, 3 Aug. 2010, *D. E. Boufford et al.* 42593 (KUN). **Kangding,** Dapao Shan, 4000 m, 11 Aug. 1951, *W. G. Hu & Z. He* 10749 (WUK); Kangding, Dapao Shan, 3768–4074 m, 16 July 2017, *Q. Yu et al.* THP-KD-4578 (CDBI); Kangding, Zheduo Shan, 4000 m, 21 Aug. 1974, *Y. Q. He & H. J. Wang* 8132 (WUK); Kangding, Gongga Shan, base camp, 4744 m, 9 Aug. 2017, *X. F. Gao et al.* THP-KD-5713 (CDBI); Kangding, Gongga

Shan, base camp, 4335 m, 8 Aug. 2017, *X. F. Gao et al.* THP-KD-5785 (CDBI); Kangding, 4400 m, 20 Aug. 1934, *H. Smith* 11218 (PE). **Luding,** E slope of Gongga Shan, 3850, 30 June 1962, *K. Y. Lang, L. Q. Li & Y. Fei* 326 (PE). **Mianning,** Yele village, Lamagetou, 4200 m, 4 Aug. 2009, *T. Yoshida* K23 (KUN). **Xiangcheng,** Dawang Shan, 3900–4100 m, *Qinghai-Xizang Exped.* 3700 (PE). **Yanyuan,** 4000 m, 23 July 1983, *Qinghai-Xizang Exped.* 12331 (PE).



Map 45(2)–115: *Pedicularis mussotii* Franch.

Ser. 39. Pseudomacranthae

Ser. Pseudomacranthae P. C. Tsoong ex H. P. Yang, Acta Phytotax. Sin. 33: 249. 1995. Type: *Pedicularis aschistorrhyncha* C. Marquand & Airy Shaw.

Herbs more or less stemless or stem scape-like. Leaves mostly basal, persistent, and often pinnatisect; cauline leaves alternate or pseudo-opposite. Inflorescences capitate or short-racemose. Calyx lobes 2–5. Corolla more than 3 cm long; tube usually not exceeding the calyx; beak wide; lower lip often enveloping galea.

Three species; all endemic to the Pan-Himalaya.

1a. Inflorescences corymbiform; corolla yellow, 40–50 mm long..... 116. *P. corymbifera*

1b. Inflorescences racemose; corolla purple or white, 20–30 mm long.

2a. Corolla lip long-ciliate, middle lobe reniform and cordate at base..... 117. *P. elwesii*

2b. Corolla lip glabrous, middle lobe oblong and not cordate at base..... 118. *P. aschistorrhyncha*

116. *Pedicularis corymbifera* H. P. Yang,
Acta Phytotax. Sin. 18: 244. 1980; Yang,

Holmgren & Mill in Wu & Raven (eds.),
Fl. China 18: 193. 1998. Type: China, Tibet,

Bomi, Guxiang, 3400 m, 5 July 1965, *T. S. Ying & D. Y. Hong 650419* [lectotype designated by Lin (2007): PE(00095702)].

Herbs perennial, 10–20 cm tall, black when dry. Roots conical, fleshy, 8–15 cm long. Stems usually numerous, procumbent, or ascending. Basal leaves laxly cespitose; petiole 4–7 cm long, broadly winged, densely pubescent; leaf blade ovate to ovate-oblong, 4–7 cm long, 1–3 cm wide, pinnatipartite to pinnatisect; segments 7–12 pairs, ovate to rounded, dentate; cauline leaves few. Inflorescences corymbiform, 5–8-flowered; bracts leaflike. Calyx oblong, 18–20 mm long, pilose, 1/2 cleft anteriorly; lobes 3, unequal in size. Corolla yellow with a red beak, 20–30 mm long; tube erect, slightly longer than calyx; galea slightly falcate, more or less twisted; beak bent downward, 3–4 mm long, 2-cleft; lower lip usually enveloping galea, ciliate, middle lobe emarginate. Filaments anterior 2 densely pubescent. Figure 45(2)–49.

Phenology: flowering from July to August.

Habitats: open rocky slopes, open forests; 3400 m.

Distribution: endemic; L Yarlung Zangbo [Map 45(2)–116].

L YARLUNG ZANGBO: Bomi, Yigong, 3150 m, 19 Aug. 1983, *B. S. Li, S. Z. Cheng & T. S. Ying 6704* (PE).

117. *Pedicularis elwesii* Hook. f., *Fl. Brit. India* 4: 312. 1884; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 323. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 192. 1998. \equiv *Pedicularis elwesii* var. *typica* H. L. Li, *Proc. Acad. Nat. Sci. Philad.* 101: 144. 1949. Type: India, Sikkim, Lachen, 4267 m (14000 ft), 15 July 1849, *J. D. Hooker 24* [lectotype designated by Mill (2001: 89): K].

Pedicularis elwesii subsp. *minor* (H. L. Li) P. C. Tsoong, in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 324. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 192. 1998. **syn. nov.** \equiv *Pedicularis elwesii* var. *minor* H. L. Li, *Proc. Acad. Nat. Sci. Philad.* 101: 145. 1949. Type: China, SE Tibet, “Province

of Tsarung, northern slopes of Mt. Kenichum-po, north of Sikitung, Upper Salween River”, “Flowers reddish-purple, alpine meadow”, 4114 m (13500 ft), May–June 1932, *J. F. Rock 22167* [holotype: NY(00090929); isotypes: E(E00386158), GH(00097220)].

Pedicularis elwesii subsp. *major* (H. L. Li) P. C. Tsoong, in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 324. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 192. 1998. **syn. nov.** \equiv *Pedicularis elwesii* var. *major* H. L. Li, *Proc. Acad. Nat. Sci. Philad.* 101: 145. 1949. Type: China, Tibet, “Province of Tsarung. Regions of the Solo-la”, 3657 m (12000 ft), May–June 1932, *J. F. Rock 22251* [holotype: NY; isotypes: GH(00097219), US(00730808), E(E00386159), K(K000708712)].

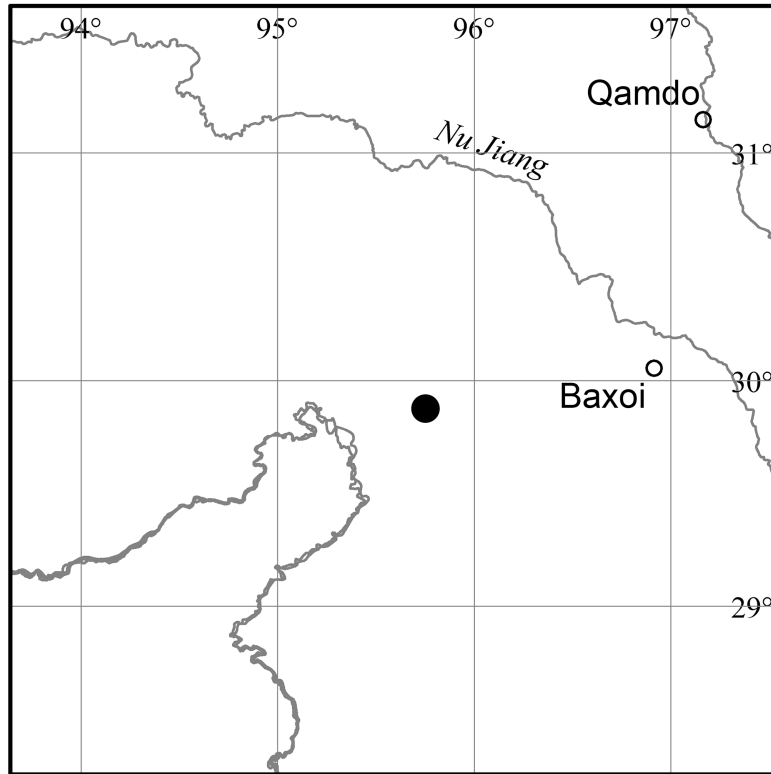
Herbs perennial, usually 10–35 cm tall, densely pubescent, nearly black when dry. Roots 2 or 3, more or less fusiform, fleshy. Stems 1–4, erect or slightly spreading at base, unbranched, densely pubescent. Basal leaves sparsely cespitose; petiole 2–12 cm long, densely tomentose; leaf blade ovate-oblong to lanceolate-oblong, 3.5–9.5(–18) cm long, 1–2.5 cm wide, abaxially densely tomentose, abaxially glabrous except for finely tomentose midvein, pinnatipartite; segments 10–20(–30) pairs, ovate to ovate-oblong, pinnatifid, margin double-dentate; cauline leaves few, alternate or sometimes more or less opposite, smaller than basal leaves, short-petiolate. Racemes 5–8(–15) cm long; bracts leaflike; pedicels 0.7–1.5 cm long. Calyx 10–12 mm long, 1/2 cleft anteriorly; lobes 3 or 5, unequal, posterior one smallest, all dentate. Corolla purple to purplish-red, 25–30 mm long; tube erect, 8–10 mm long; galea strongly curved; beak unciniate, 5–6 mm long, 2-cleft or entire; lower lip completely enveloping galea, 17–20 mm long, 20–23 mm wide, long ciliate, middle lobe reniform and cordate at base. Filaments long-pubescent. Capsule oblong-lanceolate, 17–20 mm long, 5–6 mm wide. Figure 45(2)–50.

Phenology: flowering from June to August.

Habitats: in open grasses, in short turf of riversides, at altitudes of 3000–4500 m.



Figure 45(2)–49: *Pedicularis corymbifera* H. P. Yang. a, habit. Drawn by T.-L. ZHANG [*Flora Xizangica*. 4: 364, figure 361: 1. 1985].



Map 45(2)-116: *Pedicularis corymbifera* H. P. Yang

Distribution: endemic; U Yarlung Zangbo, C Nepal, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S Hengduan, U Irrawaddy [Map 45(2)-117].

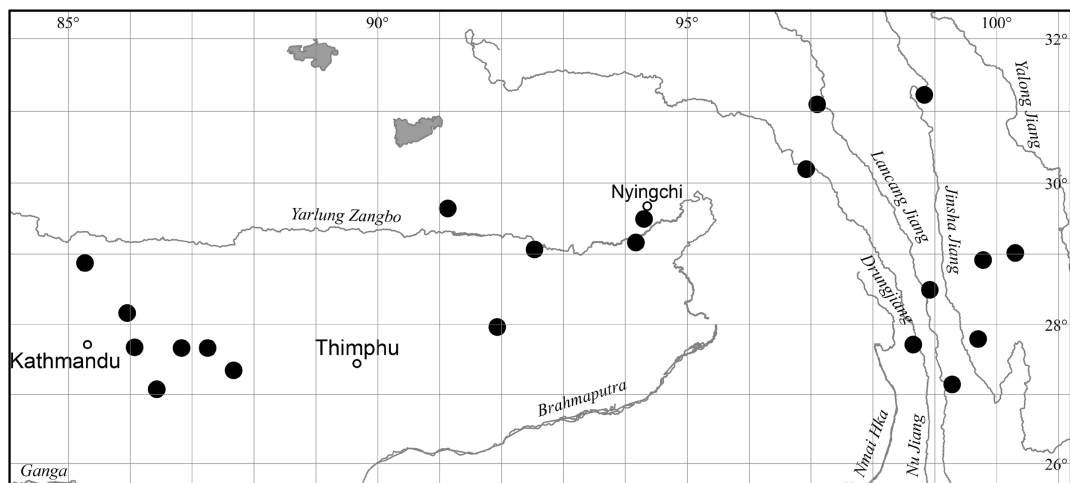
Notes: *Pedicularis elwesii* subsp. *minor* (H. L. Li) P. C. Tsoong and *P. elwesii* subsp. *major* (H. L. Li) P. C. Tsoong were described as subspecies mainly based on the height of plants and size of leaves. Our molecular phylogenetic results reveal that individuals from different populations form a well-supported clade, which does not support a further intra-specific division.

U YARLUNG ZANGBO: **Gyirong**, Gongdang, 4600 m, 4 Aug. 1975, *Qinghai-Xizang Exped.* 7189 (PE, HNWP). **Nyalam**, near the city, 4800 m, 25 June 1975, *Qinghai-Xizang Exped.* 5888 (PE). **C NEPAL:** **Bagmati**, Rasuwa, Brangchen Kharka, 4550 m, 11 June 1949, *O. V. Polunin* 286 (BM). **Janakpur**, Dolakha, Rolwaling, 4572 m, 30 June 1964, *J. D. A. Stainton* 4713

(BM). **E NEPAL:** **Kosi**, Sankhuwasabha, Arun Valley, 3810 m, 12 June 1956, *J. D. A. Stainton* 634 (BM). **Mechi**, Taplejung, 4267 m, 14 July 1956, *J. D. A. Stainton* 1112 (BM). **Sagarmatha**, Solukhumbu, Inkhu, 3657 m, 27 June 1964, *D. Cosh* 301 (BM). **M YARLUNG ZANGBO:** **Lhasa**, 5000 m, 18 Aug. 1965, *Y. T. Zhang & K. Y. Lang* 1920 (PE). **L YARLUNG ZANGBO:** **Gyaca**, 4710 m, 25 July 1975, *Qinghai-Xizang Suppl. Exped.* 75-0731 (PE). **Mainling**, 5100 m, 17 July 1972, *Tibet Chin. Medic. Herb. Exped.* 4012 (PE). **Nyingchi**, 4700 m, 4 Aug. 1983, *B. S. Li & S. Z. Cheng* 6103 (PE). **YARLUNG ZANGBO-BRAHMAPUTRA:** **Cona**, 4500 m, 17 July 1975, *C. Y. Wu, S. K. Chen & S. L. Lu* 75-1003 (PE). **TANGUT:** **Baxoi**, 4200 m, 28 Aug. 1973, *Qinghai-Xizang Exped.* 73-1307 (PE). **Qamdo**, 4300 m, 10 Aug. 1970, *Qinghai-Xizang Exped.* 12754 (PE). **N HENGDUAN:** **Baiyü**, Ronggai, 4295 m, 14 July 2020, *Y. Yu & J. J. Fu* 02021831



Figure 45(2)–50: *Pedicularis elwesii* Hook. f. a, habit; b, flower; c, capsule. Drawn by C.-Y. LIU [*Fl. Reipubl. Popularis Sin.* 68: 323, figure 73: 1-3. 1963].



Map 45(2)-117: *Pedicularis elwesii* Hook. f.

(SZ). **S HENGDUAN: Daocheng**, Riwa Shan, near the city, 3800 m, 2 July 1982, *T. C. Wei & X. H. Hu 30021* (CDBI); Daocheng, Haizi Shan, 4450 m, 24 July 2001, *F. S. Yang Y0075* (PE). **Dêqên**, 4100 m, 9 Aug. 1940, *K. M. Feng 6433* (PE); Dêqên, Baimaxue Shan, 4600 m, 13 July 1981, *no record number* (HITBC075696); Dêqên, Baimaxue Shan, 4450 m, 10 July 1989, *K. C. M. Zhang 89081* (SABG); Dêqên, Baimaxue Shan, 4500 m, 13 July 1981, *Qinghai-Xizang Exped. 2699* (PE); Dêqên, Meilixue Shan, Kawaboga, 4000 m, 8 Sept. 1990, *Z. D. Fang 1730* (SABG); Dêqên, Renzhixue Shan, 4300 m, 11 July 2001, *F. S. Yang Y0033* (PE); Dêqên, Yuning, Mingyang, 3600–3900 m, 25 Aug. 1981, *PE Hengduan Shan Exped. 3776* (PE). **Gongshan**, 3700 m, 7 Aug. 1938, *T. T. Yü 19738* (PE). **Shangri-la** (Zhongdian), 3300 m, 29 June 1937, *T. T. Yü 11828* (PE, KUN); Shangri-la (Zhongdian), Nixibala, 4050 m, 7 July 1987, *Z. D. Fang 0913* (SABG). **Weixi**, Kangpu, 4000 m, 19 Aug. 1987, *Z. D. Fang 00327* (SABG). **Xiangcheng**, Wuming Shan, 4450 m, 24 July 2001, *F. S. Yang Y0068* (PE).

118. *Pedicularis aschistorrhyncha* C. Marquand & Airy Shaw, *J. Linn. Soc. Bot.* 48: 210. 1929; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 325. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 192.

1998. Type: China, SE Tibet, “Tumbatse, in marshy meadows. Lower lip white, upper lip purple”, 3352–3657 m (11000–12000 ft), 13 July 1924, *F. Kingdon-Ward 5930* [holotype: K(K000739104)].

Pedicularis fletcheri P. C. Tsoong, *Acta Phytotax. Sin.* 3: 294, 324. 1955; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 325. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 192. 1998. **syn. nov.** ≡ *Pedicularis fletcheriana* P. C. Tsoong, *Bull. Brit. Mus. (Nat. Hist.), Bot.* 2: 19. 1955, nom. illeg. Type: China, Tibet, Mainling (Kongbo Province, Lusha Chu), 3505 m (11500 ft), 15 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 4828* [holotype: BM(BM000885890); paratypes: PE(00031290, 00031291)].

Herbs annual, 15–40 cm tall, more or less black when dry. Stems single to 10, erect, outer stems usually ascending, glabrous. Basal leaves 10–15 cm long; petiole 3–7 cm long; cauline leaves several, alternate or sometimes pseudo-opposite; petiole covered with long glandular hairs; leaf blade oblong-lanceolate, 4–9 cm long, 1.5–2 cm wide, glabrous on both surfaces, pinnatisect; segments 7–9 pairs, ovate-oblong, incised-dentate. Inflorescences racemose, usually 8–15 cm long; bracts leaflike; pedicels ca. 1.5 cm long. Calyx 20–25 mm long, 1/4–1/2 cleft anteriorly, long-

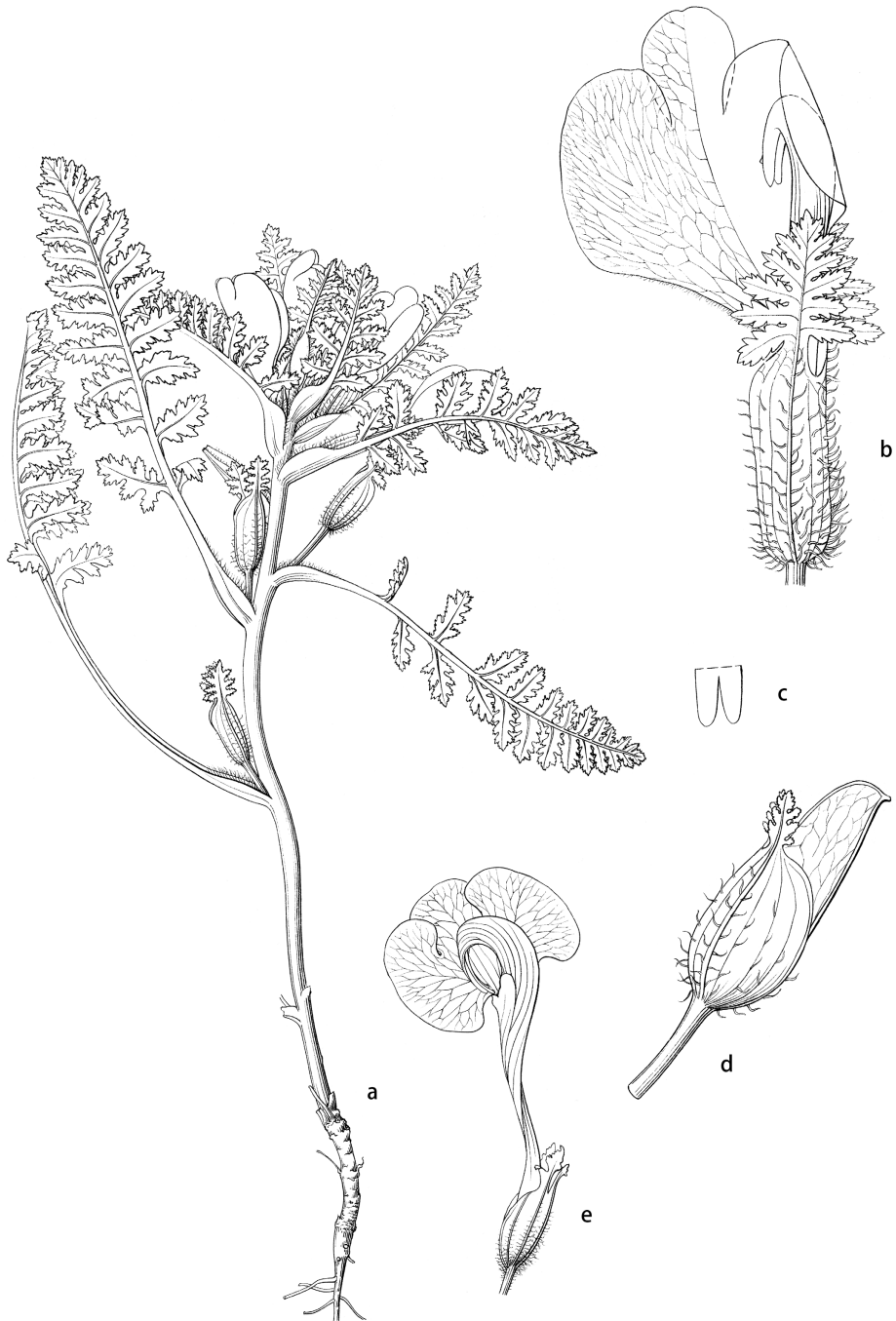


Figure 45(2)–51: ***Pedicularis aschistorrhyncha*** C. Marquand & Airy Shaw. a-d: a, habit; b, flower; c, beak; d, capsule. Drawn by C.-Y. LIU for *P. fletcherii* P. C. Tsong [Fl. Reipubl. Popularis Sin. 68: 325, figure 73: 4-7. 1963]. ***Pedicularis wilsonii*** Bonati. e, flower. Drawn by C.-Y. LIU [Fl. Reipubl. Popularis Sin. 68: 329, figure 74: 7. 1963].

pubescent; lobes 2 or 4, unequal in size, leaflike. Corolla white, with red-tinged center to lower lip, 25–30 mm long; tube 18–22 mm long, glabrous; galea slightly falcate, 3–4 mm wide, more or less purple; beak bent downward, 2–3 mm long; lower lip completely enveloping galea, 15–18 mm long, 20–25 mm wide, finely ciliate or glabrous, middle lobe emarginate. Filaments 2 pubescent, 2 glabrous. Capsule 12–15 mm long and 9 mm wide. Seeds ca. 2.3 mm long and 1.2 mm wide. Figure 45(2)–51.

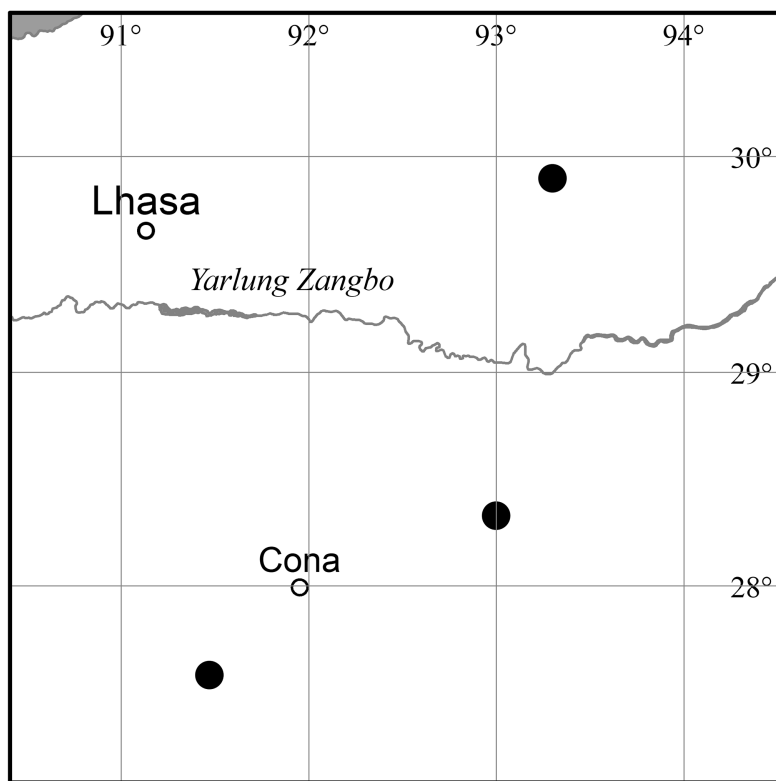
Phenology: flowering from June to July.

Habitats: alpine meadows, marshy meadows; 3400–4200 m.

Distribution: endemic; Bhutan, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra [Map 45(2)–118].

Notes: Tsoong described *P. fletcheri* P. C. Tsoong as new and stated that it is different from *P. aschistorrhyncha* C. Marquand & Airy Shaw by deeply cleft calyx. Only one sheet (K000739104) of type collection is available. After specimen examination and field investigation, we find that it is difficult to distinguish *P. fletcheri* P. C. Tsoong from *P. aschistorrhyncha* C. Marquand & Airy Shaw. Hence, we reduce the former as a new synonym of *P. aschistorrhyncha* C. Marquand & Airy Shaw.

BHUTAN: Tashi Yangtshi, 2743 m, 5 July 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 20480* (BM). **L YARLUNG ZANGBO:** Gongbo'gyamda, Lushan Chu, 3505–3810 m (11500–12500 ft), 15 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 14058* (PE00031291). **Yarlung Zangbo-Brahmaputra:** Chayul Chu, 3353 m, 24 July 1936, *F. Ludlow & G. Sherriff 2427* (BM).



Map 45(2)–118: *Pedicularis aschistorrhyncha* C. Marquand & Airy Shaw

Ser. 40. *Wilsoniae*

Ser. *Wilsoniae* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 148. 1949.

Herbs low, more or less stemless. Leaves long-petiolate, shallowly crenate-lobed to pinnatipartite. Flowers axillary. Calyx deeply cleft anteriorly, 2- or 3-lobed. Corolla tube mostly more than 2 times as long as calyx, expanded apically; beak long; lower lip large.

Two species; both endemic to the Pan-Himalaya.

- 1a. Leaf blade pinnatisect; segments pinnatifid to pinnatipartite; root single, linear 119. *P. dulongensis*
.....
- 1b. Leaf blade pinnatipartite; segments margin dentate; roots numerous, fusiform, fleshy 120. *P. wilsonii*
.....

119. *Pedicularis dulongensis* H. P. Yang, Acta Phytotax. Sin. 28: 143. 1990; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 194. 1998. Type: China, Yunnan, Gongshan, Dulong, 3500–3600 m, 24 July 1982, *Qinghai-Xizang Exped. 8506* [lectotype designated by Lin (2007): PE(00031479)].

Herbs perennial, 10–15 cm tall, more or less black when dry. Stems more or less absent. Basal and cauline leaves densely clustered; petiole 1–3 cm long, slender, glabrous; leaf blade elliptic-oblong to oblong, 2–3 cm long, abaxially pubescent, adaxially glabrous, pinnatisect; segments 5–9 pairs, ovate, pinnatifid or coarsely serrate. Flower pedicels 1–1.5 cm long. Calyx cylindrical-campanulate, 15–18 mm long, 2/3 cleft anteriorly, densely white-villous with multicellular hairs; lobes 5, unequal in size, leaflike, posterior one smaller than lateral lobes. Corolla red, obscure, 50–70 mm long; tube erect, 30–50 mm long, villous with multicellular hairs; galea nearly falcate, very enlarged; beak incurved, 5–6 mm long; lower lip 12–15 mm long, 25–30 mm wide, middle lobe smaller than lateral pair. Filaments all pubescent. Capsule ovoid-oblong, 10–15 mm.

Phenology: flowering from June to August.

Habitats: moist meadows on mountain slopes; 3500–3600 m.

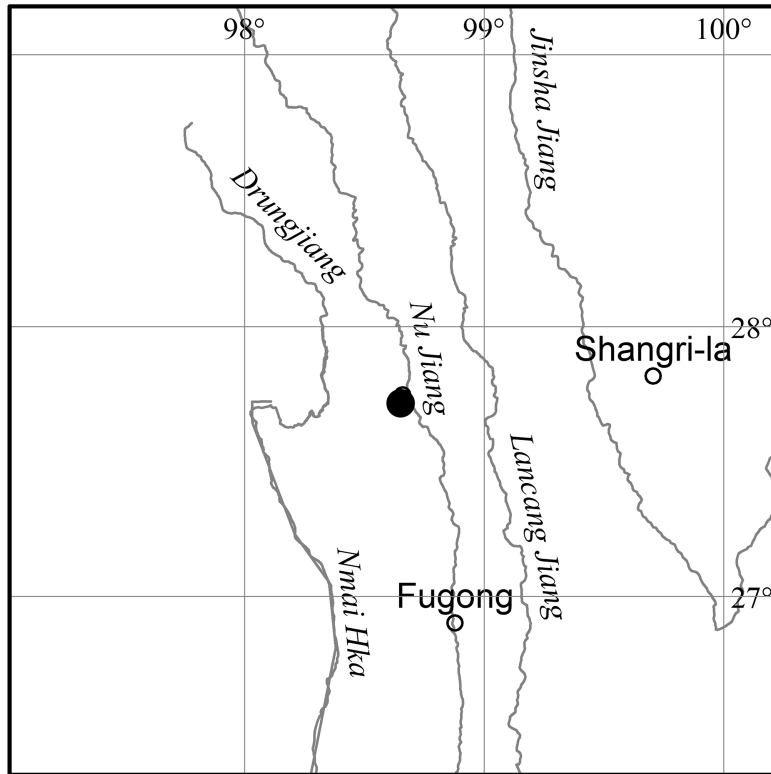
Distribution: endemic; S Hengduan [Map 45(2)–119].

Notes: Yang in the protologue of *P. dulongensis* H. P. Yang recorded calyxes as five lobes, but we find that the calyxes have two leaflike lobes. Our molecular phylogenetic results reveal that *P. dulongensis* H. P. Yang forms a separated clade in lack of molecular data of *P. wilsonii* Bonati.

S Hengduan: Gongshan, Dulong, 3500–3600 m, 24 July 1982, *Qinghai-Xizang Exped. 8506* (KUN475326, PE00031478–PE00031480).

120. *Pedicularis wilsonii* Bonati, Bull. Soc. Bot. France 54: 184, 376. 1907; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 329. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 194. 1998. Type: China, Sichuan, possible in Kangding (no more detailed information), collected in 1904, *E. H. Wilson 4238* [holotype: P(P03005325)].

Herbs perennial, 7–10 cm tall, more or less black when dry. Roots fusiform, more or less fleshy. Stems 2 or 3, 2–3 cm tall, or absent, pubescent. Basal leaves few; petiole 1.5–2 cm long; leaf blade elliptic to oblong-ovate, usually 5–6 cm long, glabrous on both surfaces, pinnatipartite; segments 10–13 pairs, ovate-oblong; cauline leaves usually



Map 45(2)-119: *Pedicularis dulongensis* H. P. Yang

pseudo-opposite, smaller than basal leaves. Flowers few; pedicels 1–2.5 cm, glabrescent. Calyx 10–15 mm long, 2/3 cleft anteriorly, pubescent; lobes 3, unequal in size, posterior one linear, entire, lateral lobes larger, leaf-like. Corolla red throughout; tube 30–40 mm long, slender; galea falcate apically; beak bent downward, straight or cylindric, ca. 4 mm long; lower lip 15–20 mm long, 25–30 mm wide, middle lobe ca. 1/2 size of lateral lobes, sparsely ciliate. Filaments glabrous or pubescent. Figure 45(2)–51.

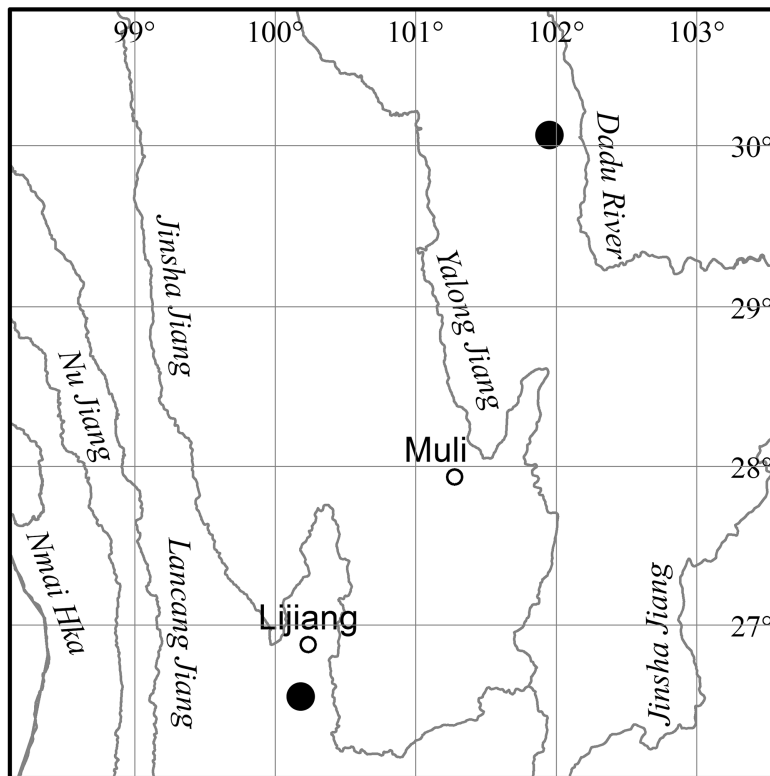
Phenology: flowering in June to August.

Habitats: moist meadows on mountain slopes; 3500–3600 m.

Distribution: endemic; S Hengduan [Map 45(2)–120].

Notes: When Bonati described *P. wilsonii* Bonati as new, he cited one collection *Wilson 4238*. One sheet of this collection attached with dissected corolla and Bonati's notes has been deposited in the herbarium P, so it should be the holotype.

S Hengduan: **Heqing**, collected in 1939, detailed information unknown, *K. M. Feng 744* (KUN). **Kangding**, 1904, *E. H. Wilson 4238* (P03005325).



Map 45(2)-120: *Pedicularis wilsonii* Bonati

Ser. 41. Flammeae

Ser. Flammeae Prain, Ann. Roy. Bot. Gard. Calc. 3: 100. 1890.

Herbs less than 20 cm tall, roots fusiform, fleshy. Leaf blade pinnatipartite to pinnatisect. Inflorescences spicate, centrifugal, with dense flowers. Calyx 5-lobed. Corolla tube decurved distally; galea toothless; beakless; lower lip spreading. Capsule oblique.

One species; distributed in the Pan-Himalaya; also in N Asia, Europe, N America.

121. *Pedicularis flammea* L., Sp. Pl. 2: 609. 1753.

Type: *Herb. Linn. No. 763.21* [lectotype designated by Yu *et al.* (2014: 173) : LINN].

Herbs perennial, 5–10(-20) cm tall, black when dry. Roots branched, more or less fusiform, fleshy. Stems usually scapelike, woolly. Leaves mostly basal; petiole 2–4 cm long, pubescent; leaf blade linear-lanceolate to linear, 1.5–7 cm long, abaxially sometimes pubescent along veins, adaxially usually glabrous, pinnatisect; segments 10–30 pairs, ovate to oblong, dentate; cauline

leaves 1 or 2, similar to basal leaves but smaller. Inflorescences 3–10 cm long; bracts linear-lanceolate to linear, as long as, or shorter than flowers, usually woolly. Calyx 9–12 mm long; lobes 5, more or less equal in size. Corolla yellow, the upper part of galea red to deep purple, or tip of galea brown, occasionally lower lip purple-spotted, 18–25 mm long; tube falcate apically, 6–15 mm long, apex obtuse or more or less acute; galea rounded in front; lower lip 5–7 mm long, 7–14 mm wide, middle lobe rounded, smaller than lateral lobes. Filament anterior 2 pubescent. Stigma

included or slightly exserted. Capsule long ovoid to ovoid-lanceolate, 15–18 mm long, 7 mm wide.
Chromosomes: $2n = 16$.

Phenology: flowering from June to September.

Habitats: alpine meadows, pastures, damp limestone rocks, tundra, grassy slopes; 100–5400 m.

Distribution: U Ganga & Indus, U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, M Yarlung Zangbo, L Yarlung Zangbo, Tangut, N Hengduan, S Hengduan [Map 45(2)–121]; also in Gansu, Hebei, Qinghai, Shaanxi, Shanxi, Xinjiang, Tibet of China, and in Japan, Kazakstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, C and N Europe, N North America.

Notes: *Pedicularis oederi* Vahl was separated from *P. flammea* L. in 1806 and described as new species based on collections from Scandinavia. Because of its distribution through alpine and arctic Europe, northern Asia, and arctic North America, several subspecies and varies under *P. oederi* were described as new. However, infra-species delimitation is confusing due to complicated morphological variation. Here, after extensive examinations of herbaria specimens, we consider that *P. oederi* Vahl should be merged into *P. flammea* L. and treated as a subspecies of the latter. This treatment is supported by molecular evidence.

- 1a. corolla orange-yellow, the upper half of galea red to deep purple..... 121a. subsp. *flammea*
 1b. corolla bright yellow, the tip of galea crimson..... 121b. subsp. *oederi*

121a. *Pedicularis flammea* subsp. *flammea*

Stems one to several, simple, reddish to purple. Corolla tube 7–15 mm long, corolla orange-yellow, the upper half of galea red to deep purple.

Phenology: flowering and fruiting from June to September.

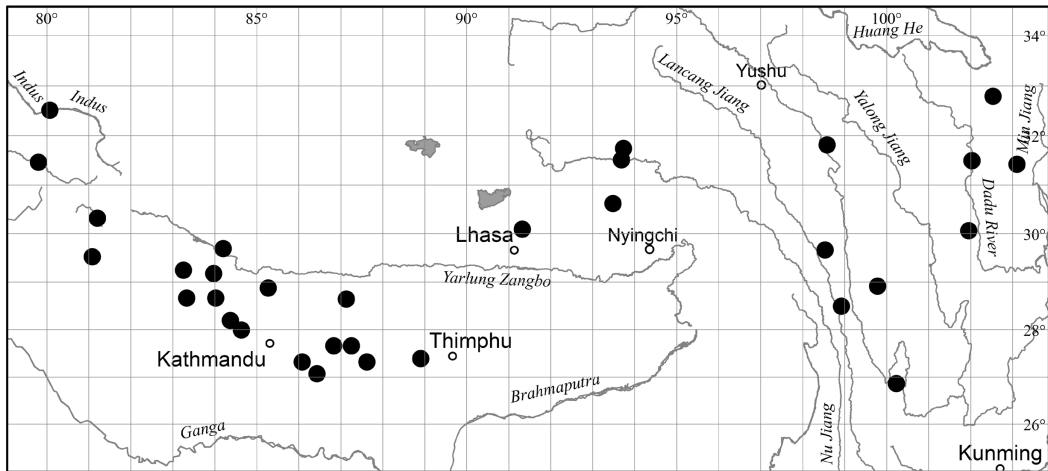
Habitats: alpine meadows, tundra, grassy slopes; 100–2500 m.

Distribution: North America & West Europe.

121b. *Pedicularis flammea* subsp. *oederi* (Vahl)

F. S. Yang, **comb. et stat. nov.** ≡ *Pedicularis oederi* Vahl, in Hornemann, Dansk Oekonom. Plantel. ed. 2, 580. 1806; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 331. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 195. 1998.
syn. nov. Type: protologue, “Den vorer paa Fjeldene i Norge men sielden, f. Er. paa Bangsfjeldet i Opdalen, paa Devre imellen Fogstuen og Toste”, not seen.

Pedicularis habachanensis subsp. *multipinnata*
 P. C. Tsoong, in Chien & Chun, Fl. Reipubl.



Map 45(2)–121: *Pedicularis flammea* L. subsp. *oederi*

- Popularis Sin. 68: 339. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 197. 1998. **syn. nov.** Type: China, NW Yunnan (no detailed information), 16 June 1937, T. T. Yü 11632 [holotype: PE(00033146)].
- Pedicularis bhutanomuscoides* T. Yamaz., J. Jap. Bot. 78: 71. 2003. **syn. nov.** Type: Bhutan, Paro Distr. Bunte La “open *Rhododendron anthopogon* dwarf-scrub with mat fragment on under N-facing slope”, 4930 m, 10 June 2000, G. Miehe & S. Miehe 00-184-07 [holotype: TI].
- Pedicularis qinghaiensis* T. Yamaz., J. Jap. Bot. 78: 200. 2003. **syn. nov.** Type: China, Qinghai, near Sazin Gompa, open *Picea crassifolia* forest, 3600 m, 2 Aug. 2002, G. Miehe, Sonamco & K. Koch 02-5-34 [(holotype: TI)].
- Pedicularis hypophylla* T. Yamaz., J. Jap. Bot. 78: 202. 2003. **syn. nov.** Type: China, Qinghai, near Sazin Gompa, *Picea crassifolia* forest, 3600 m, 2 Aug. 2002, G. Miehe, Sonamco & K. Koch 02-5-31b [holotype: TI].
- Pedicularis stylosa* H. P. Yang, Acta Phytotax. Sin. 18(2): 242. 1980; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 196. 1998. **syn. nov.** Type: China, Tibet, Nyalam, 4300 m, 27 June 1975, *Qinghai-Xizang Veget. Exped. 6501* [holotype: PE(00032957)].
- Pedicularis heteroglossa* (Prain) Pusalkar & D. K. Singh, Edinb. J. Bot. 67: 57–64. 2010. **syn. nov.** ≡ *Pedicularis oederi* var. *heteroglossa* Prain, J. Asiatic Soc. Bengal 58: 276. 1889. ≡ *Pedicularis oederi* subsp. *heteroglossa* (Prain) Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 141. 1943. ≡ *Pedicularis asplenifolia* Wall. ex Benth., Scroph. Ind. 54. 1835. Type: India, Dhauli Valley, Kumaon, 4267–4572 m, 4 Sept. 1884, *Duthie 3228* [lectotype designated by Posalkar & Singh (2010: 59): DD].
- Pedicularis oederi* subsp. *branchiophylla* (Pennell) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 334. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 195. 1998. **syn. nov.** ≡ *Pedicularis branchiophylla* Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 142. 1943. Type: India, Sikkim, Uachezali, 4900 m, 22 July 1909, *W. W. Smith & G. H. Cave 1714* [holotype: PH(00019430)].
- Pedicularis oederi* subsp. *multipinna* (H. L. Li) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 334. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 196. 1998. **syn. nov.** ≡ *Pedicularis oederi* var. *multipinna* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 89. 1949. Type: China, Sichuan, Kangding, “grasslands of Yuoong-His, Minya country, south of Tatsienlu”, 4150 m, July 1929, *J. F. Rock 17479* [holotype: PH; isotypes: E(E00284013), US(00324231)].
- Pedicularis oederi* subsp. *oederi* var. *sinensis* (Maxim.) Hurus., J. Jap. Bot. 22: 73. 1948. **syn. nov.** Type: not designated.
- Pedicularis oederi* var. *angustiflora* (H. Limpr.) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 334. 1963. **syn. nov.** ≡ *Pedicularis angustiflora* H. Limpr., Report. Sp. Nov. 18: 18. 1922. ≡ *Pedicularis stenantha* Franch. Type: China, Sichuan, Kangding, Tongolo, collected in 1893, *Soulié 768* [lectotype designated here: K(K000708737)].
- Pedicularis oederi* var. *rubra* (Maxim.) H. Limp., Repert. Sp. Nov. 20: 202. 1924. ≡ *Pedicularis versicolor* var. *rubra* Maxim., Bull. Acad. St. Pétersb. 32: 619. 1888. Type: Russia-Sinkiang border “Thianschan, montibus altissimis Chen-tengri (Krasnov, 1886).” Not designated.
- Pedicularis versicolor* Vahl, Veg. Helvet. 9: 118. 1813; Maxim., Bull. Acad. St. Pétersb., 32: 618. 1888. Type: Europe, “Hab. locis subuliginosis apricis in regione subalpina et alpina inferiore alpinum mediae altitudinis ubique frequentus; uti in Pilato et exinde per Schwander.” Not designated.
- Herbs low, 8–20 cm tall. Roots branched, more or less fusiform. Bracts linear-lanceolate to linear, usually woolly. Corolla bright-yellow, the upper half of galea crimson, tube 6–15 mm long. Figure 45(2)–52.

Phenology: flowering from June to September.

Habitats: alpine meadows, pastures, damp limestone rocks, tundra, grassy slopes; 300–5300 m.

Distribution: U Ganga & Indus, U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, M Yarlung Zangbo, L Yarlung Zangbo, Tangut, N Hengduan, S Hengduan [Map 45(2)–121]; also in Gansu, Hebei, Qinghai, Shaanxi, Shanxi, Xinjiang, and Tibet of China, Japan, Kazakstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, C and N Europe, and N North America.

Notes: Yamazaki (2003. J. Jap. Bot. 78: 71) described *P. bhutanomuscoides* T. Yamaz. as new based on two collections from Paro, Bhutan. He stated that it resembles *P. muscoides* subsp. *himalayca* T. Yamaz. but differs in larger and more serrated leaves and larger flowers. However, types of *P. bhutanomuscoides* T. Yamaz. are characterized by fish-gill-shaped laminas, very short lower corolla lips, and much small middle lip (2–3 mm long). Moreover, the size (1.5–4.5 long, 4–10 mm wide) of leaf blade, number (10–25 pairs) of the leaf segments, and length (12–15 mm) of corolla tube of *P. bhutanomuscoides* matches well *P. oederi* Vahl. All the evidence supports that *P. bhutanomuscoides* T. Yamaz. should be merged into *P. oederi* Vahl and treated as a new synonym of the latter. Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 339) described *P. habachanensis* subsp. *multipinnata* P. C. Tsoong as new based on one collection from NW Yunnan, China. He stated that it differs from *P. habachanensis* Bonati in more leaf segments. However, *P. habachanensis* subsp. *multipinnata* P. C. Tsoong is quite different from *P. habachanensis* Bonati in narrower (2–3 mm) and denser leaf segments. It is characterized by a long petiole, linear blade, and long gill-like leaves, with a shape and number of segments (13–23 pairs) matching the typical *P. oederi* Vahl. These diagnostic traits point to *P. oederi* Vahl. Hence, *P. habachanensis* subsp. *multipinnata* is treated here as a new synonym of *P. flammaea* subsp. *oederi* (Vahl) F. S. Yang.

Yamazaki (2003. J. Jap. Bot. 78: 200–202) described two new “species” based on two col-

lections (*G. Miehe, Sonamco & K. Koch 02-5-31b & 02-5-34*) sampled from one population (Open *Picea crassifolia* forest. 3600 m, 35°31' N, 98°48' E) in Sazin Gompa, Qinghai Province, China. Collection *02-5-31b* was named *P. hypophylla* T. Yamaz. and collection *02-5-34* was named *P. qinghaiensis* T. Yamaz. He stated that *P. hypophylla* is similar to *P. oederi* subsp. *heteroglossa* (Prain) Pennell but differs in smaller corolla and galea with two small projections at the inner base, and *P. qinghaiensis* differs from *P. oederi* subsp. *heteroglossa* (Prain) Pennell in densely pilose calyx and smaller corolla. In addition, Yang described *P. stylosa* H. P. Yang as new based on one collection from Nyalam, and she stated that it differs from *P. oederi* Vahl in protrudent style (4 mm long) and without small projections at the inner base of galea. After examinations of more herbarium specimens, we find that the corolla length (18–20 mm) of two species described by Yamazaki falls into the length range of corolla of *P. oederi* Vahl, and the small projections, length of style, and pilose of calyx vary between and within populations. Hence, these two “species” are treated here as new synonyms of *P. flammaea* subsp. *oederi* (Vahl) F. S. Yang. In addition, the following taxa are treated as new synonyms because there are no morphological gaps among these taxa: *P. stylosa* H. P. Yang, *P. heteroglossa* (Prain) Pusalkar & D. K. Singh, *P. oederi* subsp. *branchiophylla* (Pennell) P. C. Tsoong, *P. oederi* subsp. *multipinna* (H. L. Li) P. C. Tsoong, *P. oederi* subsp. *oederi* var. *sinensis* (Maxim.) Hurus., *P. oederi* var. *angustiflora* (H. Limpr.) P. C. Tsoong, and *P. oederi* subsp. *multipinna* (H. L. Li) P. C. Tsoong.

U Ganga & Indus: Burang, Barchengqu, 4700 m, 22 July 1976, *Qinghai-Xizang Exped.* 76-8285 (PE, HNWP). **Gar,** Toumen, Yemagou, 5240 m, 9 July 1976, *Qinghai-Xizang Exped.* 76-7969 (PE). **Zanda,** Qusong, Magang, 4500 m, 27 June 1976, *Qinghai-Xizang Exped.* 76-8055 (PE, HNWP). **U YARLUNG ZANGBO:** Gyirong, Bahaogou, 4700 m, 28 June 1972, *Tibet Chin. Medic. Herb. Exped.* 662 (PE). **Tingri,** Fushila, 5300 m, 10 June 1990, *Sino-Jap. Exped.* T560 (PE). **Zhongba,** Page, near forest and lake, 5350 m, 9 Aug. 1975, *Qinghai-Xizang Exped.*

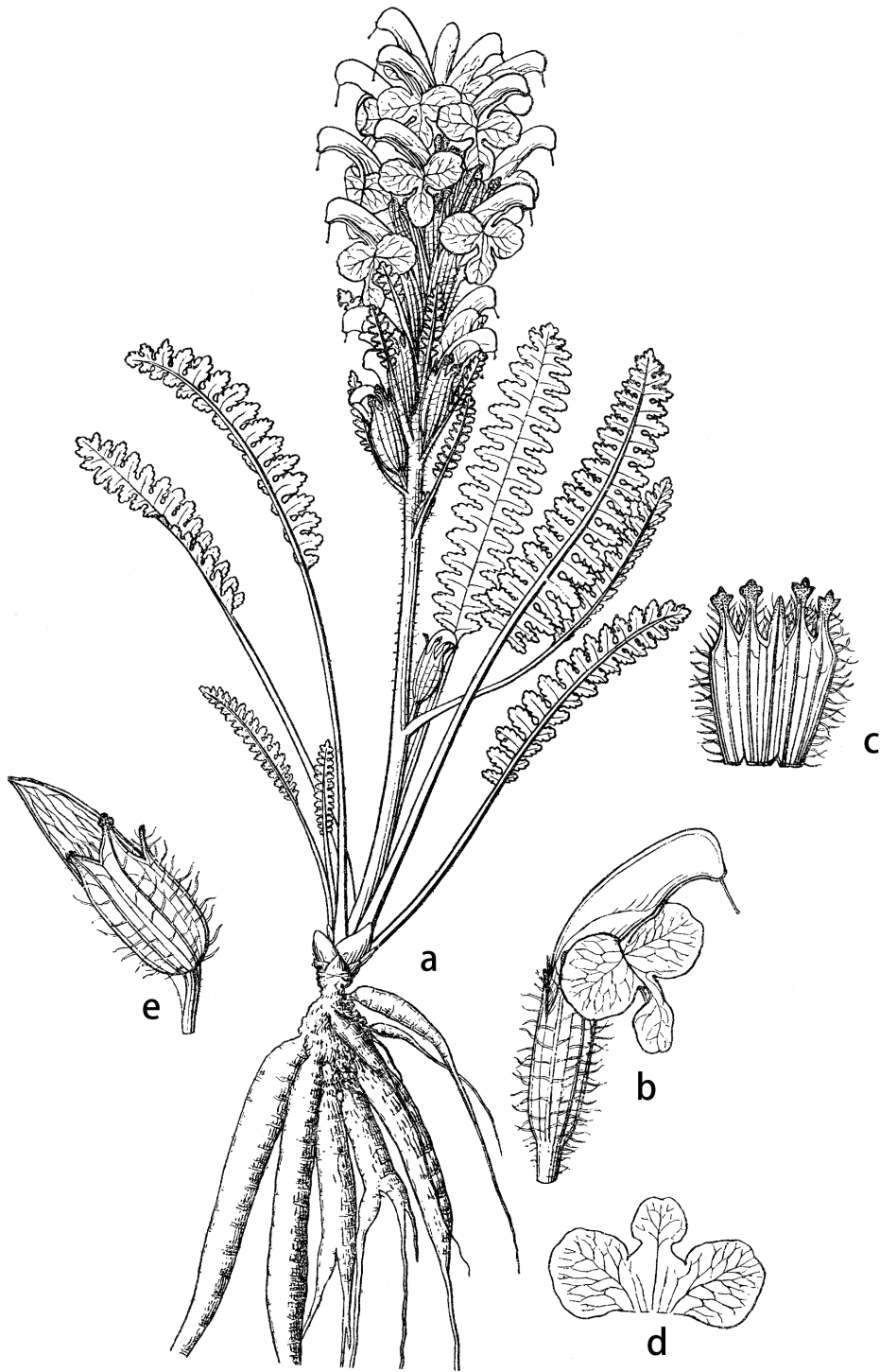


Figure 45(2)–52: *Pedicularis flammea* subsp. *oederi* (Vahl) F. S. Yang. a, habit; b, flower; c, calyx; d, corolla lip; e, capsule. Drawn by C.-Y. LIU [Modified from C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 333, figure 75: 1-5. 1963].

6711 (PE, HNWP). **W NEPAL:** Karnali, Dolpa, Balangra La, 3940–4240 m, 28 May 1952, *O. V. Polunin*, *W. R. Sykes* & *L. H. J. Williams* 1020 (BM); Karnali, Dolpa, Jangla Bhanjyang, 3800 m, 5 June 1973, *S. Einarsson*, *L. Skärby* & *B. Wetterhall* 487 (BM); Karnali, Dolpa, Phoksumdo Khola, 4240 m, 18 June 1963, *J. D. A. Stainton* 4322 (BM); Karnali, Dolpa, Nahure, 5150 m, 27 June 1952, *O. V. Polunin*, *W. R. Sykes* & *L. H. J. Williams* 44 (BM). **Seti**, Bajhang, 4363 m, 29 July 1976, *H. Tabata*, *K. R. Rajbhandari* & *K. Tsuchiya* 1771 (KYO). **C NEPAL:** **Bagmati**, Rasuwa, 5000 m, 21 July 1992, *H. Takayama*, *K. Arai* & *F. Miyamoto* 9233121 (E); Bagmati, Rasuwa, Gosainkund, 4240–4850 m, 28 July 1967, *S. B. Malla* 9539 (BM); Bagmati, Rasuwa, Langtang Himal, 4550 m, 28 July 1962, *J. D. A. Stainton* 4071 (BM). **Dhawalagiri**, Mustang, 4720 m, 11 Aug. 2001, *S. Noshiro*, *M. Amano* & *T. Kurosawa* 20104163 (E); Dhawalagiri, Mustang, Muktinath, 3650–4200 m, 15 July 2000, *Y. Iokawa*, *M. N. Subedi*, *Y. Takahashi* et al. 20020248 (E); Dhawalagiri, Mustang, Taglung, 4390 m, 16 July 1954, *J. D. A. Stainton*, *W. R. Sykes* & *L. H. J. Williams* 1830 (BM); Mustang, Thinigaon, 4550 m, 22 June 1954, *O. V. Polunin*, *W. R. Sykes* & *L. H. J. Williams* 1295 (BM); Dhawalagiri, Myagdi, Sauwala Khola, 3790 m, 4 June 1954, *J. D. A. Stainton*, *S. W. R. Sykes* & *L. H. J. Williams* 2975 (BM). **Gandaki**, Gorkha, Jarang Khola, 4550 m, 3 July 1950, *D. G. Lowndes* 1109 (BM); Gandaki, Lamjung, 4390 m, 13 July 1954, *J. D. A. Stainton*, *W. R. Sykes* & *L. H. J. Williams* 6332 (BM); Gandaki, Manang, 4000–5100 m, 31 July 1983, *H. Ohba*, *H. Kanai*, *M. Wakabayashi* et al. 8350771 (E). **Janakpur**, Ramechhap, Bigphera Lho Glacier, 4150–4700 m, 28 July 1985, *T. Kikuchi*, *M. Wakabayashi*, *M. Suzuki* et al. 8580534 (KYO). **E NEPAL:** **Kosi**, Sankhuwasabha, 4620 m, 23 July 1988, *M. Suzuki*, *N. Naruhashi*, *N. Kurosaki* et al. 8850626 (TI). **Sagarmatha**, Solukhumbu, Dudh Koshi Valley, Gokyo, 4700 m, 8 July 1970, *J. F. Dobremez* 411 (BM). **M Yarlung Zangbo: Lhünzhub**, 4270 m, 11 June 1960, *G. X. Fu* 216 (PE). **Yadong**, Pali, 4600 m, 15 June 1975, *Qinghai-Xizang Suppl. Exped.* 750345 (PE, KUN, HNWP). **L Yalung Zangbo: Lhari**, 4700 m, 8 June 1976, *D. D. Tao* 10473 (PE). **TANGUT: Biru**, 4300 m, 18 June 1961, *J. N. Wang* 3436 (PE). **Dêgê**, Queer Shan, 4889 m, 28 July 1959, *S. Jiang* 02504 (PE). **Sogxian**, 4700 m, 17 June 1961, *J. N. Wang* 3421 (PE). **N HENGDUAN: Hongyuan**, Shuajingsi Temple, 3550 m, 19 June 1959, *S. Jiang* 01127 (PE). **Jinchuan**, Kasa, Kongka Shan, 4500 m, 30 May 1958, *X. Li* 77540 (PE). **Lixian**, Longri, 3500 m, 20 June 1959, *S. Jiang* 01137 (PE). **Markam**, Zhegu Shan, 4200 m, 23 June 1957, *X. Li* 71678 (PE). **S HENGDUAN: Dêqên**, Bamaxue Shan, 4600 m, 13 June 1981, *Qinghai-Xizang Exped.* 2360 (PE). **Kangding**, Zheduo Shan, 4200 m, 27 May 1973, *Qinghai-Xizang Exped.* 73-14 (PE). **Xiangcheng**, 8 July 1973, *Sichuan Veget. Exped.* 2917 (PE, CDBI). **Yulong** (Lijiang), Yulongxue Shan, 1910, *G. Forrest* 6097 (PE).

Ser. 42. *Corydaloides*

Ser. *Corydaloides* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 148. 1949.

Stems and branches often procumbent to ascending. Leaves alternate or pseudo-opposite; leaf blade pinnatisect. Inflorescences terminal, usually distinctly centrifugal, or flower axillary. Calyx 5-lobed. Corolla tube decurved distally; galea toothless, beakless; lower lip spreading.

Two species; both endemic to the Pan-Himalaya.

Notes: Our molecular phylogenetic results indicate that two species of the series *Corydaloides* form a well-supported clade.

- 1a. Leaf blade ovate-elliptic to ovate-oblong, segments usually 4–5 pairs; corolla galea straight.....
 122. *P. corydaloides*
- 1b. Leaf blade narrowly ovate-oblong, segments usually 7–12 pairs; corolla galea falcate
 123. *P. cryptantha*

122. *Pedicularis corydaloides* Hand.-Mazz., Sym. Sin. 7: 851. 1936; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 335. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 196. 1998. Type: China, Yunnan, “NW-Yunnan, Bambusreiche Gebüsche der ktp. St. [Kalttemperierte (subalpine) Stufe] des birm. Mons. (Nordost-birmanisches west yünnesisches Monsungebiet) an der Westseite des Passes Pangblanglong zwischen Salween und Irrawadi, Glimmerschiefer, 3500–3800 m, 10 July 1916 (9515).” [holotype: WU(WU0060233); isotypes: E(E00284036), PH00097211)].

Herb perennial, 8–16 cm tall, slender. Stems erect, short, slender, sparsely long branched apically, with remote scales at base, outer stems usually procumbent to ascending, sometimes branched, pubescent. Basal leaves numerous, petiole 3–7 cm long, slender, puberulent; leaf blade ovate-elliptic to ovate-oblong, 1–4 cm long, 0.8–1.8 cm wide, pinnatipartite, abaxially white-scurfy, adaxially glabrous; segments usually 4–6 pairs, ovate to oblong, pinnatifid or incised-dentate. Stems and leaves usually pseudo-opposite, smaller than basal leaves. Flowers axillary, usually racemose apically, centrifugal; pedicels 2–14 mm long. Calyx 5–6 mm long, pubescent; lobes 5, unequal in size, posterior one usually lanceolate and entire, lateral lobes larger, serrate. Corolla yellow; tube cylindric, longer than calyx; galea straight, 5–6 mm long, sparsely glandular-pilose apically, minutely apiculate at apex; lower lip ca. as long as galea, ciliate, lobes more or less equal in size, rounded. Filaments all pubescent. Capsule 4–6 mm long and 4–5 mm wide. Figure 45(2)–53.

Phenology: flowering from June to August.

Habitats: forests, shrubby grass of hillsides, alpine meadows; 3200–3800 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra, S Hengduan [Map 45(2)–122].

Notes: Our molecular phylogenetic results reveal that two accessions of *P. corydaloides* Hand.-Mazz. form a strongly supported clade sister to *P. cryptantha* C. Marquand & Airy Shaw, supporting a closely related phylogenetic relationship between the two species.

YARLUNG ZANGBO-BRAHMAPUTRA: **Cona**, Jiba, 3500 m, 19 July 1975, C. Y. Wu *et al.* 75-1092 (PE, HNWP). **Delei Valley**, 3000–3700 m, 28 June 1926, F. Kingdon-Ward. 8373, 8383 (K, KUN). **Zayü**, Chawalong village, 3200 m, Aug. 1935, C. W. Wang 65750 (PE). **S HENGDUAN:** **Gongshan**, 3500–3800 m, 10 July 1916, H. R. E. von Handel-Mazzetti 9515 (NAS). **Weixi**, Tungchuling, Tsidang, 4000 m, 14 July 1937, T. T. Yü 8973 (KUN).

123. *Pedicularis cryptantha* C. Marquand & Airy Shaw, J. Linn. Soc. Bot. 48: 211. 1929; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 336 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 196. 1998. Type: China, Tibet, “S. E. Tibet, on the glassy banks of streams, in woods, Tsela, Dzong”, 3352 m (11000 ft), 29 May 1924, F. Kingdon-Ward 5711 [**lectotype designated here:** K(K000739184); isolectotypes: BM(BM000885997), E(E00284060)].

Pedicularis breviscaposa T. Yamaz., Acta Phytotax. Geobot. 15: 147. 1954. **syn. nov.** Type: Nepal, inter Pisang, et Tat Pani, 3100 m, 26 May 1953, S. Nakao J. H. E. 195 [holotype: KYO(KYO00079833)].

Pedicularis cryptantha subsp. *erecta* P. C. Tsoong, Acta Phytotax. Sin. 3: 275. 1955; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 337. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 197. 1998. **syn. nov.** Type: China, Tibet, Mainling/Lhünzê, 2900–3400 m, 25 May 1947, F. Ludlow, G. Sherriff & H. H. Elliot 15060 [holotype: BM(BM000885998); isotype: E(E00284061)].

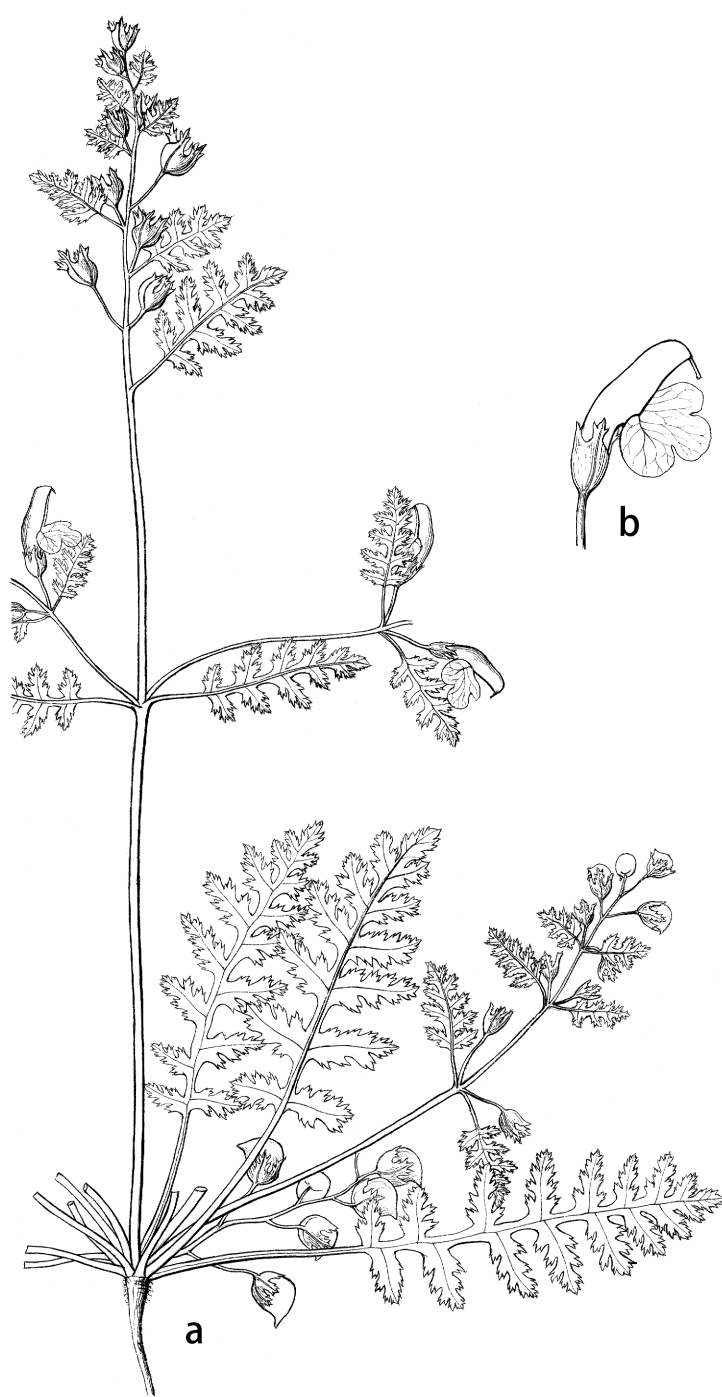
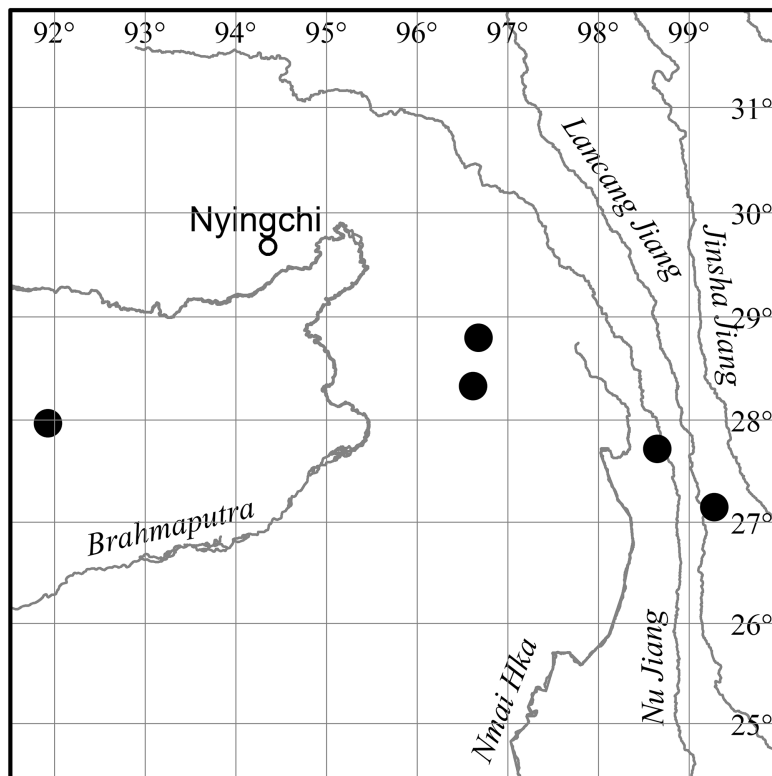


Figure 45(2)–53: *Pedicularis corydaloides* Hand.-Mazz. a, habit; b, flower. C.-Z. JI modified from F.-X. WANG [*Fl. Reipubl. Popularis Sin.* 68: 335, figure 76: 1-2. 1963].



Map 45(2)-122: *Pedicularis corydaloides* Hand.-Mazz.

Pedicularis nyingchiensis H. P. Yang & Y. Tateishi, Acta Phytotax. Sin. 31: 288. 1993; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 197. 1998. **syn. nov.** Type: China, Tibet, Nyingchi, 3000–3300 m, 20 May 1986, *The Tohoku University China Exped.* (T. Natio, K. Y. Lang, Y. Tateishi et al.) 1282 [holotype: PE(00033066)].

Herbs perennial, 8–15 cm tall, more or less black when dry. Roots more or less fusiform, and fleshy. Stems usually procumbent to ascending, short, pubescent; branches densely clustered. Basal leaves numerous; petiole 3–6 cm long, parsley pubescent; leaf blade narrowly ovate-oblong, pinnatisect, 3.5–7 cm long, 1.6–1.8 cm wide, adaxially sparsely pubescent to glabrous; segments 7–12 pairs, narrowly ovate-oblong, pinnatisect, margin double-dentate. Flowers axillary, 10–20-flowered, sometimes racemose apically, centrifugal; bracts leaflike,

lanceolate; pedicels more than 2 cm, slender. Calyx tube cylindric, 3–4 mm long, sparsely to densely pubescent; lobes 5, unequal in size in size. Corolla yellow to cream-colored, 13–20 mm long, tube expanded, curved apically; galea more or less falcate, 7–9 mm long, front rounded, apex slightly acute; lower lip with middle lobe rounded, smaller than lateral lobes, entire or more or less erose, middle lobe sometimes slightly emarginated. Filaments all glabrous. Figure 45(2)–54.

Phenology: flowering from May to August.

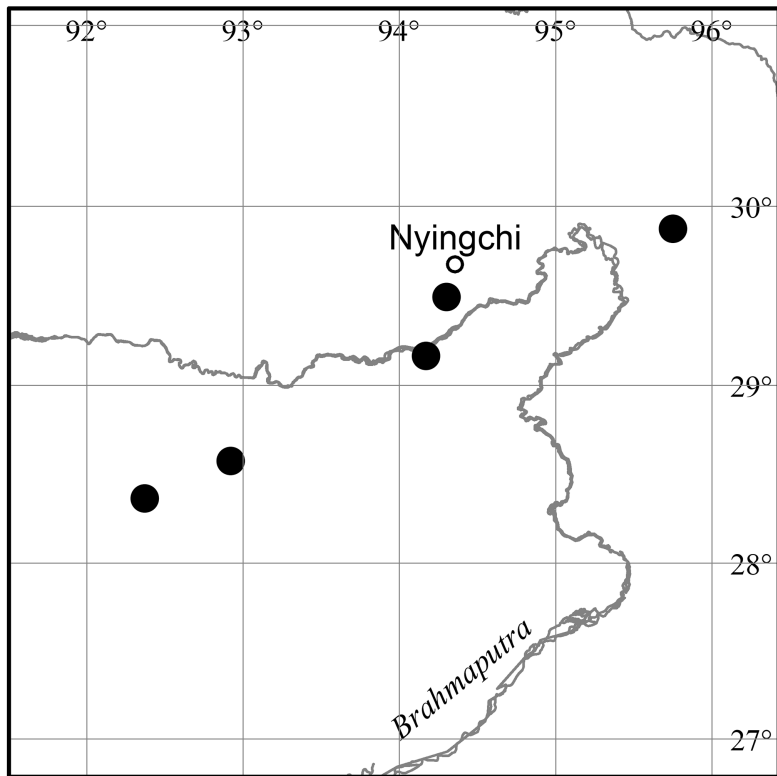
Habitats: grassy stream banks, woods, and *Pinus* forests; 2700–4700 m.

Distribution: **endemic;** L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra [Map 45(2)–123]; may also be in Bhutan.

Notes: Yamazaki described *P. breviscaposa* T. Yamaz. as new based on several collections



Figure 45(2)–54: **Pedicularis cryptantha** C. Marquand & Airy Shaw. a, habit; b, flower. C.-Z. JI modified from F.-X. WANG [*Fl. Reipubl. Popularis Sin.* 68: 336, figure 76: 3-4. 1963].



Map 45(2)-123: *Pedicularis cryptantha* C. Marquand & Airy Shaw

from Nepal. He stated that it is similar to *P. cryptantha* C. Marquand & Airy Shaw but differs in pinnatifid segments of leaves, acute-serrate lobules, and larger flowers. Tsoong described *P. cryptantha* subsp. *erecta* P. C. Tsoong as new based on a collection from SE Tibet (stored in the herbarium BM), which is considered to be different from typical *P. cryptantha* by the erect and small plant. Field observation found that the height of typical *P. cryptantha* varies within populations, and small individuals are often erect. Yang described *P. nyingchiensis* H. P. Yang & Y. Tateishi as new based on a collection from Nyingchi (SE Tibet), and she stated that it resembles *P. cryptantha* but differs in lower lip with an erose margin emarginated middle lobe, and short and thin roots. Field observation found that the lower lip is marginally erose slightly or

entirely within the same populations and the concave middle lobe is obscure. After examining herbarium specimens of *P. cryptantha* and its close relatives mentioned above, we find that all these taxa should be one species and these “species” should be treated as synonyms of *P. cryptantha* C. Marquand & Airy Shaw. Our molecular phylogenetic results reveal that three individuals of *P. cryptantha* C. Marquand & Airy Shaw form a well-supported clade sister to *P. corydaloides* Hand.-Mazz.

L YARLUNG ZANGBO: Bomi, Xiaowazong, 3000 m, 8 June 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 13106* (PE); Bomi, Guxiang, 3300 m, 14 June 1965, *T. C. Ying & D. Y. Hong 650231* (PE); Bomi, Zhamu, 2700 m, 9 July 1965, *Y. T. Zhang & K. Y. Lang 480* (PE). **Mainling,** near the Jiage, ca. 3200 m, 26 July 1975,

Qinghai-Xizang Suppl. Exped. 75824 (PE). **Nyingchi**, Dangniang, 3200 m, 22 June 1972, *Tibet Chin. Medic. Herb. Exped. 3549* (PE, HNWP); Nyingchi, Nixi, 3100 m, 2 Aug. 1965, *T. Zhang & K. Y. Lang 1248* (PE); Nyingchi, 3000–3300 m, 20 May 1986, *The Tohoku University China Exped. (T. Natio, K. Y. Lang, Y. Tateishi et al.) 1282* (PE). **YARLUNG ZANGBO-BRAHMAPUTRA: Lhünzê**, 2900–3400 m, 25 May 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 15060* (BM). **Rushon, Sanga Choling**, 3700–3900 m, 29 June 1926, *F. Ludlow & G. Sherriff 2250* (BM).

Ser. 43. Acaules

Ser. Acaules Prain, Ann. Roy. Bot. Gard. Calc. 3: 91. 1890.

Herbs low, nearly stemless. Leaves alternate; petiole long; lanceolate to oblong-lanceolate, pinnatisect. Flowers axillary; pedicel long. Corolla large; galea falcate, apex usually acute, beakless.

Three species: one in the Pan-Himalaya; also in Europe and NE Asia.

124. *Pedicularis artselaeri* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 24: 84. 1878; Li, Proc. Acad. Nat. Sci. Philad. 101: 159. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 86. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 119. 1998. Type: China, Hebei, Zhangjiakou, collected in 1876, collector unknown (syntypes: LE).

Herbs perennial, 3–12 cm tall, slightly black when dry. Roots fleshy. Stems 1 to several together, delicate, enveloped in lanceolate to ovate, membranous scales, pubescent. Petiole 5.5–9 cm long, delicate, diffuse, densely tomentose; leaf blade oblong-lanceolate, 7–10 cm long, 2–2.5 cm wide, abaxially rust colored pubescence along veins, adaxially sparsely long-pubescent; segments 8–14 pairs, ovate, pinnatipartite, incised-dentate. Pedicel up to 10 cm long, slender, curved, and villous. Calyx 12–18 mm long; lobes 5, more or less equal in size, leaflike. Corolla purple, 30–40 mm long; tube erect, slightly longer than 1.5 times as long as calyx; galea 11–13 mm long, apex acute or obtuse; lower lip slightly longer than galea, lobes rounded, more or less equal in size. Filaments pubescent. Capsule completely enclosed by calyx, ovoid, ca. 13 mm long.

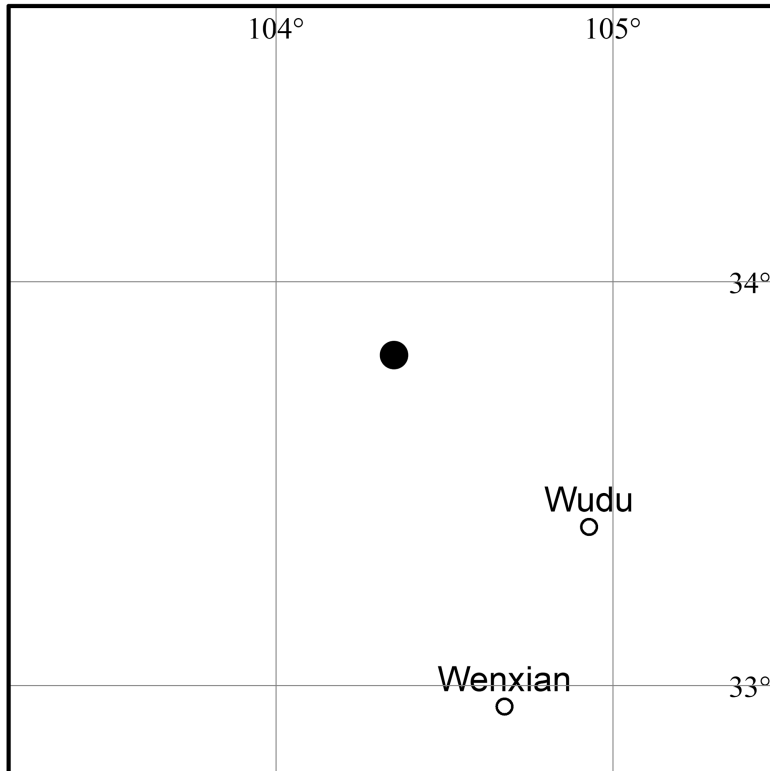
Phenology: flowering and fruiting from May to August.

Habitats: moist places, rocky slopes, forests; 1000–2800 m.

Distribution: N Hengduan [Map 45(2)–124]; also in Beijing, Hebei, Hubei, Shaanxi, Shanxi, NE Sichuan of China.

Notes: When Maximowicz (1878) described *P. artselaeri* Maxim. as new, he provided information “Mongolia orientali australi: Siwantze non procul ab oppido Kalgan (rev. Pat. Artse-laer sp. 1. legit 1876).”, which is now known as Wanquan Distr., Zhangjiakou, Hebei Province, China. A sheet in the herbarium LE noted as type matches well the record and it should be the holotype. Forbes & Hemsley (1890. J. Linn. Soc. Bot. 26: 205) cited two collections, one was collected by *Moellendorff ex. Maximowicz* from Xiaowutai Shan, and the other was collected by *A. Henry (No. 5326)* from Hubei Province. *Henry 5326* and the holotype were mounted on the same sheet, but the former is not a type collection.

N HENGDUAN: Zhugqu, Chagang, 1600 m, 26 May 1999, *Bailongjiang Exped. 1410* (PE).



Map 45(2)-124: *Pedicularis artselaeri* Maxim.

Ser. 44. *Pseudo-oederianae*

Ser. *Pseudo-oederianae* H. Limpr., Repert. Spec. Nov. Regni Veg. 20: 217. 1924. Type: *Pedicularis pseudoversicolor* Hand.-Mazz.

Herbs less than 15 cm tall. Roots fusiform and fleshy. Leaves alternate. Basal leaves numerous; petiole long; leaf blade pinnatisect. Inflorescences more than 1/2 height of plant, centrifugal. Calyx lobes 5. Corolla tube decurved; galea with 1 marginal tooth near apex, beakless.

Two species; both endemic to the Pan-Himalaya.

Notes: The series *Pseudo-oederianae* H. Limpr. is closely related to the series *Flammeae* Prain and *Rhynchodontae* Prain. It differs from the series *Flammeae* in galea with one marginal tooth near apex and differs from the series *Rhynchodontae* in galea projected into a broad beaklike apex, with several marginal teeth on each side.

- 1a. Corolla yellow with purple-red galea; corolla lip ciliate..... 125. *P. pseudoversicolor*
- 1b. Corolla red throughout; corolla lip not ciliate..... 126. *P. habachanensis*

125. *Pedicularis pseudoversicolor* Hand.-Mazz.,
Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl.
57: 104. 1920; Tsoong in Chien & Chun, Fl.

Reipubl. Popularis Sin. 68: 337. 1963; Yang,
Holmgren & Mill in Wu & Raven (eds.), Fl.
China 18: 197. 1998. Type: China, Yunnan,

Shangri-la (Zhongdian), 4450–4650 m, 11 Aug. 1914, *H. R. E. von Handel-Mazzetti* 4705 [holotype: WU(WU0060217)].

Herbs perennial, 5–15 cm tall, black when dry. Roots numerous, more or less fusiform, 10–15 cm long, 7 mm in diameter. Stems usually single, stout, and pubescent. Basal leaf petiole 1.5–3 cm long; leaf blade lanceolate, 2–6 cm long, 0.6–1.2 cm wide, abaxially white-scurfy, tinged purple along veins, pinnatisect; segments 11–18 pairs, oblong or obovate, sparsely ciliate, incised-dentate; cauline leaves 1–3 or absent, alternate. Inflorescences 3–10 cm long, dense; proximal bracts leaflike, pubescent; pedicels up to 4 mm or almost absent, wide. Calyx 10–12 mm long; lobes 5, lateral lobes ca. 1/2 as long as tube, unequal in size. Corolla yellow, with purple-red galea, 20–28 mm long; tube slightly bowed and expanded apically, slightly longer than calyx; galea bent apically, 10–14 mm long; lower lip shorter than galea, sparsely ciliate. Filaments 2 pubescent apically, 2 glabrous throughout. Figure 45(2)–55.

Phenology: flowering from June to August.

Habitats: alpine meadows; 4300–4600 m.

Distribution: endemic; S Hengduan [Map 45(2)–125].

Notes: Our molecular phylogenetic results reveal that two individuals of *P. pseudoversicolor* Hand.-Mazz. are clustered into one clade including individuals of *P. flammea* L. and its close relatives. Morphologically, *P. pseudoversicolor* is similar to the next species *P. habachanensis* Bonati. Further studies are necessary to clarify the taxonomic confusion.

S HENGDUAN: Dêqên, Jiansheju, 3600 m, Aug. 1935, *C. W. Wang* 68981 (PE, KUN). **Shangri-la** (Zhongdian), Xiaozhongdian, Habaxue Shan, 4200–4500 m, 22 June 1915, *H. R. E. von Handel-Mazzetti* 6898 (K); Shangri-la (Zhongdian), Jianrentung, 3600 m, 12 June 1937, *T. T. Yü* 12135 (PE); Shangri-la (Zhongdian), Chungtian plateau, 3300 m, 5 July. 1939, *K. M. Feng* 1476 (PE); Shangri-la (Zhongdian), Hongshan forest farm, 3600 m, 15 June 1981, *Qinghai-Xizang Exped.* 1085 & 1509 (PE); Shangri-la (Zhongdian), Daxue Shan, 4270 m, 24 June 1989, *Z. D. Fang* 1213 (SABG); Shangri-la

(Zhongdian), Geza to Langdu, 4400–4500 m, 26 June 1988, *Z. D. Fang & X. H. Li* 0751 (SABG). **Weixi**, Tungchuling, Sungyenka, 4000 m, 12 July 1937, *T. T. Yü* 8956 (PE); Weixi, Tungchuling, Sungyenka, 4000 m, 12 July 1937, *T. T. Yü* 8956 (PE); Weixi, Tungchuling, Chenchiao, 4000 m, 15 July 1937, *T. T. Yü* 9033 (PE); Weixi, Kangpu, 4000 m, 23 June 2016, *Z. D. Fang* DJDC-566 (SABG); Weixi, Yezhi, 3600 m, Aug. 1935, *C. W. Wang* 68382 (PE). **Yulong** (Lijiang), yongning (no more detailed information), 1933, *McLaren* 106 (K).

126. *Pedicularis habachanensis* Bonati, Notes Roy. Bot. Gard. Edinb. 15: 151. 1926; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 338. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 197. 1998. Type: China, Yunnan, Shangri-la (Zhongdian), Habaxueshan, 4267 m (14000 ft), *J. F. Rock* 9683 [holotype: E(E00438449); isotypes: BM(BM001010986), NY(00090931, 00090932)].

Herbs perennial, 8–15 cm tall, black when dry. Rhizome 1.5–3 cm long, branched, fusiform, 10–15 cm long. Stems single to several, erect, unbranched, with lines of hairs. Basal leaf petiole 2.5–4 cm long, fleshy, glabrous; leaf blade linear to elliptic-oblong, 3–4 cm long, 0.8–1.2 cm wide, pinnatisect; segments 8–23 pairs, triangular or more or less ovate-oblong, pinnatifid, incised-dentate; cauline leaves few, alternate. Inflorescences; subcapitate, with dense flowers; proximal bracts linear. Flowers short-pedicellate. Calyx 10–12 mm long; lobes 5, unequal in size, long ciliate. Corolla red throughout; tube 10–12 mm long; galea ca. as long as tube, slightly falcate; lower lip much shorter than galea. Filaments 2 densely pubescent, 2 glabrous.

Phenology: flowering in July.

Habitats: alpine swampy meadows; 4100–4600 m.

Distribution: endemic; S Hengduan [Map 45(2)–126].

Notes: Tsoong (1963. Fl. Reipubl. Popularis Sin. 68: 339) described *P. habachanensis* subsp. *multipinnata* P. C. Tsoong as new based on one collection from NW Yunnan, China. He stated

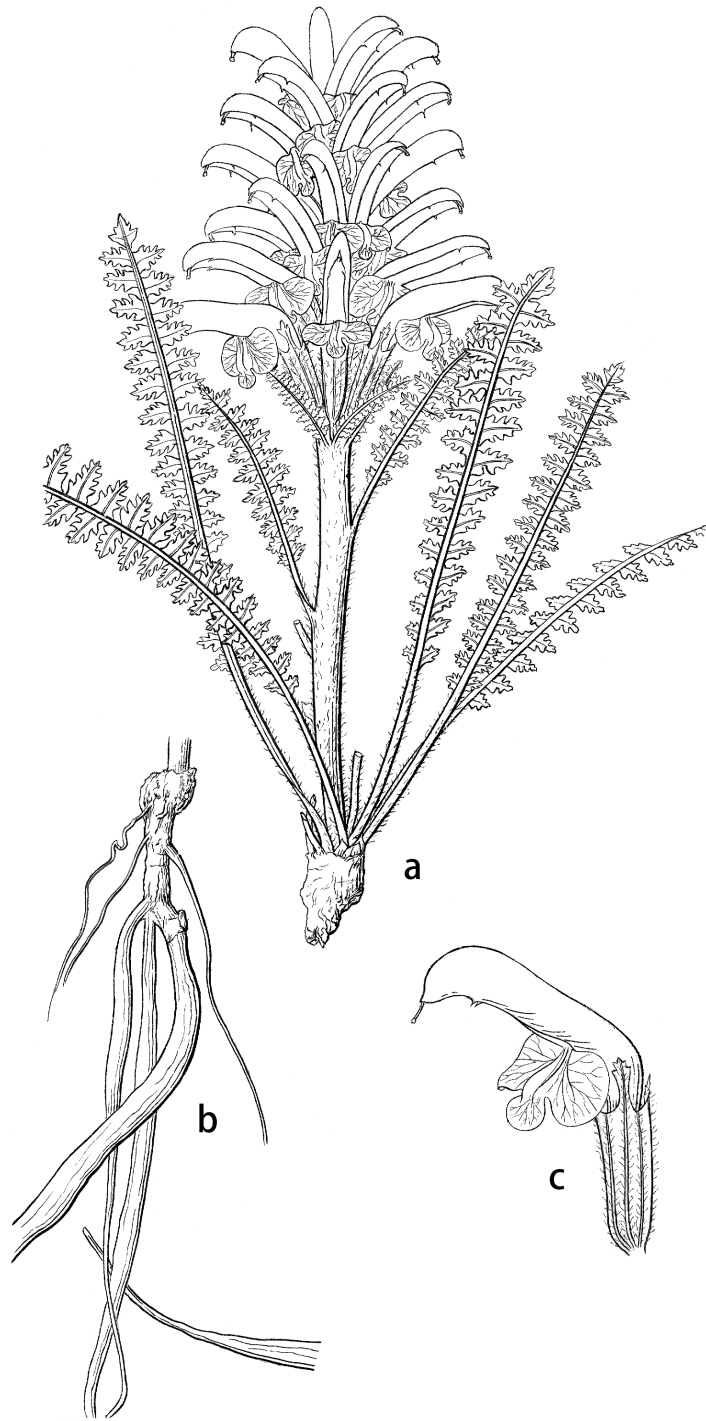
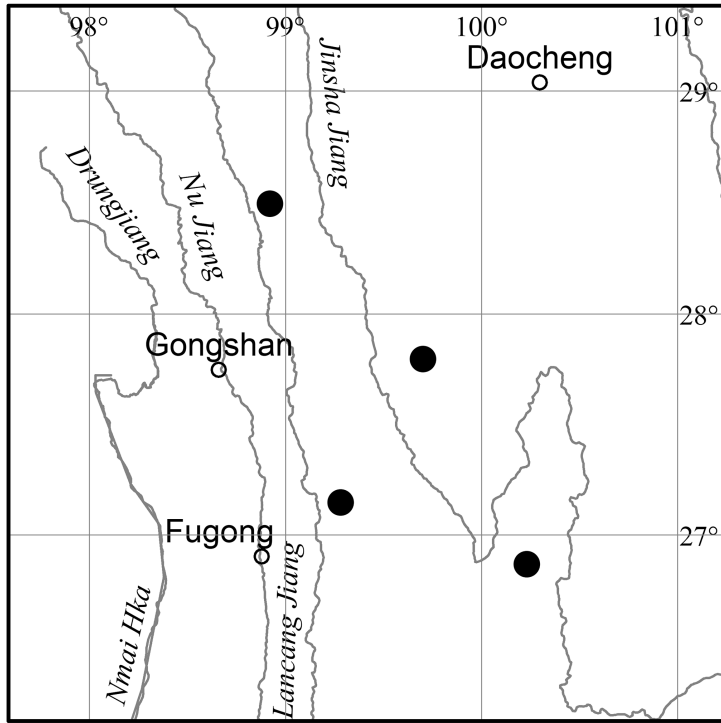
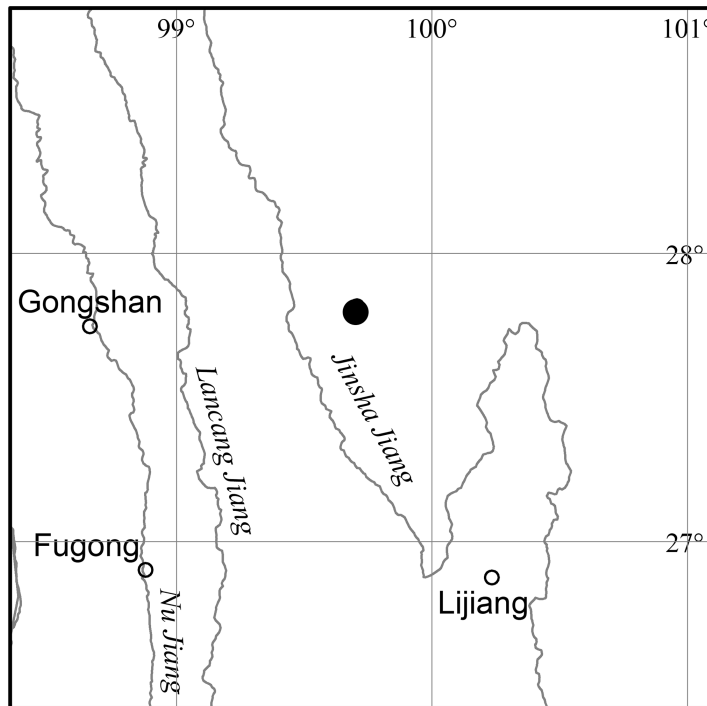


Figure 45(2)–55: *Pedicularis pseudoversicolor* Hand.-Mazz. a, habit; b, root; c, flower. Drawn by F.-X. WANG [*Fl. Reipubl. Popularis Sin.* 68: 337, figure 77: 1-3. 1963].



Map 45(2)-125: *Pedicularis pseudoversicolor* Hand.-Mazz.



Map 45(2)-126: *Pedicularis habachanensis* Bonati

that it differs from *P. habachanensis* Bonati in leaf with more segments (13–23). We find that *P. habachanensis* subsp. *multipinnata* is characterized by long petiole, linear blade, and long gill-like leaves (linear-oblong, simple pinnatifid, oval segments with rounded dentations). These diagnostic traits point it to *P. oederi* Vahl. Hence, *P. habachanensis* subsp. *multipinnata* is here transferred to the series *Flammea* and treated as a new synonym of *P. flammea* L.

S HENGDUAN: Shangri-la (Zhongdian), Xiaozhongdian, Habaxue Shan, 3650 m, 16 June 1936, *T. T. Yü 11632* (PE00033146, PE00119010, PE00119011); Shangri-la (Zhongdian), Habaxue Shan, 4300 m, 3 July 1987, *Z. D. Fang & J. H. Mu 0046* (SABG); Shangri-la (Zhongdian), Habaxue Shan, N of Likiang city, July 1923, *J. F. Rock 9683* (N).

Ser. 45. Rhynchodontae

Ser. Rhynchodontae Prain, Hooker's Icon. Pl. 23: t. 2290. 1894.

Roots fusiform. Leaves almost all basal; leaf blade pinnatisect. Inflorescences centrifugal. Calyx lobes 5. Corolla large; galea projected into a broad beaklike apex, with several marginal teeth on each side.

One species; endemic to the Pan-Himalaya.

Notes: Our molecular phylogenetic results indicate that the series *Rhynchodontae* is closely related to the series *Flammeae* Prain and *Filiculae* H. L. Li.

127. Pedicularis rhynchodonta Bureau & Franch., J. Bot. (Morot) 5: 108. 1891; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 339. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 198. 1998. Type: China, Sichuan, Kangding (Tatsien-lou), collected in 1890, *Prince Henri d'Orléans s.n.* [lectotype designated by Yu *et al.* (2015: 145): P(P02968591)].

Herbs perennial, 10–20(–30) cm tall, black when dry. Roots fascicled, fleshy, more or less fusiform. Stems dark purple, shiny, pubescent when young, glabrescent. Leaves mostly basal, in a rosette; petiole 2–7 cm long; leaf blade linear-oblong to lanceolate-oblong, 3–11 cm long, abaxially sparsely long-pubescent, adaxially glabrous, pinnatisect; segments 12–26 pairs, triangular to ovate-oblong, pinnatifid to incised-dentate; cauline leaves few, alternate, smaller than basal leaves. Inflorescences 3–9 cm long; bracts slightly longer than calyx; pedicels short, sparsely pubescent. Calyx 8–11 mm long, slightly cleft anteriorly; lobes 5, more or less equal in size, serrate. Corolla purple-red, 20–25 mm long; tube ca. as long as calyx; galea bent apically, 10–12 mm long, truncate, proximal teeth most

distinct and longest; lower lip slightly shorter than galea, praemorse-serrulate and ciliate. Filaments 2 pubescent, 2 glabrous. Capsule lanceolate-ovoid, 11–14 mm long. Figure 45(2)–56.

Phenology: flowering from May to June.

Habitats: alpine meadows, grassy slopes; 3700–4700 m.

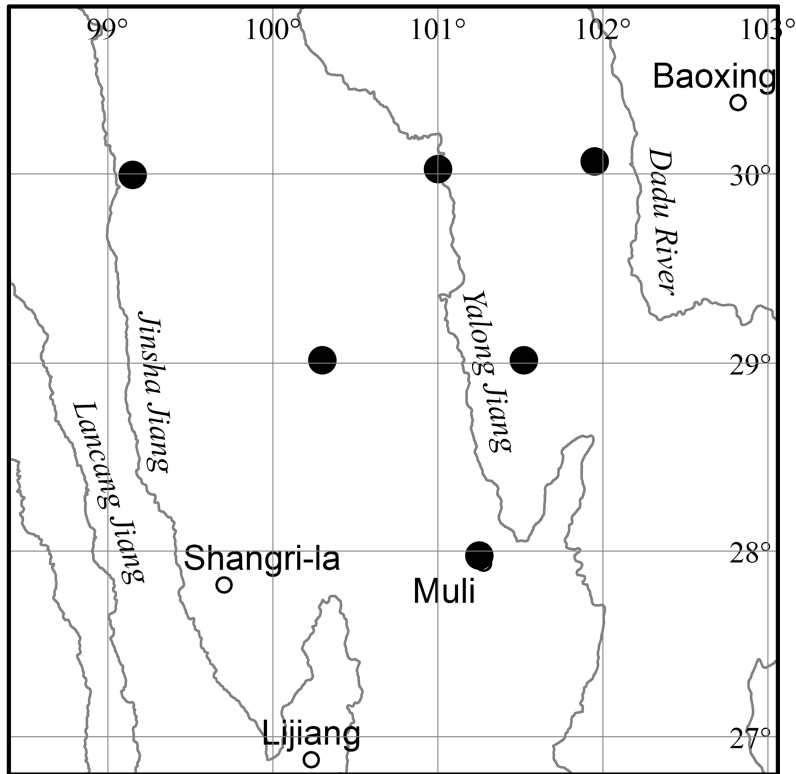
Distribution: endemic; N Hengduan, S Hengduan [Map 45(2)–127].

Notes: Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 96) described *P. rhynchodonta* fo. *maxima* Bonati as new, which has flowers about the same size as those of typical form (*P. rhynchodonta* fo. *typica* H. L. Li), but it is much larger in its vegetative parts with stems up to 30 cm tall and leaves up to 18 cm long. Our molecular phylogenetic results reveal that seven accessions of *P. rhynchodonta* form a well-supported clade sister to *P. filicula* Franch. ex Maxim.

N HENGDUAN: Batang, Haizi Shan, 4500 m, 4 July 1980, *X. H. Hu 28201* (CDBI). **Yajiang,** Jianziwan Shan, 4200 m, 20 June 1983, *Hengduan Shan Veg. Exped. 4236* (PE); Yajiang, Zihemayan Shan, 4100 m, 7 June 1961, *S. Jiang 5085* (PE). **S HENGDUAN:** Daocheng, Gongga



Figure 45(2)–56: *Pedicularis rhynchodonta* Bureau & Franch. a, habit; b, flower. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 339, figure 78: 1-2. 1963].



Map 45(2)-127: *Pedicularis rhynchodonta* Bureau & Franch.

Shan, Jiamairongfeng, 4500 m, 29 Aug. 1981, *Qinghai-Xizang Exped.* 5554 (PE); Daocheng, Bowa Shan, 3800 m, 2 July 1982, *T. C. Wei & X. H. Hu 30023* (CDBI); Daocheng, Bowa Shan, 4220 m, 2 June 1980, *X. H. Hu 28137* (CDBI); Daocheng, Haizi Shan, 4550 m, 2 June 1980, *X. H. Hu 28154* (CDBI); Daocheng, Haizi Shan, 4530 m, 31 July 2001, *F. S. Yang 2048* (PE);

Daocheng, near the city, 3800 m, *T. C. Wei & X. H. Hu 30023* (CDBI). **Jiulong**, 4070 m, 15 June 1960, *Z. T. Guan 22-0618* (PE). **Kangding**, 4000 m, 24 July 1934, *H. Smith 10686* (PE); Kangding, Zheduo Shan, 4300 m, 25 July 2001, *F. S. Yang 2012* (PE). **Muli**, 3900 m, 13 June 1937, *T. T. Yü 6193* (PE); Muli, Ma-chin, Ching-chung, 3750 m, 21 June 1937, *T. T. Yü 6515* (PE).

Ser. 46. Filiculae

Ser. Filiculae H. L. Li, *Proc. Acad. Nat. Sci. Philad.* 101: 9. 1949.

Herbs mostly low. Roots fleshy. Leaves almost all basal; cauline leaves alternate; petiole long; blade pinnatifid to pinnatisect. Inflorescences racemose, centrifugal, or flower axillary. Calyx 5-lobed. Corolla large; tube less than 2 times as long as calyx; beak short, sometimes dentate apically; lower lip often less than 12 mm wide.

Eight species; seven in the Pan-Himalaya (7 endemics).

Notes: *Pedicularis anomala* P. C. Tsoong & H. P. Yang is transferred to the series *Strobilaceae* P. C. Tsoong from the series *Filiculae* and treated as a new synonym of *P. strobilacea* Franch. Our molecular phylogenetic results indicate that the series *Filiculae* is closely related to the series *Flammeae* and *Pseudo-oederianae*.

- 1a. Petiole 2–4 times longer than blade; corolla galea decurved at middle, rectangle 128. *P. tantalorhynchoides*
- 1b. Petiole usually less than 2 times long than blade; corolla galea more or less falcate.
 - 2a. Leaf segments 10–25 pairs (*P. tsangchanensis* 6–11 pairs, but calyx 10–11 mm long); calyx 10–15 mm long.
 - 3a. Corolla yellow, with purple beak; corolla tube 30–35 mm long..... 129. *P. lecomtei*
 - 3b. Corolla purple–red; corolla tube 20–30 mm long.
 - 4a. Leaf segments 6–11 pairs; corolla surface sparsely pubescent..... 130. *P. tsangchanensis*
 - 4b. Leaf segments 10–25 pairs; corolla surface glabrous.
 - 5a. Corolla lip ciliate; filaments 2 pubescent, 2 glabrous..... 131. *P. filicula*
 - 5b. Corolla lip not ciliate; filaments all pubescent 132. *P. wallichii*
 - 2b. Leaf segments 3–13 pairs; calyx 5–7 mm long.
 - 6a. Leaf blade oblong, pinnatisect 133. *P. filiculiformis*
 - 6b. Leaf blade lanceolate-oblong, pinnatipartite..... 134. *P. takpoensis*

128. *Pedicularis tantalorhynchoides* P. C. Tsoong, Acta Phytotax. Sin. 3. 285, 322. 1955. Type: China, Bomi, Pasum Chu, Ba La, 4720 m, 27 June 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 14025* [holotype: BM(BM000847080); isotype: E(E00284044)].

Herbs perennial, 4–20 cm tall. Roots thick, fleshy, straight, 15–30 cm long, and sparsely branched. Stems branched below, simple, erect, sparsely pubescent. Leaves alternate, barely all basal; petiole slender, 5–7 cm long, glabrous; leaf blade linear, 3–3.5 cm long, 1.1–1.8 cm wide, pinnatipartite to pinnatisect, lobes 5–10-paired, ovate. Inflorescences in terminal racemes; bracts leaf-like. Calyx tube 5–7 mm long, sparsely hairy, 5-lobed, posterior one small, lanceolate, entire, lateral lobes oblong, stipitate. Corolla tube straight, 8–13 mm long, glabrous; galea decurved at the middle, glabrous, erect part 3–4 mm long, arched part 4–5 mm long, gradually narrowing into a beak, 4–6 mm long; lower

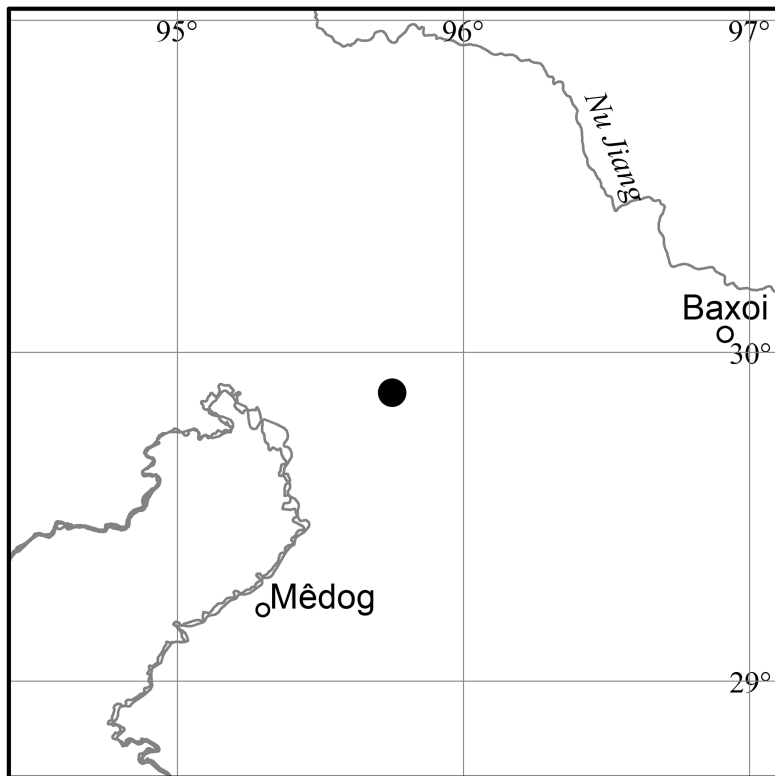
lip broad, 8–10 mm long, 11–13 mm wide, pilose on margins, 3-lobed, middle lobe broad oval, 4 mm long and 5–6 mm wide. Filaments 2 densely pilose, 2 glabrous. Capsule oblong-lanceolate, acuminate at apex, 10 mm long, 4–5 mm wide.

Phenology: flowering in July.

Habitats: on steep and grassy slopes; 4000–4800 m.

Distribution: endemic; L Yarlung Zangbo [Map 45(2)–128].

Notes: Tsoong described *P. tantalorhynchoides* P. C. Tsoong as new based on three collections from SE Tibet and placed it in the series *Tantalorhynchae* P. C. Tsoong ex H. B. Yang. However, it was neglected in both *Fl. Reipubl. Popularis Sin.* and *Fl. China*, in which *Tantalorhynchae* is a monospecific series including only *P. tantalorhyncha* Franch. ex Bonati. It resembles *P. tantalorhynchoides* P. C. Tsoong but differs in opposite or verticillate leaves and



Map 45(2)-128: *Pedicularis tantalorhynchoides* P. C. Tsoong

flowers. Because *P. tantalorhynchoides* P. C. Tsoong is quite different from *P. tantalorhyncha* Franch. ex Bonati in alternate leaves and flowers, we placed it in the series *Filiculae* H. L. Li based on morphological similarity between *P. tantalorhynchoides* P. C. Tsoong and the species of the series *Filiculae*.

L YARLUNG ZANGBO: Bomi, Tsanang La, near Paka, 4267 m, *F. Ludlow*, *G. Sherriff* & *G. Taylor* 5874 (E00640500).

129. *Pedicularis lecomtei* Bonati, Bull. Soc. Bot. France 55: 543. 1908; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 341. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 198. 1998. Type: China, Yunnan, Heqing, “Ma-cul-chan”, 3500 m, 10 July 1889, *J. M. Delavay* 3755 [lectotype designated here: P(P00587595); isolectotype: P(P00587596)].

Herbs perennial, 5–12 cm tall, black when dry. Roots fascicled, fusiform. Stems unbranched, rust-colored villous. Leaves barely all

basal; petiole 3–4 cm long, pubescent; leaf blade oblong-lanceolate to linear-lanceolate, 3–5.5 cm long, 6–11 mm wide, abaxially densely white-scurfy, adaxially glabrescent, pinnatipartite; segments 10–20 pairs, ovate to long ovate, pinnatifid or incised-dentate. Inflorescences racemose, 4–5 cm long; proximal bracts leaflike; pedicels 1–1.5 cm long, slender, densely rust-colored villous. Calyx 10–15 mm long, villous, slightly cleft anteriorly; lobes 5, unequal in size, leaflike. Corolla yellow, with purple beak, 28–35 mm long; tube straight, 12–22 mm long, glabrous; galea more or less falcate apically; beak 1–3 mm long, indistinctly 1- or 2-toothed near apex; lower lip 9–12 mm long, 12–16 mm wide. The filament densely villous. Figure 45(2)–57.

Phenology: flowering from June to July.

Habitats: rocky slopes; 3500 m.

Distribution: endemic; S Hengduan [Map 45(2)–129].

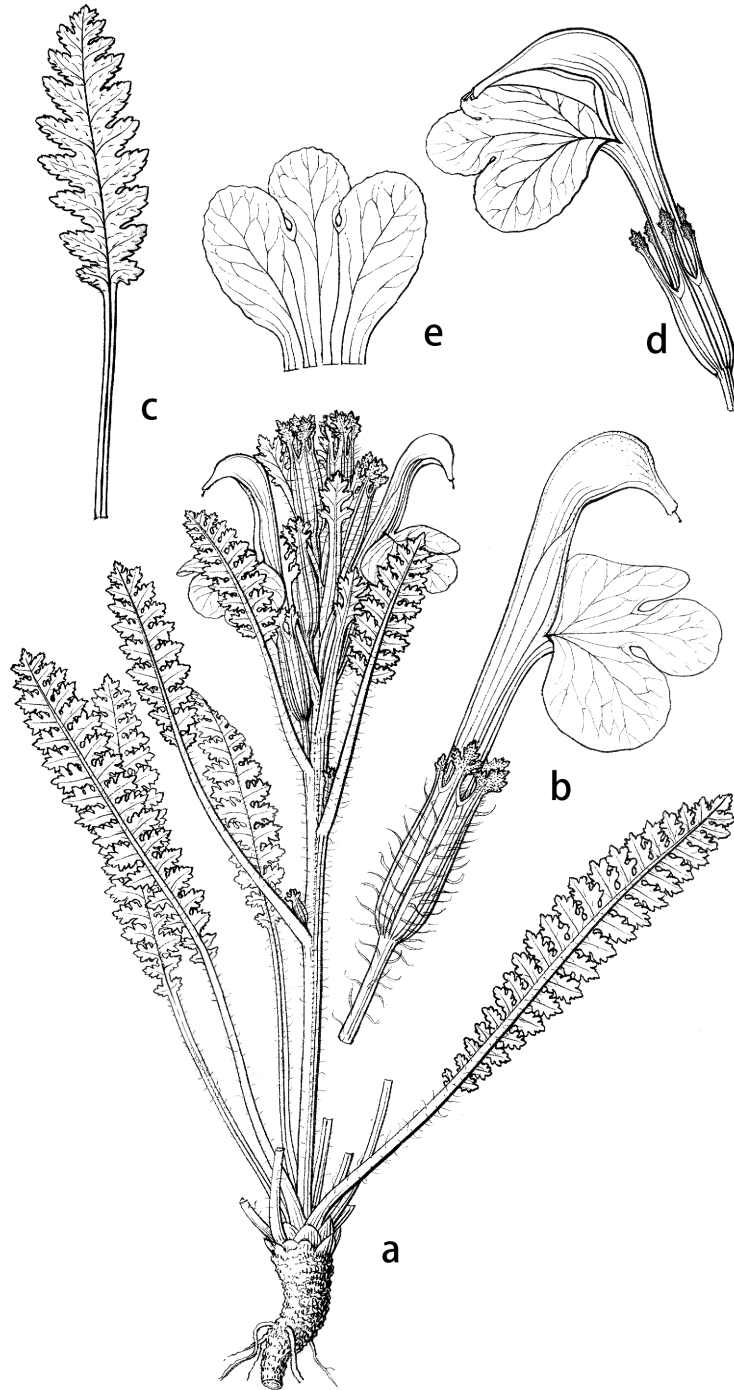
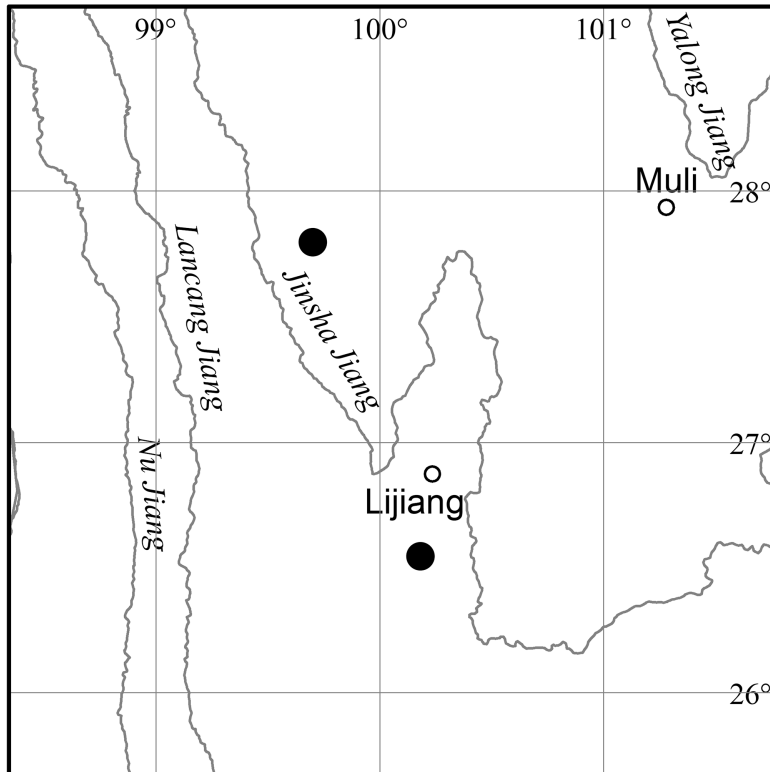


Figure 45(2)–57: ***Pedicularis lecomtei*** Bonati. a-b: a, habit; b, flower. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 341, figure 78: 3-4. 1963]. ***Pedicularis tsangchanensis*** Franch. ex Maxim. c-e: c, leaf; d, flower; e, corolla lip. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 344, figure 79: 4-6. 1963].



Map 45(2)-129: *Pedicularis lecomtei* Bonati

Notes: Our molecular phylogenetic results reveal that *P. lecomtei* Bonati is nested in a clade including *P. flammaea* L. and *P. oederi* Vahl. Morphologically, the former is quite different from the latter by falcate galea, obvious beak (2–2.5 mm), and 1- or 2-toothed near the apex. The incongruence between morphological and molecular data might reflect a complex reticulate evolutionary history between these closely related species. Two sheets of *J. M. Delavay 3755* in the herbarium P were labelled as “type”, one of which is selected as lectotype.

S HENGDUAN: Heqing, “Ma-cul-chan”, 3500 m, 10 July 1889. *J. M. Delavay 3755* (P, PE). **Shangri-la** (Zhongdian), Nixigongla to Dongwangsecang, 3960 m, 7 July 1989, *Z. D. Fang 0912* (SABG).

130. *Pedicularis tsangchanensis* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb.

32: 571. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 344. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 199. 1998. Type: China, Yunnan, Dali, Cang Shan, 4000 m, collected in 1884, *J. M. Delavay 1101* [**lectotype designated here:** P(P02968513); isolectotype: P(P02968512)].

Herbs perennial, 8–15 cm tall, black when dry. Roots linear, slightly fleshy. Stems usually 2 or 3, ascending, unbranched, more or less pubescent, with 1 or 2 lines of hairs. Basal leaf petiole 1–3 cm long, pubescent; leaf blade ovate-oblong to lanceolate-oblong, 3–4 cm long, 1–1.5 cm wide, adaxially slightly pubescent, abaxially densely long pubescence along midvein, pinnatifid to pinnatipartite; segments 6–11 pairs, crenate-dentate; cauline leaves alternate, sometimes pseudo-opposite, short-petiolate; leaf blade 1.5–3.5 cm long, 1–1.5 cm wide. Inflorescences racemose,

centrifugal; proximal bracts leaflike, distal ones linear, ca. as long as calyx; pedicels 0.5–1 cm at base, slender, pubescent. Calyx 10–11 mm long, slightly cleft anteriorly, densely pubescent; lobes 5, unequal in size, dentate. Corolla red, 25–30 mm long; tube erect, 15–18 mm long, sparsely pubescent; galea bent apically; beak 3–5 mm long, 2-cleft apically; lower lip 12–15 mm long, 14–17 mm wide, glabrous, erose-dentate. Filaments 2 pubescent, 2 glabrous. Figure 45(2)–57.

Phenology: flowering from June to July.

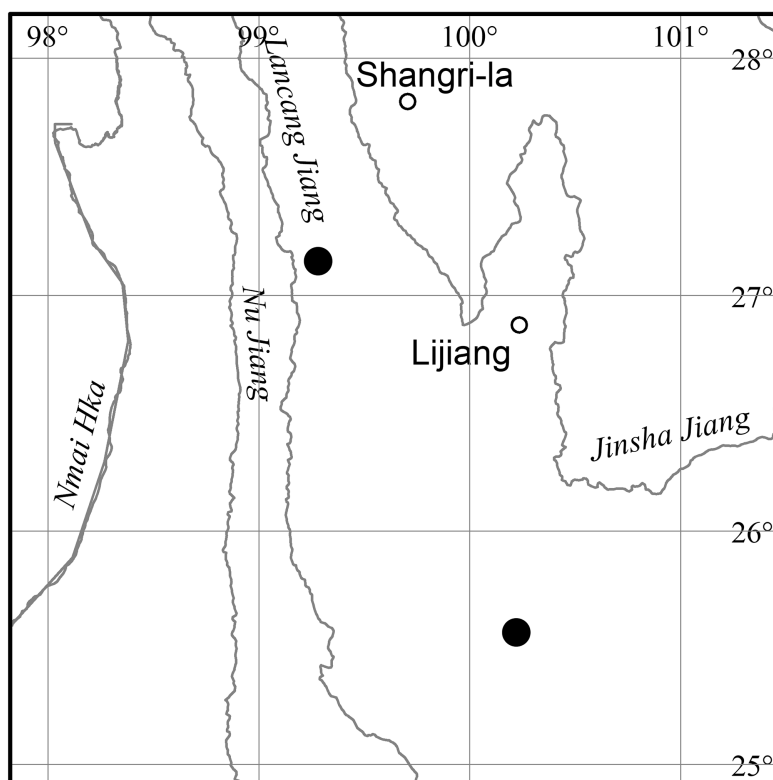
Habitats: rocky slopes; ca. 4000 m.

Distribution: endemic; S Hengduan [Map 45(2)–130].

S HENGDUAN: Dali, Cang Shan, Longquanfeng, 4000 m, July 1941, *H. C. Wang 1077* (KUN). Weixi, Tungchuling, Chenchiao, 4000 m, 15 July 1937, *T. T. Yü 9033* (IBSC0575038, PE00116699, PE00116629).

131. *Pedicularis filicula* Franch. ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 573. 1888; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 343. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 199. 1998. Type: China, Yunnan, Lijiang, July 1884, *J. M. Delavay Pedicularis No. 16* [**lectotype designated here:** P(P02985390); isolectotypes: P(P02985391), P(P02985393)].

Herbs perennial, 5–18 cm tall, dark black when dry. Roots fleshy, fusiform, fascicled. Stems 3 or 4 (up to 6), unbranched, with 2 or 3 lines of densely rust-colored hairs. Leaves mostly basal, usually in a dense rosette; petiole 2–4 cm long, sparsely pubescent apically; leaf blade linear-lanceolate, 2–6 cm long, 5–13 mm wide, adaxially glabrous, abaxially white-scurfy, pinnatisect; segments 10–25 pairs, lanceolate-ovate, margin



Map 45(2)–130: *Pedicularis tsangchanensis* Franch. ex Maxim.

double-dentate; cauline leaves few, smaller than basal leaves or absent. Inflorescences 2–3 (up to 10) cm, centrifugal, usually densely pubescent, with long rust-colored hairs; pedicels 1–3 mm long. Calyx 11–13 mm long; lobes 5, unequal in size, leaflike. Corolla purple-red; tube ca. as long as calyx; galea bent at a right angle apically; beak 3–4 mm long, truncate apically, denticulate; lower lip 8–11 mm long, ciliate, erose. Filaments glabrous or anterior 2 sparsely pubescent. Capsule oblong, 9–12 mm long, 5 mm wide. Figure 45(2)–58.

Phenology: flowering and fruiting from May to July.

Habitats: alpine meadows; 2800–4900 m.

Distribution: endemic; S Hengduan [Map 45(2)–131].

Notes: Maximowicz did not cite the record number of *P. filicula* and only provided information “China: Yunnan, pratis alte alpinis prope glaciem Li-Kiang (*Delavay!* In herb. Paris)”. Hence, types are here designated based on this record. In addition, *P. filicula* var. *saganaica* Hand.-Mazz. [holotype: WU(WU0060229)] is different from the typical plants in shorter beaks and glabrous filaments.

S HENGDUAN: Muli, Kalk, 4475–4525 m, 30 July 1915, *H. R. E. von Handel-Mazzetti 7341* (WU); Muli, Mountains of Yetai, N of Kulu, 4030 m, May 1932, *J. F. Rock 23907* (NAS). **Shangri-la** (Zhongdian), Habaxue Shan, 3500 m, 1 June 1937, *T. T. Yü 11504* (PE, KUN). **Yulong** (Lijiang), Yulongxue Shan, *G. Forrest 5761* (K); Yulong (Lijiang), 3350–3650 m, June 1094, *G. Forrest 2460* (K); Yulong (Lijiang), 2800 m, June 1935, *C. W. Wang 71764* (NAS, PE); Yulong (Lijiang), 2500 m, July 1935, *C. W. Wang 70806* (PE); Yulong (Lijiang), Xuesong Cun, 2800 m, 18 Aug. 1937, *T. T. Yü 15540* (PE); Yulong (Lijiang), Xuesong Cun, 3000 m, 27 June 1939, *X. G. Zhao 30326* (PE); Yulong (Lijiang), Yangtze watershed, prefectural district of Likang, eastern slopes of Likang snow range, 4000 m, 25 May 1922, *J. F. Rock 3972* (PE).

132. *Pedicularis wallichii* Bunge ex Walp., *Repert. Bot. Syst* (Walpers). 3: 415. 1844; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.*

68: 342. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 198. 1998. ≡ *Pedicularis wallichii* Bunge, *Bull. Acad. Saint-Petersb.* 8. 251. 1841 (nom. nud). Type: Nepal, Gossain Than, *Wallich 416A* [lecto-type designated by Husain *et al.* (2010: 150): CAL].

Pedicularis wallichoides T. Yamaz., *J. Jap. Bot.* 46: 246. 1971. **syn. nov.** Type: Nepal, Central Nepal, Mul Karka, Chilime Khola, 3800–4000 m, 3 July 1970, *Kanai & Shakya 762247* [holotype: TI].

Pedicularis trichodonta T. Yamaz., *J. Jap. Bot.* 53: 325. 1978. **syn. nov.** Type: Nepal, E Nepal, Saju, Pokhari, 4000–4300 m, 16 June 1972, *H. Kanai, H. Ohashi, K. Iwatsuki et al. 72206* [holotype: TI].

Herbs perennial, 3.5–15 cm tall, black when dry. Roots fleshy, fusiform. Stems single, sparsely pubescent, unbranched. Basal leaves few, 1–4; petiole 2–6 cm long, sparsely pubescent; cauline leaves 1–3, petiole 1–6 cm long, sparsely pubescent; leaf blade linear-lanceolate, 1–3 cm long, 2.5–10 mm wide, glabrous or glabrescent on both surfaces, pinnatisect to pinnatifid; segments 9–25 pairs, ovate-lanceolate, sinuate-dentate. Inflorescences racemose, 1–5-flowered; bracts leaflike; pedicels short, less than 10 mm long. Calyx 8–13 mm long, glabrous, slightly cleft anteriorly; lobes 5, lanceolate, posterior one small, lanceolate, entire, lateral lobes oblong, obtuse at apex, crenate, pilose on margins. Corolla purple-red; tube 10–18 mm long, 2–3 mm wide, glabrous, sometimes with pilose lines above; galea decurved at middle, glabrous, erect part 6–8 mm long, arched part 8–9 mm long, 2–3 mm wide; beak 3–4 mm long, truncate, dentate and ciliate at apex; lower lip 12–14 mm long, 13–16 mm wide, glabrous, sinuate-dentate. Filaments all pilose. Capsule obliquely lanceolate, 14–20 mm long, 4–8 mm wide. Figure 45(2)–59.

Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; 3800–4800 m.

Distribution: endemic; W Nepal, C Nepal, E Nepal [Map 45(2)–132].

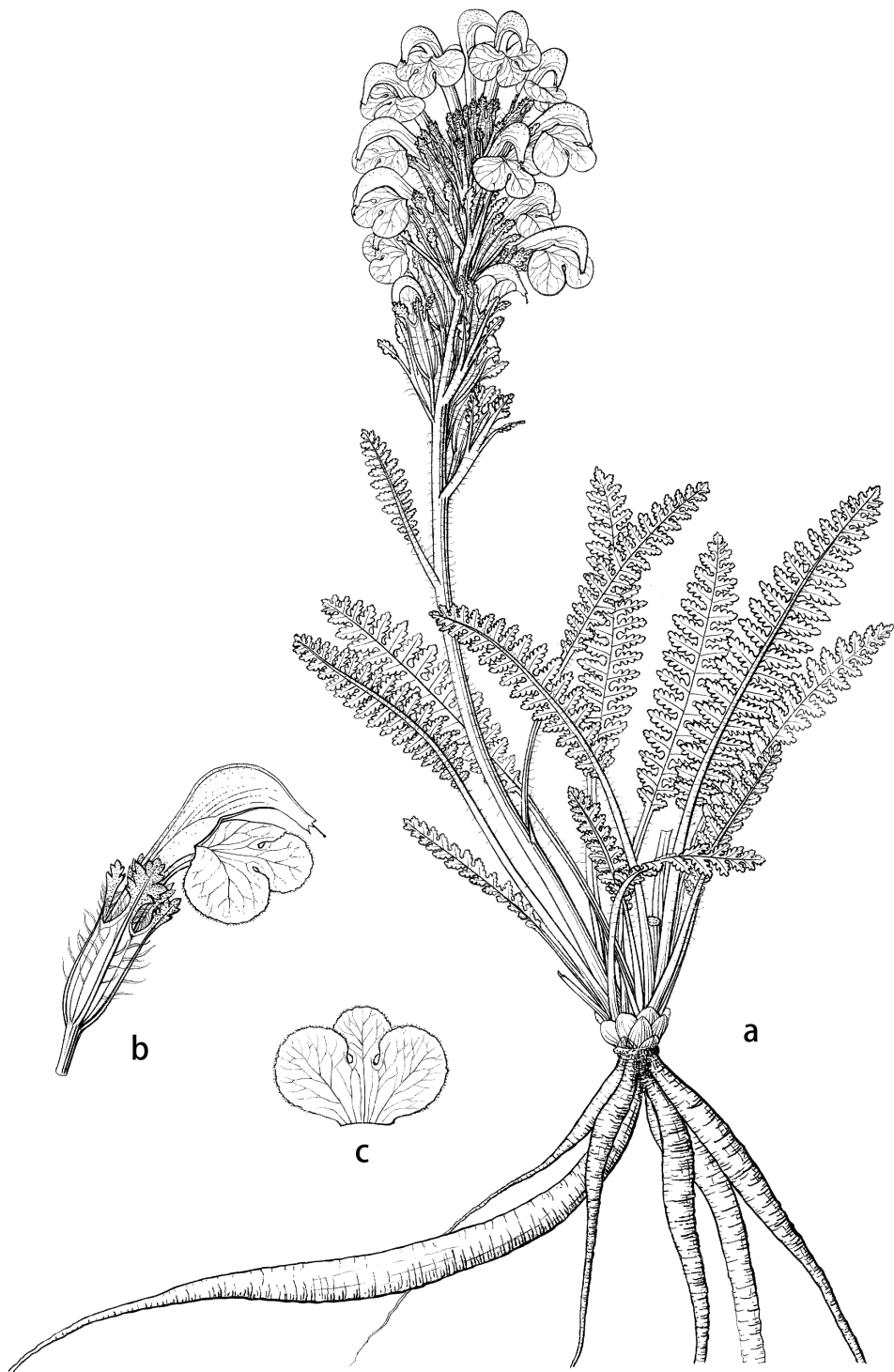
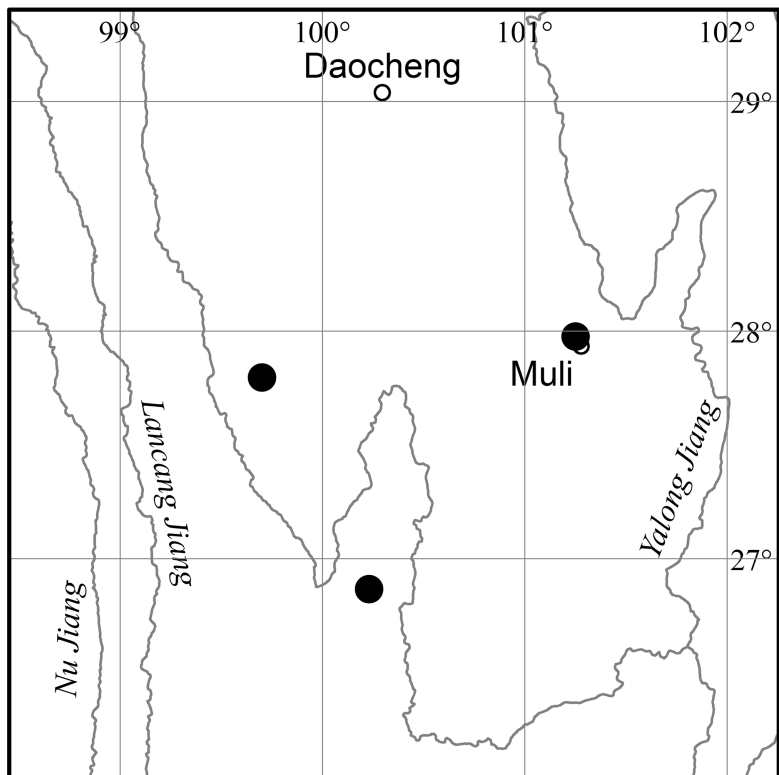


Figure 45(2)–58: **Pedicularis filicula** Franch. ex Maxim. a, habit; b, flower; c, corolla lip. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 343, figure 79: 1-3. 1963].



Map 45(2)-131: *Pedicularis filicula* Franch. ex Maxim.

Notes: Yamazaki described *P. wallichoides* as new based on several specimens from Central Nepal. In 1978, he re-treated the collections of this species as two “species”, i.e., specimens from Central and Western Nepal were treated as a synonym of *P. wallichii* Bunge ex Walp., while specimens from Eastern Nepal were treated as *P. trichodonta* T. Yamaz. He stated that the latter (lower lip of corolla denticulate on margin) differs from the former (lower lip of corolla entire or scatteringly dentate on margin). *Pedicularis wallichoides* and *P. trichodonta* are here treated as new synonyms of *P. wallichii* Bunge ex Walp., because there are no morphological gaps among these “species”.

W NEPAL: **Karnali,** Dolpa, Jangla Bhanjyang, 3900 m, 14 June 1973, *S. Einarsson, L. Skärby & B. Wetterhall* 654 (BM); Karnali, Jumla, Bhurchula Lekh, 4090 m, 13 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams*

4637 (BM). **C NEPAL:** **Bagmati,** Rasuwa, Langtang, 4700 m, June 1949, *O. V. Polunin* 622 (BM). **Dhawalagiri,** Mustang, Mukti-nath, 4550 m, 26 June 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 1461 (BM); Dhawalagiri, Myagdi, Sauwala Khola, 3640 m, 4 June 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 2979 (BM). **Gandaki,** Gorkha, Ganesh Himal, 4090 m, 11 July 1962, *J. D. A. Stainton* 3989 (BM); Gandaki, Lamjung, Rambrong Pass, 4090 m, 2 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 6061 (BM). **Janakpur,** Dolakha, Rolwaling, 4240 m, 4 July 1954, *J. D. A. Stainton* 4757 (E); Janakpur, Ramechhap, 4220–4500 m, 20 July 1985, *H. Ohba, T. Kikuchi, M. Wakabayashi et al.* 8570575 (BM). **E Nepal:** **Mechi,** Taplejung, Kangrang La, 4090 m, 18 June 1969, *L. H. J. Williams* 778 (BM); Mechi, Taplejung, Topke Gola, 4240 m, 4 July 1971, *L. W. Beer* 8279 (BM). **Kosi,** Sankhuwasabha, Lumbasumba Himal, 4550 m,

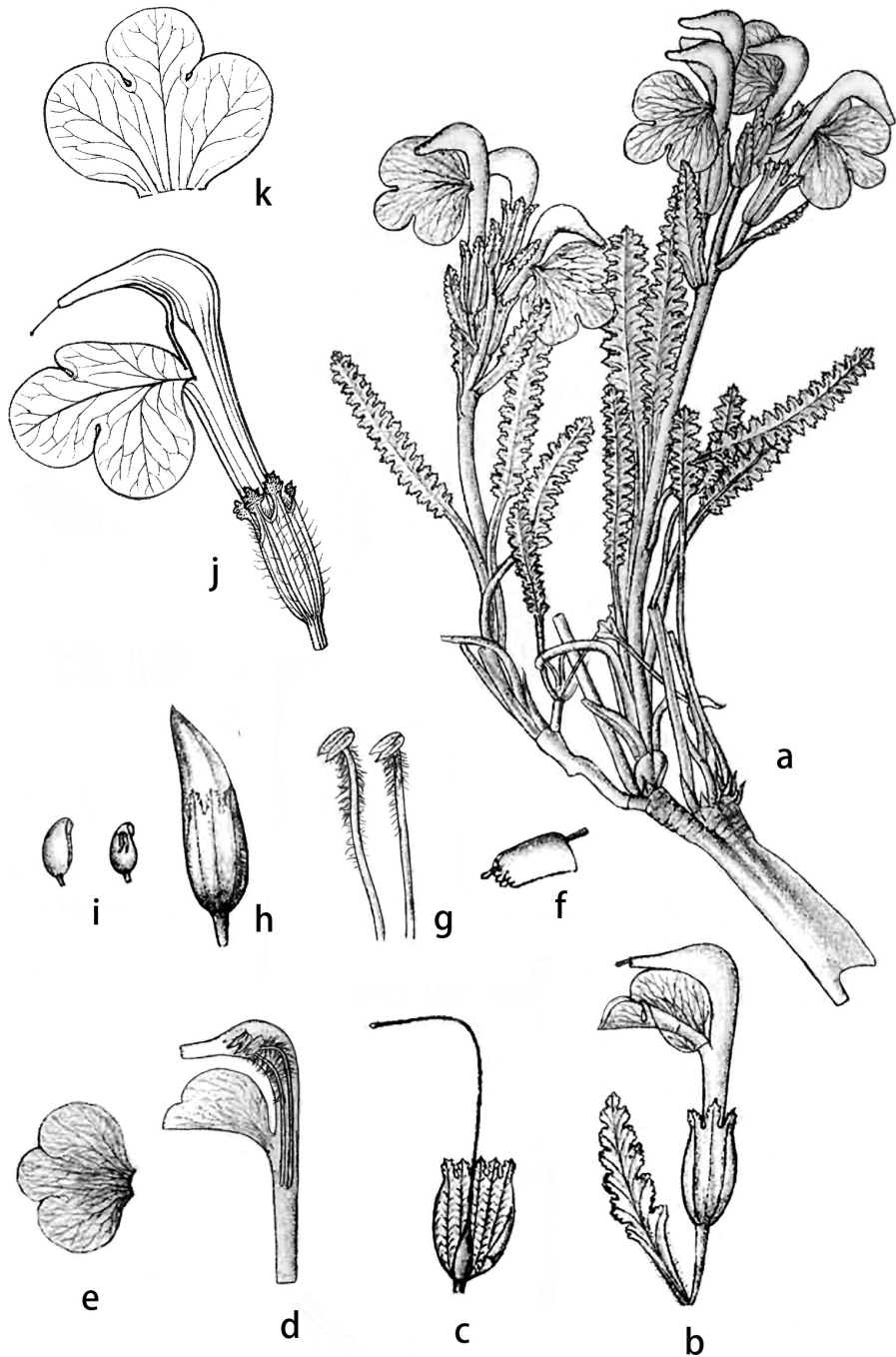
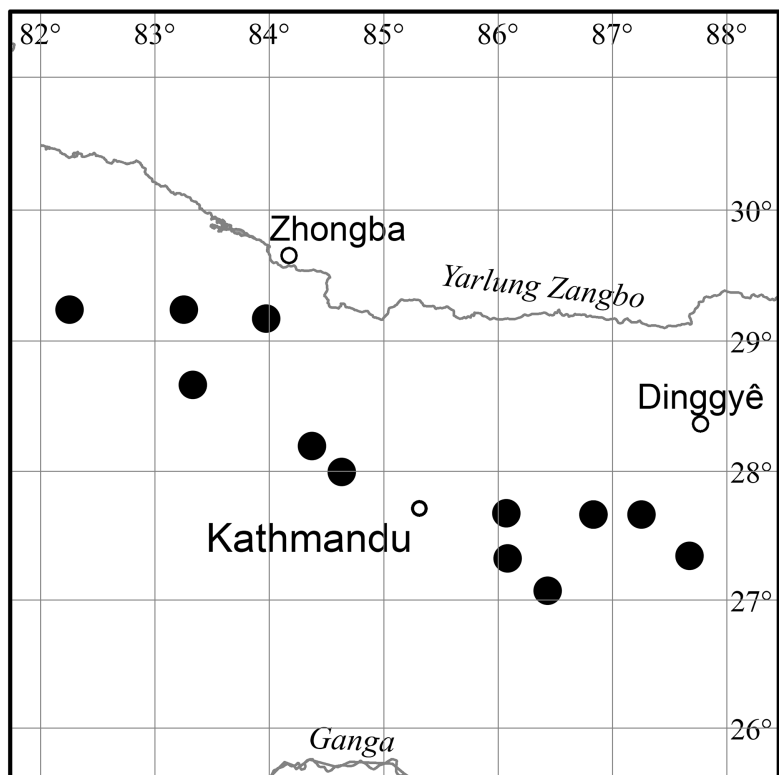


Figure 45(2)–59: *Pedicularis wallichii* Bunge ex Walp. a-i: a, flowering habit; b, flower; c, calyx; d, corolla; e, corolla lip; f, beak; g, stamen; h, capsule; i, seed. Modified from D. Prain [*Ann. Roy. Bot. Gard. Calc.* 3: 245, plate 17: 1-8. 1890]. *Pedicularis filiculiformis* P. C. Tsoong. j-k: j, flower; k, corolla lip. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 345, figure 79: 7-8. 1963].



Map 45(2)-132: *Pedicularis wallichii* Bunge ex Walp.

1971, *G. F. Smith 114* (BM). **Sagarmatha**, Solukhumbu, Inkhu Khola, 4090 m, 26 June 1964, *D. McCosh 285* (BM).

133. *Pedicularis filiculiformis* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 275. 1955; Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 345. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 200. 1998. Type: China, SE Tibet, Taktsang, Tsari, 4400 m, 22 June 1936, *F. Ludlow & S. Sherriff 2197* [holotype: BM(BM000885918); isotype: E(E00284057)].

Pedicularis filiculiformis var. *dolichorhyncha* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 275, 317. 1955. **syn. nov.** Type: Bhutan, Lema, 4420 m, 20 June 1949, *F. Ludlow, G. Sherriff & J. H. Hicks 20380* [holotype: BM(BM000885999); isotype: PE(00031289)].

Herbs perennial, 7–13 cm tall, glabrous, black when dry. Roots numerous, fleshy. Stems 1 to several, with dense, lanceolate, membranous scales at base. Leaves mostly basal; petiole 1.5–4 cm long, glabrous; leaf blade oblong, 0.7–3 cm long, 5–11 mm wide, adaxially glabrous, abaxially white-scurfy, pinnatisect; segments 6–13 pairs, oblong, margin double-dentate; cauline leaves 3 or 4, short-petiolate and smaller than basal leaves. Inflorescences racemose, ca. 10-flowered, centrifugal; bracts leaflike. Calyx 7–10 mm long; lobes 5, unequal in size. Corolla red, with deep red galea and yellowish-white throat, 18–22 mm long; tube erect, bent at a right angle apically, 14–15 mm long; galea more or less bent at a right angle apically; beak 3–4 mm long, slightly 2-cleft apically; lower lip 9–10 mm long, 9–12 mm wide. Filaments anterior 2 pubescent. Figure 45(2)–59.

Phenology: flowering and fruiting from June to August.

Habitats: shaded or damp places, rocky hill-sides; 4500–4700 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra, Bhutan [Map 45(2)–133].

Notes: Tsoong described *P. filiculiformis* var. *dolichorhyncha* P. C. Tsoong as new and stated that it differs from the typical plants in longer beak. Based on the original description and a survey of herbarium specimens, the length of beak varies between 4–5 mm (*P. filiculiformis*) to 4.5–5 mm (*P. filiculiformis* var. *dolichorhyncha*), and a number of flowers vary among individuals. There are no morphological gaps between the two taxa, and thus *P. filiculiformis* var. *dolichorhyncha* is here merged.

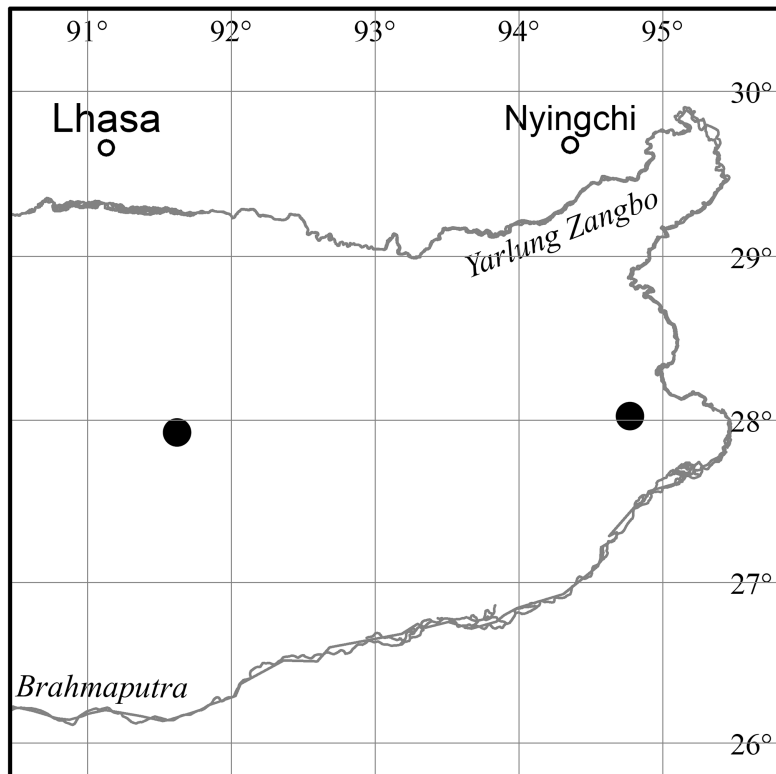
YARLUNG ZANGBO-BRAHMAPU-TRA: Tsari (Migyutin), 4400 m, 22 June 1936, *F. Ludlow & S. Sherriff* 2197 (E00284057).
BHUTAN: Shingbe, Me La, 4420 m, 20 June

1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 20380 (BM, PE).

134. *Pedicularis takpoensis* P. C. Tsoong, *Acta Phytotax. Sin.* 3: 276. 1955; Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 346. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 200. 1998. Type: China, SE Tibet, Chiniung La, Langong, 4420 m, 20 June 1938, *F. Ludlow, G. Sherriff & G. Taylor* 5614 [holotype: BM(BM000847079); isotype: PE(00032952)].

Pedicularis cacuminidenta T.Yamaz., *J. Jap. Bot.* 78: 74 (2003). **syn. nov.** Type: Bhutan, Lema, 4420 m, 20 June 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 20380 [holotype: BM(BM000885999); isotype: PE(00031289)].

Herbs perennial, 5–10 cm tall, black when dry. Roots fleshy. Stems usually numerous,



Map 45(2)–133: *Pedicularis filiculiformis* P. C. Tsoong

red, with 2 or 3 lines of sparse hairs. Basal leaves long-petiolate, glabrous; leaf blade lanceolate-oblong, 7–15 mm long, 3–5 mm wide, adaxially glabrous, abaxially white-scurfy, pinnatipartite; segments 7 or 8 pairs, crenate-dentate; cauline leaves smaller than basal leaves; segments 3–5 pairs. Inflorescences racemose, 7- or 8-flowered, centrifugal; bracts leaflike. Calyx tube 5–7 mm

long, slightly cleft anteriorly, pubescent; lobes 5, leaflike, unequal in size. Corolla red, with deep red galea apically and white throat, 18–22 mm long; tube 15–18 mm long, glabrous; galea more or less bent at a right angle apically; beak bent downward, straight, 5–6 mm long, slender; lower lip 9–10 mm long, 10–12 mm wide. Filaments anterior 2 slightly pubescent. Figure 45(2)–60.

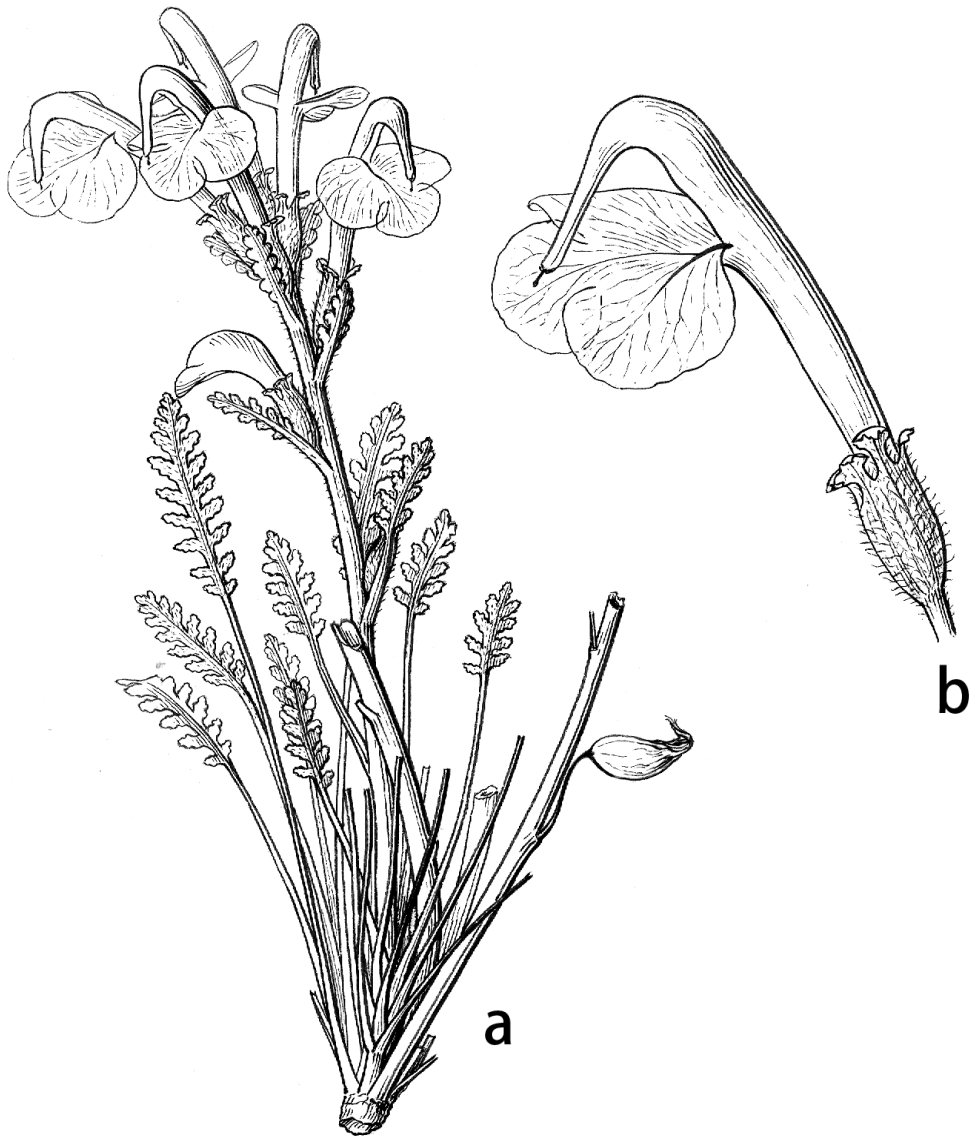
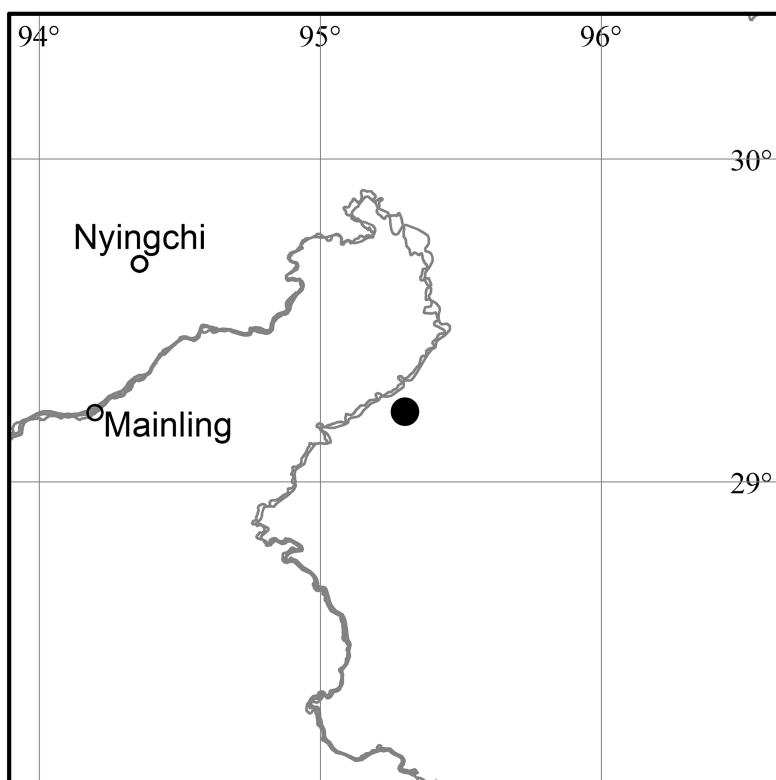


Figure 45(2)–60: *Pedicularis takpoensis* P. C. Tsong. a, habit; b, flower. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 346, figure 80: 3–4. 1963].



Map 45(2)-134: *Pedicularis takpoensis* P. C. Tsong

Phenology: flowering from June to July.

Habitats: open rocky slopes; ca. 4500 m.

Distribution: endemic; Yarlung Zangbo-Brahmaputra [Map 45(2)-134].

Yarlung Zangbo-Brahmaputra: Mêdog, Chiniung La, 4420 m, 20 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 5614* (BM).

Ser. 47. *Macrorhynchae*

Ser. *Macrorhynchae* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 9. 1949.

Stems single or few. Leaves almost all basal. Inflorescences long spicate, centrifugal. Calyx 5-lobed. Corolla tube less than 2 times as long as calyx; galea erect, more than 3 times as long as lower lip; beak long, more than 3 times as long as lower lip, slender, often S-shaped; lower lip very small.

One species; endemic to the Pan-Himalaya.

Notes: Our molecular phylogenetic results indicate that the series *Macrorhyncha* H. L. Li is closely related to the series *Flammeae* Prain and *Filiculae* H. L. Li.

135. *Pedicularis macrorhyncha* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 108. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 346. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 200. 1998. Type: China, Yunnan, Shangri-la (Zhongdian), 9 July 1939, *K. M. Feng 1595* [holotype: A(00097238); isotype: PE(00134089)].

Herbs perennial, 15–25 cm tall, black when dry. Roots numerous, fleshy, and more or less fusiform. Stems usually single, puberulent. Basal leaves few; petiole 1–2 cm long; leaf blade lanceolate-linear to lanceolate-oblong, 2.5–9 cm long, 0.4–2 cm wide, adaxially puberulent, abaxially pubescent along veins, pinnatisect; segments 10–18 pairs, ovate-lanceolate to lanceolate, margin double-dentate; cauline leaves few or absent, alternate or sometimes pseudo-opposite. Inflorescences centrifugal, 7–18 cm long; bracts leaflike; pedicels 1–3 mm long. Calyx tubular, 8–11 mm long, ca. 1/4 cleft anteriorly, pubescent; lobes 5, equal or slightly unequal in size, dentate. Corolla purplish-red, 30–35 mm long; tube erect at base, more or less bent at a right angle apically, 15–18 mm long;

galea erect; beak 16–20 mm long, S-curved; lower lip much shorter than galea, glabrous. Filaments all pubescent. Capsule narrowly triangular-ovoid, 14–17 mm long. Figure 45(2)–61.

Phenology: flowering and fruiting from May to September.

Habitats: alpine meadows, open hillsides; 3500–3800 m.

Distribution: endemic; S Hengduan [Map 45(2)–135].

Notes: *Pedicularis macrorhyncha* H. L. Li is nested in the clade of the series *Flammeae* in which relationships are poorly resolved.

S HENGDUAN: **Jianchuan**, Laojun Shan, June 2016, 3650 m, *F. S. Yang 2016-001* (PE); **Jianchuan**, Laojun Shan, 3600 m, *J. F. Rock 25092* (PE). **Shangri-la** (Zhongdian), on the open hillside, 3400 m, 9 July 1939, *K. M. Feng 1595* (PE); **Shangri-la** (Zhongdian), Kongsinshu, alpine grass slope, 3400 m, 26 June 1937, *T. T. Yü 11802* (PE00134087, PE00134088; KUN475406). **Yulong** (Lijiang), NE Likiang, Tzai-koo Snow Mt., on open pasture, 31 Aug. 1939, *R. C. Ching 21278* (PE, KUN).

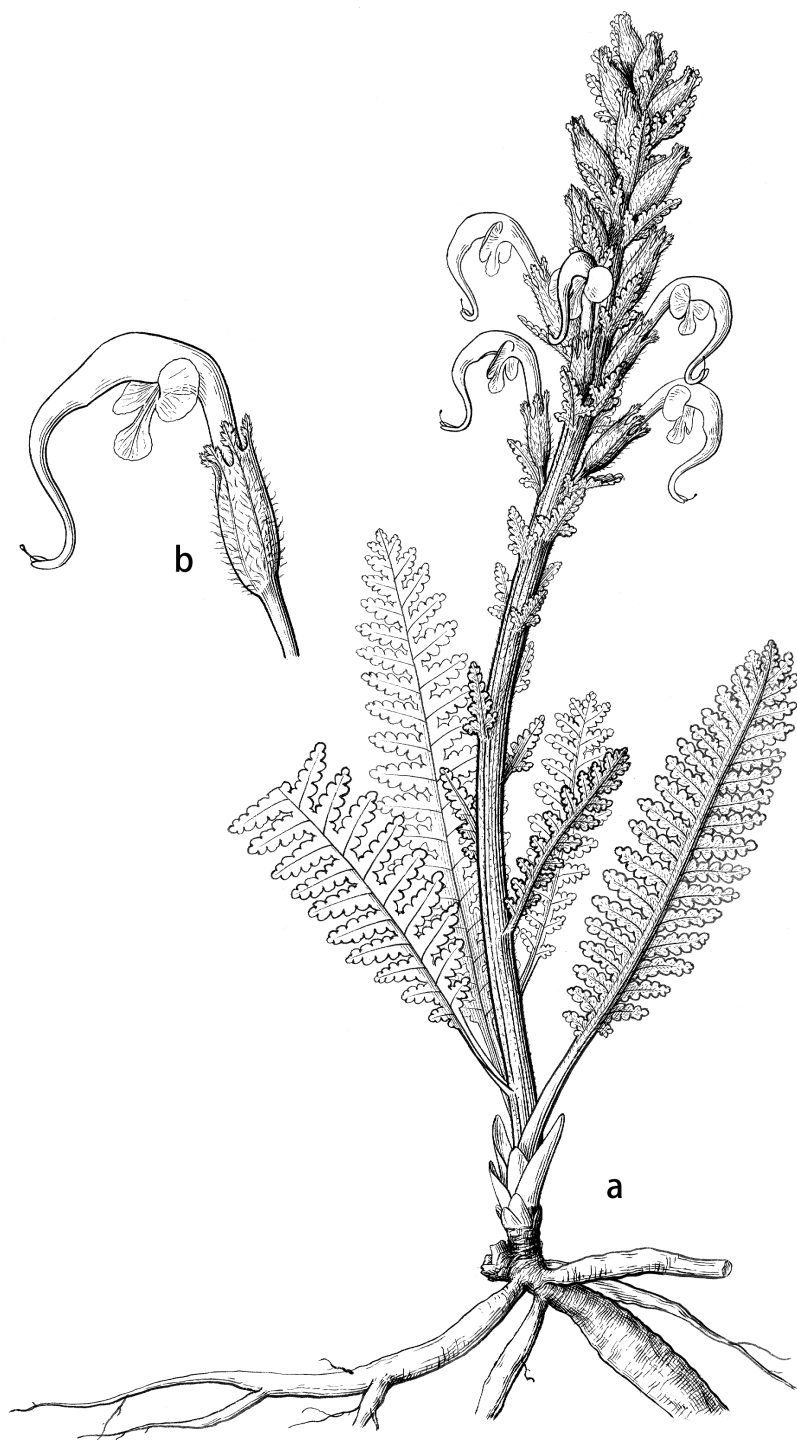
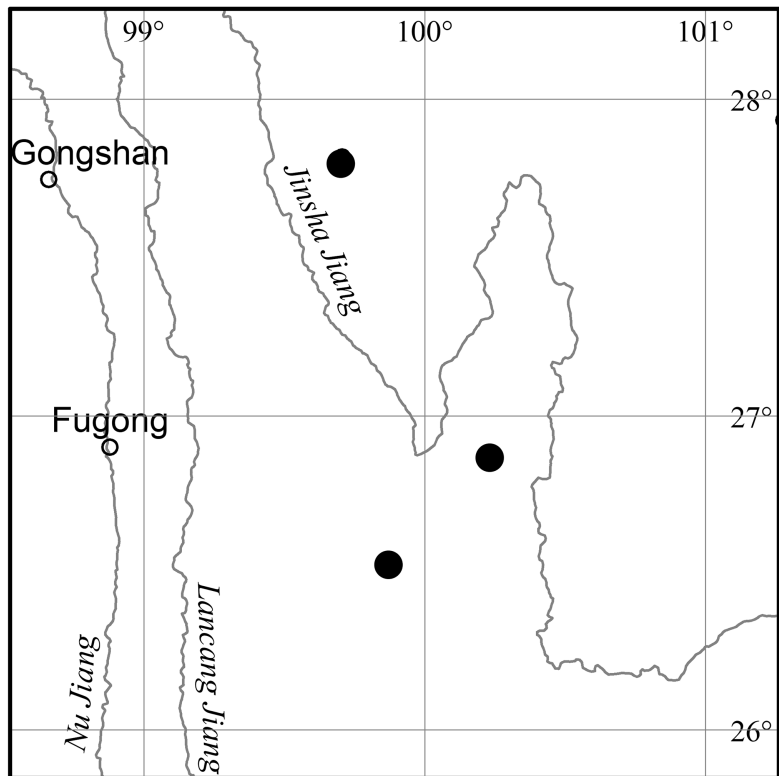


Figure 45(2)–61: *Pedicularis macrorhyncha* H. L. Li. a, habit; b, flower. Drawn by J.-Y. FENG [*Fl. Reipubl. Popularis Sin.* 68: 346, figure 80: 1-2. 1963].



Map 45(2)-135: *Pedicularis macrorhyncha* H. L. Li

Ser. 48. Robustae

Ser. Robustae Prain, Ann. Roy. Bot. Gard. Calc. 3: 69. 1890.

Herbs low, less than 20 cm tall, sometimes stemless. Leaves alternate; leaf blade pinnatifid. Inflorescences racemose. Calyx 1/3 cleft anteriorly, 5-lobed. Corolla tube not or slightly longer than calyx; beak straight or more or less coiled, usually downward uncinat, 2-cleft apically; lower lip large, often wider than long.

Two species; endemic to the Pan-Himalaya.

- 1a. Stems erect; leaf blade linear, segments 7–20 pairs..... 136. *P. garckeana*
- 1b. Stems ascending; leaf blade narrowly oblong, segments 8–10 pairs..... 137. *P. robusta*

136. *Pedicularis garckeana* Prain ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 32: 529. 1888; Prain, Ann. Roy. Bot. Gard. Calc. 3: 122. 1890; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 349. 1963; Yang, Holmgren & Mill in

Wu & Raven (eds.), Fl. China 18: 201. 1998. Type: India, Sikkim, Ching-goo, Sept. 1882, *King's collector s.n.* [neotype designated by Garg & Singh (2020: 83); CAL (CAL0000018971); isoneotype: CAL (CAL0000018972)].

Herbs perennial, 6–20 cm tall, black when dry. Roots fusiform and fleshy. Stems single to several, erect or ascending, 3–16 cm long, unbranched, pubescent. Leaves mainly radical with few alternate cauline; petiole 2–3 cm long, sheath-like, enlarged at base; leaf blade linear, often 2.5–6 cm long, 6–10 mm wide, pinnatifid to pinnatisect; segments 7–20 pairs, linear-ovate, apiculate-dentate. Inflorescences centrifugal, with dense flowers; pedicels 8–18 mm long. Calyx cylindrical-campanulate, hirsute; tube 14–17 mm long; lobes 5, unequal in size, serrate. Corolla purple, red, rose, or pink; tube 20–30 mm long, externally minutely pubescent; beak of galea coiled, 5–8 mm, slender; lower lip 18–25 cm long, 25–30 mm wide, middle lobe oblong, smaller than lateral lobes, margin undulated glabrous or with extremely sparse pubescence. Filaments all pubescent. Capsule obliquely oblong, 10–22 mm long. Figure 45(2)–62.

Phenology: flowering and fruiting from July to August.

Habitats: rock crevices, moist mountain cliffs, and open rocky moorland; 3500–4600 m.

Distribution: endemic; E Nepal, Sikkim & Darjeeling, M Yarlung Zangbo [Map 45(2)–136].

E NEPAL: Kosi, Sankhuwasabha, Barun, Khola, Yangle, 3500 m, 24 Aug. 1981, *C. Grey-Wilson 4210* (K). **SIKKIM & DARJEELING:** Sikkim, Lachung, 5180 m, 17 Aug. 1892, *G. A. Gammit 893* (CAL). **M YARLUNG ZANGBO:** Yadong, Chumbi, *Dr. King's collector 515* (K).

137. *Pedicularis robusta* Hook. f., *Fl. Brit. India* 4: 306. 1884; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 348. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 201. 1998. Type: India, Sikkim, Samdong, 4877 m, 11 Sept. 1849, *Hook. f. s.n.* [lectotype designated by Garg & Singh (2020: 90): K(K001097546); isolectotypes: CAL(CAL0000018998), K(K000739183)].

Pedicularis nepalensis Prain, *J. Asiat. Soc. Bengal* 58: 268. 1889; Tsoong, *Bull. Brit. Mus.* (Nat.

Hist.) Bot. 2: 33. 1955; Yamazaki in Hara *et al.*, *Enum. Fl. Pl. Nepal* 3: 124. 1982. **syn. nov.** Type: Nepal, Kog-gling, 4267 m, Aug. 1888, *Dr. King's collector s.n.* [lectotype designated by Garg & Singh (2020: 86): CAL (CAL0000018969); isolectotypes: BM(BM000885995); CAL(CAL0000018970); E(E00273598); K(K000739179); P(P02981423); PH(PH00020129)].

Pedicularis woodii R. R. Mill, *Edinb. J. Bot.* 58: 82. 2001. **syn. nov.** Type: Bhutan, Thimphu Distr., Dongshola, 4400 m, 19 Aug. 1990, *J. R. I. Wood 7316* [holotype: E(E00273572)].

Pedicularis daltonii Prain, *J. Asiat. Soc. Bengal*, Pt. 2, *Nat. Hist.* 58: 270. 1889; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 348. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 200. 1998. **syn. nov.** Type: India, Sikkim, Denhint, 5181 m, 9 Sept. 1849, (*Pedicularis n. 20*) *Hook. f. s.n.* [lectotype designated by Garg & Sing (2020: 80): K (K000739171)].

Herbs perennial, 5–20 cm tall, densely pubescent, black when dry. Roots thick, straight, fleshy, sparsely branched. Stems ascending, sparsely pilose. Leaves mostly basal, clustered; petiole 1–4 cm long; leaf blade broadly linear to oblong, 1–8 cm long, 0.5–2 cm wide, pinnatifid; segments 5–15 pairs, ovate, crenate-dentate, often reflexed at margins. Inflorescences dense; pedicels 4–20 mm long, sparsely pubescent. Calyx 10–13 mm long, 4–5 mm wide, pubescent; lobes 5, equal, posterior lobe oblanceolate, small, lateral lobes obovate or obovate-orbicular, acutely incised-serrate, reflexed at margins. Corolla red to purple, 25–30 mm long; tube 15–20 mm, long 2–3 mm wide, 1.5–2 times as long as calyx, glabrous or pilose; erect part 6–7 mm long, turgid part 3–4 mm wide, gradually narrowed into a beak, 5–7 mm long, obtuse and deeply bilobed at apex; lower lip 10–12 mm long, 17–20 mm wide, undulate and glabrous on margins, 3-lobed, middle lobe broadly orbicular, 6–8 mm long, 9–10 mm wide, 12–13 mm wide. Filaments long-pubescent. Capsule obliquely oblong, 15–18 mm long, 5 mm wide, short-apiculate.

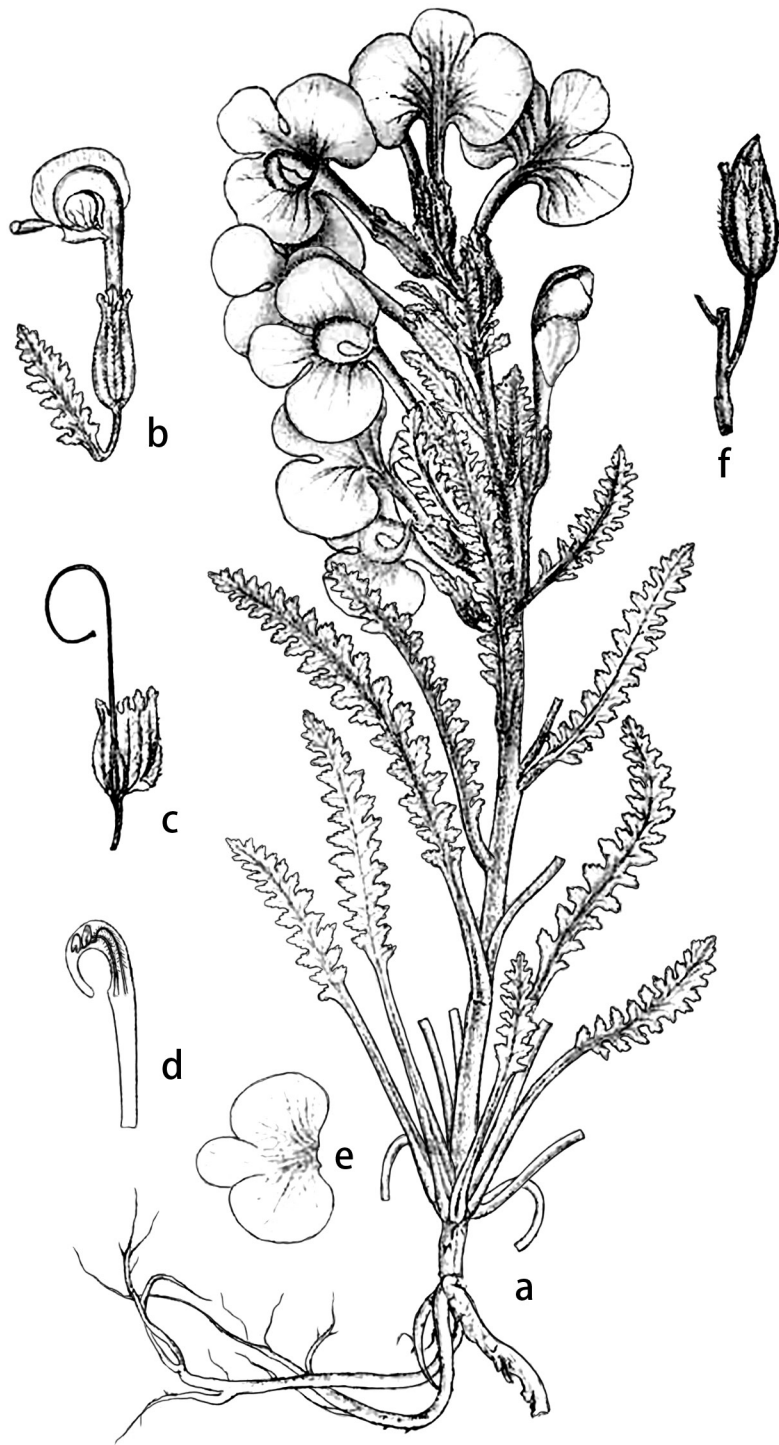
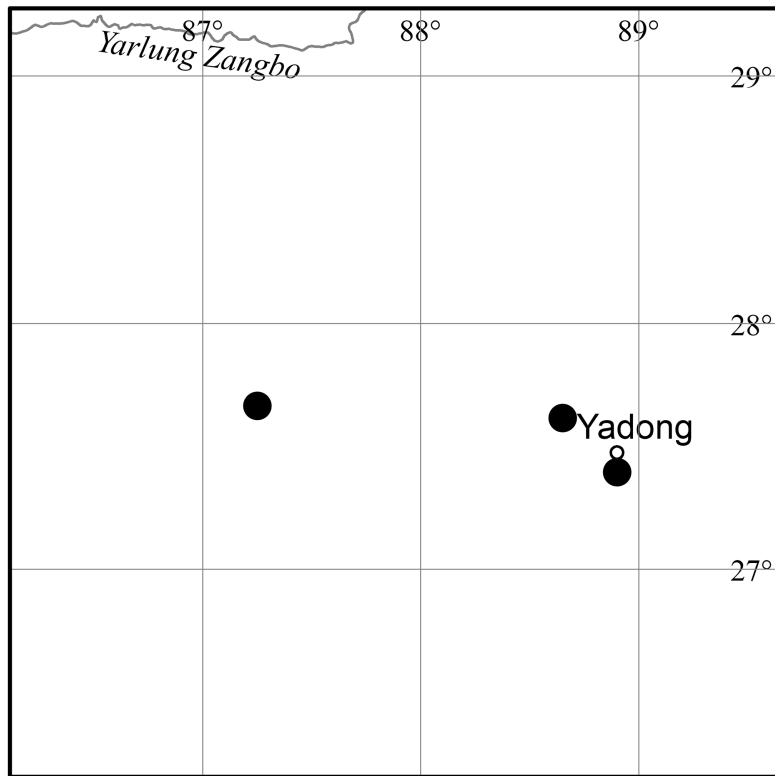


Figure 45(2)–62: *Pedicularis garckeana* Prain ex Maxim. a, habit; b, flower; c, calyx; d, corolla galea and stamen; e, corolla lip; f, capsule. Modified from D. PRAIN [*Ann. Roy. Bot. Gard. Calc.* 3: 122, plate 5: 1-6. 1890].



Map 45(2)-136: *Pedicularis garckeana* Prain ex Maxim.

Phenology: flowering and fruiting from July to August.

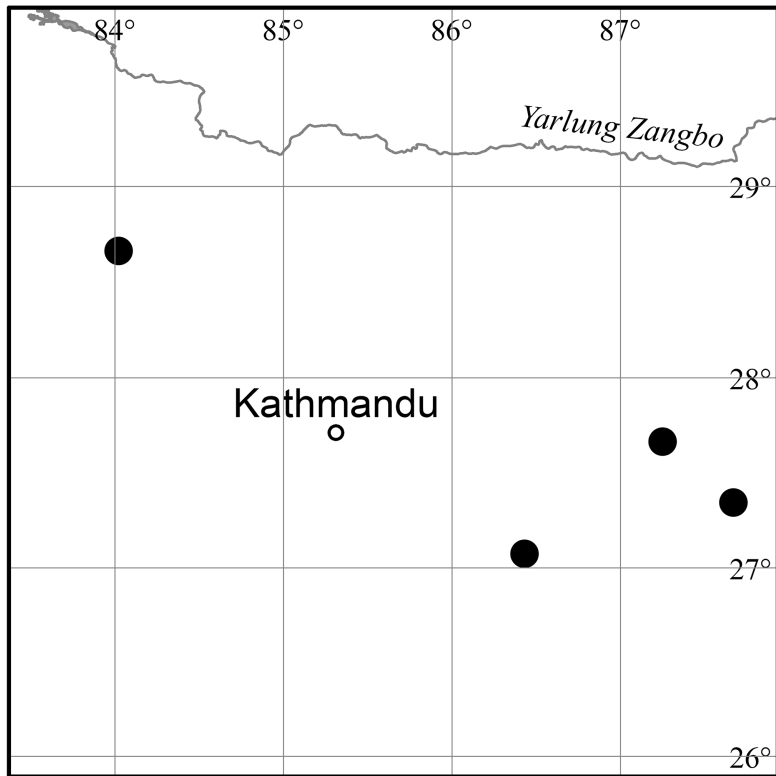
Habitats: alpine meadows, on rocks along a stream; 4000–5500 m.

Distribution: endemic; C Nepal, E Nepal [Map 45(2)-137].

Notes: *Pedicularis woodii* R. R. Mill, described by Mill as new, was thought to be most closely related to *P. megalantha* D. Don and was placed in the series *Megalanthae* Prain. However, the corolla lip of the series *Megalanthae* Prain envelops galea (upper lip), while the lower lip of *P. woodii* R. R. Mill is extensional and never envelops galea. Moreover, flowers of the series *Megalanthae* Prain are larger and plants are much taller than those of *P. woodii* R. R. Mill. Actually,

P. woodii is characterized by a stemless or short stem, short beak, with deeply bilobed at the apex. These characters are quite similar to those of *P. nepalensis* Prain, *P. garckeana* Prain ex Maxim., and *P. daltonii*. Hence, *P. woodii* is transferred to the series *Robustae* Prain and treated as a new synonym of *P. robusta* Hook. f.

C NEPAL: **Bagmati**, Rasuwa, Chilime Kharka, 4110 m, 1949, *O. V. Polunin 1141* (BM). **Gandaki**, Manang, Phedi-Thanti, Mangbhot, 4100–4400 m, 1983, *H. Ohba et al. 8330863* (TI). **E NEPAL:** **Kosi**, Sankhuwasabha, Arun Valley, Barun Khola, N of Num, 3350 m, 1956, *J. D. A. Stainton 556* (BM). **Mechi**, Taplejung, 3900–4000 m, 1978, *H. Tabata et al. 11739* (KYO).



Map 45(2)-137: *Pedicularis robusta* Hook. f.

Ser. 49. Klotzschianae

Ser. Klotzschianae R. R. Mill, Edinb. J. Bot 67. 186–187. 2010.

Leaves alternate, lanceolate; petiole long. Calyx deeply cleft anteriorly, 5-lobed. Corolla tube slightly exceeding calyx; beak more or less coiled, long, usually deeply 2-cleft; lower lip usually more than 15 mm wide.

Three species; all endemic to the Pan-Himalaya.

Notes: The series *Klotzschianae* ([unranked] Ser. *Macranthae* Bunge) included three species (Prain. 1890. Ann. Bot. Gard. Calc. 3: 69), *i.e.*, *P. macrantha* Klotzsch ex Klotzsch & Garcke (\equiv *P. klotzschii* Hurusawa), *P. scullyana* Prain ex Maxim., and *P. elwesii* Hook. f. The last species was transferred to the series *Pseudomacranthae* P. C. Tsoong ex H. P. Yang (1998. Fl. China. 18: 192). Bonati (1921. Notes Roy. Bot. Gard. Edinb. 13: 109) described *P. insignis* Bonati as new and placed it in the series *Macranthae*. Our molecular phylogenetic results (without *P. klotzschii* Hurusawa) reveal that *P. scullyana* Prain ex Maxim., *P. insignis* Bonati and an unidentified individual form a clade sister to the series *Pumiliones* Prain.

1a. Flower never purple-red; plant usually 50–90 cm tall 138. *P. scullyana*

1b. Flower yellow, purple-red or red; plant usually 15–40 cm tall.

2a. Cauline leaves usually pseudo-opposite; leaf blade lanceolate-oblong to linear-lanceolate or ovate-oblong 139. *P. insignis*

2b. Cauline leaves alternate; leaf blade oblong-lanceolate, pinnatisect or pinnatipartite.....
.....140. *P. klotzschii*

138. *Pedicularis scullyana* Prain ex Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 32: 529. 1888; Tsoong, Acta Phytotax. Sin. 3: 277, 317. 1955; Yamazaki in Hara *et al.*, Enum. Fl. Pl. Nepal 3: 125. 1982; Mill, Edinb. J. Bot. 58: 93. 2001. Type: Nepal, s. d. *J. Scully* 288 [neotype designated by Garg & Singh (2020: 90): K(K000739173); isoneotypes: CAL(CAL0000019075), CAL(CAL0000019076)].

Perennial, erect herbs, 24–90 cm tall. Stem stout, robust. Leaves with white, crisp hairs, petiole 3–6 cm long; blade pinnatipartite, lanceolate, 7–16 cm long; pinnae 14–20 pairs, oblong-lanceolate, serrate-dentate. Raceme dense terminal with many flowers; pedicels 3–7 mm long. Calyx ovate or sub-globose; tube 18–21 mm long, inflated, hirsute, 5-lobed; lobes ovate-lanceolate, deeply serrate, crestate-dentate. Corolla yellow; tube 16–18 mm long, hardly as long as calyx, pilose externally; galea beaked, reflexed out from calyx, inflated, abruptly bent in the center where the anthers located; beak 3–5 mm long, directed downwards, ending abruptly in deeply bifid apex; lower lip 3-lobed, lateral lobes twice as large as median. Filaments all pubescent. Figure 45(2)–63.

Phenology: flowering from July to August.

Habitats: open slopes and shrubberies; 3300–4800 m.

Distribution: endemic; U Yarlung Zangbo, W Nepal, C Nepal, E Nepal [Map 45(2)–138].

Notes: *Pedicularis scullyana* Prain ex Maxim. is mainly distributed in Nepal, and only recently it was collected in Nyalam, Tibet, China. Patrick is revising the Flora of Nepal and he suggests that this species should be treated as three subspecies: *P. scullyana* subsp. *dendrothauma*, *P. scullyana* subsp. *mustangensis*, *P. scullyana* subsp. *scullyana*. Further studies are necessary to clarify the infraspecific taxa.

U YARLUNG ZANGBO: Nyalam, Xiaogulin, 3600–4100 m, 19 July 2012, *F. S. Yang* 2012-07-19Nlm (PE). **W NEPAL:** Kar-

nali, Dolpa, Jangla Bhanjyang, 4000 m, 11 July 1973, *S. Einarsson, L. Skärby & B. Wetterhall* 1922 (BM); Karnali, Dolpa, Namdo, 5300 m, 25 Aug. 1973, *C. Grey-Wilson & B. Phillips* 712 (K); Karnali, Dolpa, Phoksumdo Khola, 3640 m, 12 July 1966, *T. B. Shrestha* 5354 (BM); Karnali, Jumla, 4370 m, 20 Sept. 1991, *M. Minaki, K. K. Joshi, Y. Kadota et al.* 9104152 (E). **Rapti,** Rukum, Chalikhe Pahar, 3790 m, 25 Sept. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 4590 (BM). **Seti,** Nadi, 4390 m, 2 Aug. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 6595 (BM). **C NEPAL:** **Bagmati,** Rasuwa, 4000–5100 m, 20 July 1992, *F. Miyamoto* 9220286 (E); Bagmati, Rasuwa, Gosainkund, 3640 m, 10 Sept. 1935, *F. M. Bailey* 253 (BM). **Dhawalagiri,** Baglung, Phagune Khola, 3940 m, 9 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3440 (BM); Dhawalagiri, Mustang, Muktinath, 3940 m, 28 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 2065 (BM); Dhawalagiri, Mustang, 4500 m, 11 Aug. 2002, *F. Miyamoto, N. Kurosaki, S. Akiyama et al.* 20230031 (E); Dhawalagiri, Mustang, Ommang, 3800 m, 9 Aug. 1996, *T. Hoshino, M. Amano, H. Koba et al.* 9666147 (E); Dhawalagiri, Mustang, Samar, 4850 m, 16 Aug. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* (BM); Dhawalagiri, Mustang, Thorong La, 4790 m, 9 Sept. 1977, *G. Miede* 653 (BM); Dhawalagiri, Mustang, Tukuche, 3640 m, 12 Sept. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 7780 (BM). **Gandaki,** Gorkha, Jarang Khola, 4550 m, 2 Aug. 1950, *D. G. Lowndes* 1313 (BM); Gandaki, Lamjung, Rambrong Pass, 3940 m, 3 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 6091 (BM); Gandaki, Kaski, 3790 m, 25 Aug. 1950, *D. G. Lowndes* 1441 (BM). **Janakpur,** Ramechhap, 3651–4600 m, 1 Aug. 1985, *H. Ohba* 8530666 (E). **E NEPAL:** **Kosi,** Sankhuwasabha, Thudam, 4000 m, 14 Aug. 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 770763 (BM). **Mechi,** Taplejung, Topke Gola, 3640 m, 26 July 1971, *T. B. Shrestha & D. P. Joshi* 345 (BM).

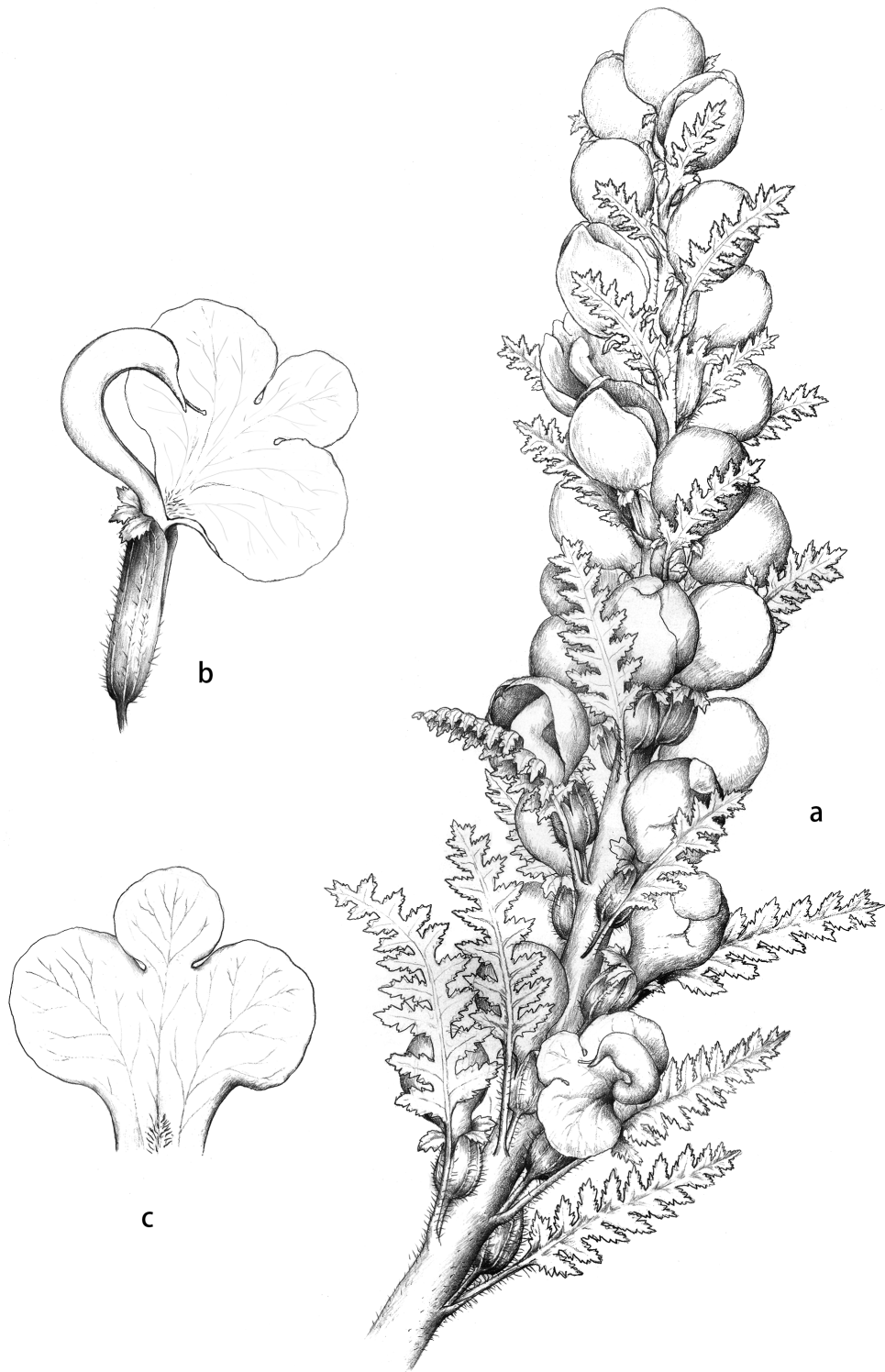
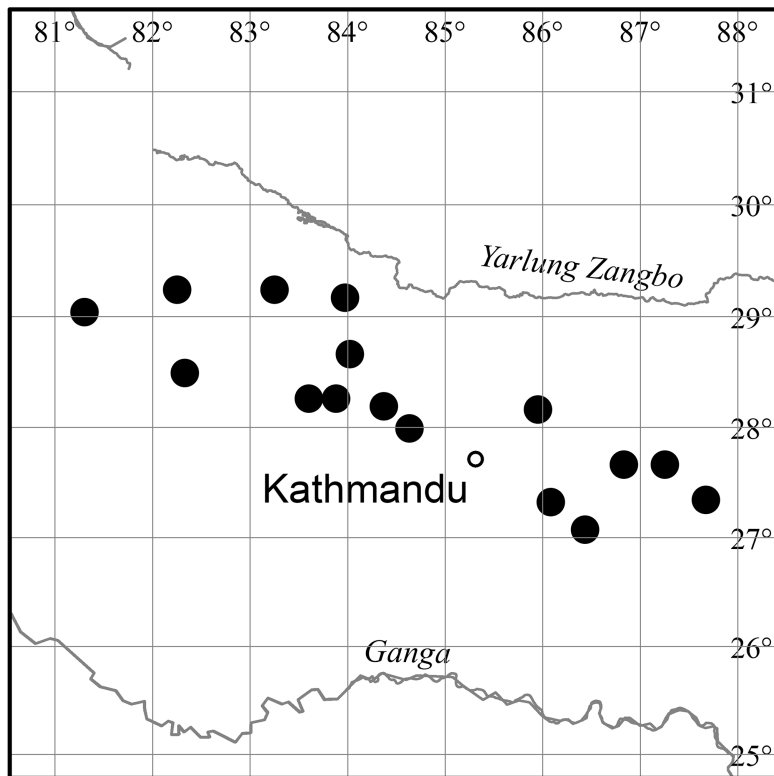


Figure 45(2)–63: *Pedicularis scullyana* Prain ex Maxim. a, inflorescence; b, flower; c, corolla lip. Drawn by A.-L. LI.



Map 45(2)-138: *Pedicularis scullyana* Prain ex Maxim.

Sagarmatha, Solukhumbu, Beni Kharka, 3970 m, 31 Aug. 1985, *H. Ohba*, *M. Wakabayashi*, *M. Suzuki et al.* 8531208 (BM).

139. *Pedicularis insignis* Bonati, Notes Roy. Bot. Gard. Edinb. 13: 109. 1921; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 350. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 201. 1998. Type: China, Yunnan, Dêqên, Doker La, 4267 m, 1913, *F. Kingdon-Ward 1105* [holotype: E(E00438462)].

Pedicularis quadrata Bonati, Notes Roy. Bot. Gard. Edinb. 13: 115. 1921. Type: China, Yunnan, Dêqên (on the border of Tibet), Ka-gwr-pw, 4724 m, 1913, *F. Kingdon-Ward 812* [holotype: E(E00438461)].

Herbs perennial, 10–18 cm tall, densely gray pubescence throughout, black when dry. Roots fascicled, fusiform. Stems single to several, cespi-

tose, unbranched. Basal leaves formed a sparse rosette; petiole 1.5–5 cm long; leaf blade lanceolate-oblong to linear-lanceolate or ovate-oblong, 5–7 cm long, 0.7–2 cm wide, abaxially densely brown villus along veins, adaxially densely ciliolate, pinnatifid; segments 9–19 pairs, ovate-triangular to triangular, crenate-dentate; cauline leaves few, usually pseudo-opposite, smaller than basal leaves. Inflorescences racemose, 4–11 cm long; proximal bracts leaflike, shorter than flowers; pedicels erect, 1–1.5 cm long, densely villous. Calyx cylindric, 8–12 mm long, cleft 1/2 anteriorly, densely villous; lobes 5, unequal in size. Corolla purple-red; tube slightly expanded and curved apically, 14–18 mm long, pubescent; galea prominently crested, marginally 1-toothed on each side; beak strongly curved; lower lip 8–9 mm long, 17–20 mm wide, lobes rounded. Filaments all pubescent. Figure 45(2)-64.

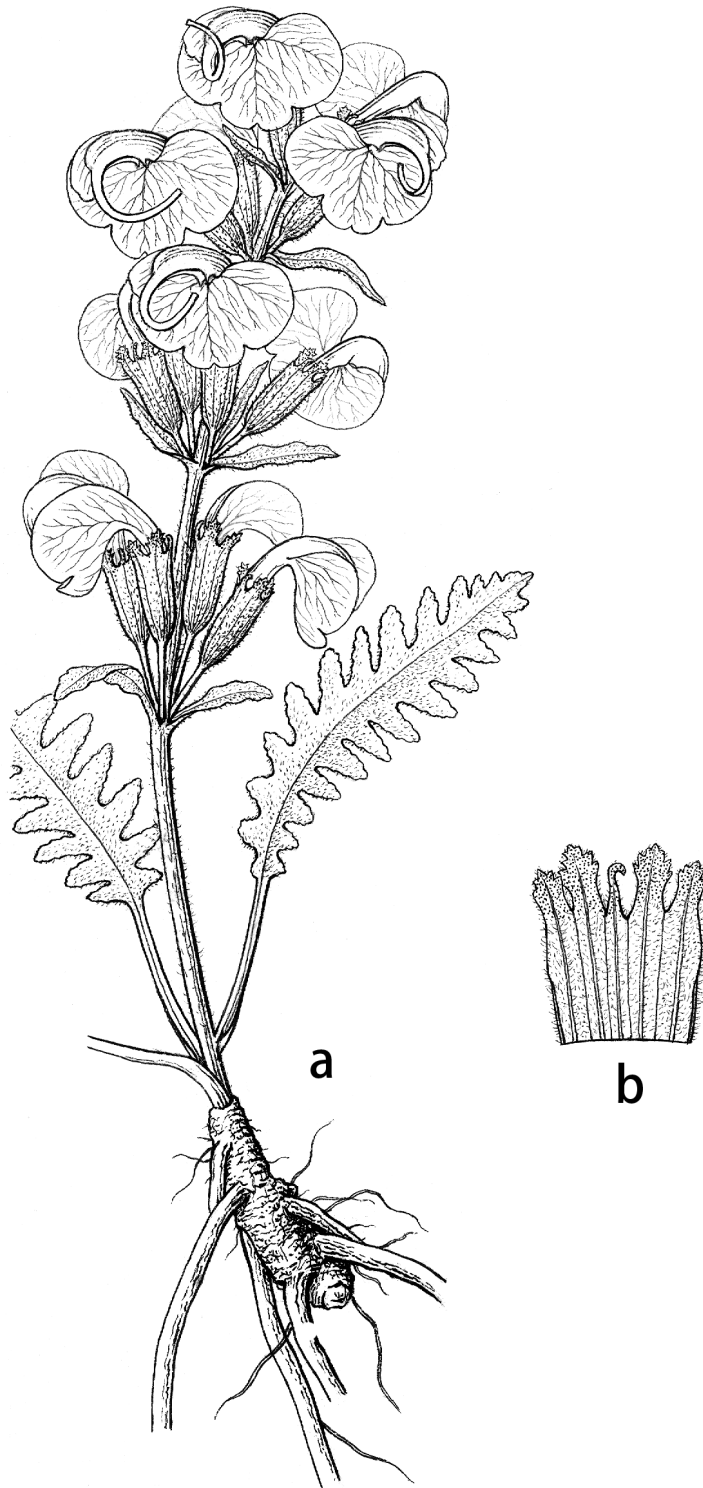
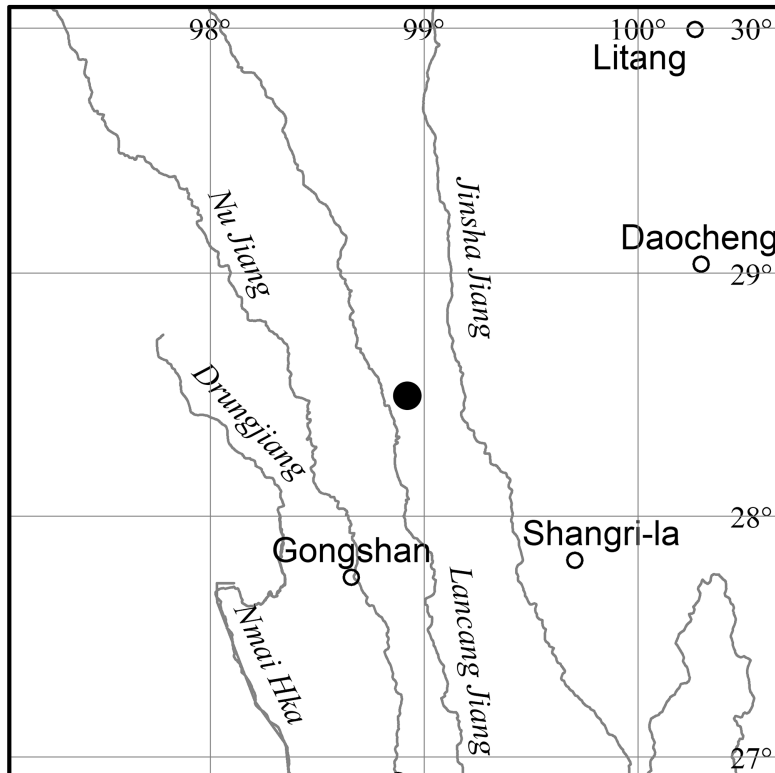


Figure 45(2)–64: **Pedicularis insignis** Bonati. a, habit; b, calyx. Drawn by Z.-H. WU [*Fl. Reipubl. Popularis Sin.* 68: 350, figure 81: 1-2. 1963].



Map 45(2)–139: *Pedicularis insignis* Bonati

Phenology: flowering from July to August.

Habitats: alpine meadows; 4200–4700 m.

Distribution: endemic; S Hengduan [Map 45(2)–139].

Notes: Bonati described *P. insignis* Bonati and *P. quadrata* Bonati as new at the same time and he placed the two species in two different series. Li (1949. Proc. Acad. Nat. Sci. Philad. 101: 146) treated *P. quadrata* as a synonym of *P. insignis*, which was followed by later authors.

S HENGDUAN: Dêqên, Doker La, 4267 m, 1913, *F. Kingdon-Ward 1105* (E); Dêqên (also may on the border of Tibet), Ka-gwr-pw, 4724 m, 1913, *F. Kingdon-Ward 812* (E); Dêqên, Mekong-Salween Divide, Sila, 4200 m, 11 Aug. 1938, *T. T. Yü 22284* (PE); Dêqên, Mekong-Salween Divide, Dokerla, 4000 m, 1 Aug. 1940, *K. M. Feng 6132* (KUN475416; PE00119130–PE00119133).

140. *Pedicularis klotzschii* Hurusawa, J. Jap. Bot. 22: 184. 1948; Tsoong, Acta Phytotax. Sin. 3: 277, 317. 1955; Polunin & Stainton, Fl. Himala-

ya 299. 1984. ≡ *Pedicularis macrantha* Klotzsch in Klotzsch & Garcke, Bot. Ergbn. Reise Waldemar 108. t. 59, 1862, non *Pedicularis macrantha* Spreng., Syst. Veg., ed. 16 [Sprengel] 4(2. Cur. Post.): 233. 1827. Type: plate 59 provided by Klotzsch in protologue was chosen as lectotype by Garg & Singh [lectotype designated by Garg & Singh: (2020: 85)].

Perennial, 5–45 cm tall. Roots fascicled, more or less fusiform. Leaves alternate, petiole 3–12 cm long; blade oblong-lanceolate, pinnatisect or pinnatipartite, 5–12 cm long, 1–2.5 cm wide; cauline leaves alternate; segments 8–12 mm long, 8–20 pairs, mucronate-dentate. Inflorescences racemose, dense; pedicels 5–9 mm long, hirsute; bracts foliaceous, smaller than leaves, often exceeding flowers. Calyx tube 11–14 mm long, densely hairy, 5-lobed, crested; lobes elliptic, coarsely toothed, nerves distinct, margin straight or recurved. Corolla 20–25 mm long, pale-yellow, rosy-red or purple, with a stout violet or mauve beak; tube

10–11 mm long, almost equal to calyx in size; galea beaked, sickle-shaped, not or slightly inflated, abruptly bent; beak slender, shortly curved, directed downwards; lateral lobes nearly equal to, or slightly broader than, median lobe. Filaments pubescent, hairs dense towards the top. Capsules 18 mm long, and 6 mm wide.

Phenology: flowering from June to July.

Habitats: open slopes and damp ground, on moist slopes; 2100–5000 m.

Distribution: endemic; U Ganga & Indus, W Nepal, C Nepal, E Nepal [Map 45(2)–140].

- 1a. Leaves pinnatipartite; corolla rosy-red or purple; beak of galea gradually tapering.....
..... 140a. subsp. *klotzschii*
- 1b. Leaves pinnatisect; corolla cream with purple-falcate upper lip; beak abruptly tapering 140b. subsp. *lutescens*

140a. *Pedicularis klotzschii* subsp. *klotzschii*

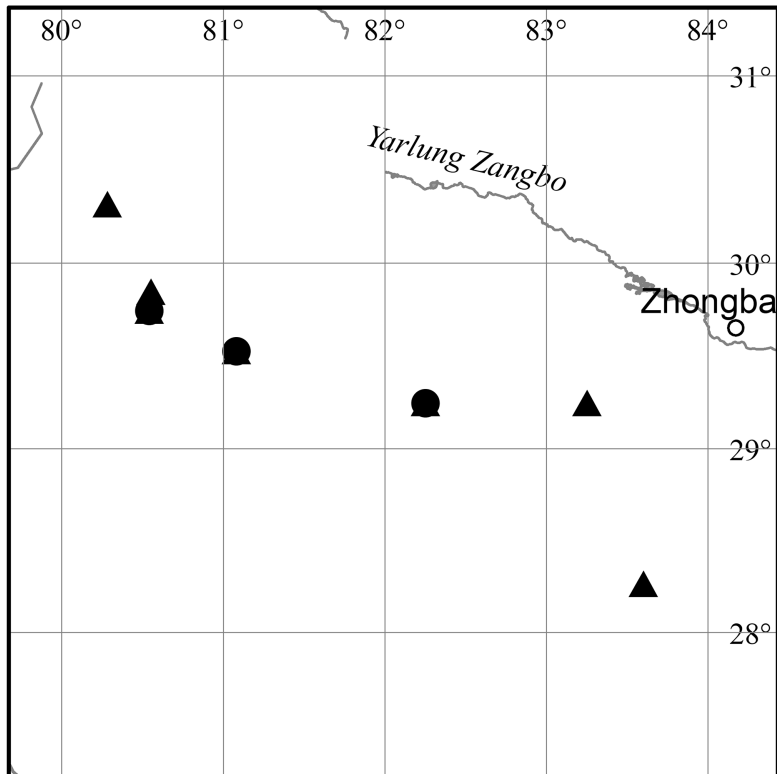
Perennial, erect, or ascending. Leaf blade pinnatipartite. Flowers rosy-red or purple; beak of galea gradually tapering; middle lobe of labium equal to lateral lobes; stamens inserted in the upper of corolla tube, above the apex of ovary, point of insertion densely woolly.

Phenology: flowering from June to July.

Habitats: open slopes and damp ground; 2100–4500 m.

Distribution: endemic; W Nepal [Map 45(2)–140].

Notes: Records of type collections were lost due to the violent death (in 1846) of Hoffmeister in the field, and “the Illustration of Klotzsch in Bot. Ergebn. Reise Waldemar [Klotzsch & Garcke]: pl. 59. 1862” was chosen as lectotype by Garg & Singh (2020. Phytotaxa 430: 85).



Map 45(2)–140: *Pedicularis klotzschii* Hurusawa
● subsp. *klotzschii* ▲ subsp. *lutescens*

W NEPAL: **Karnali**, Mugu, Rara, 3230 m, 11 July 1983, *H. Tabata et al. 15304* (KYO). Karnali, Jumla, Maharigaon, 4390 m, 15 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 1554* (BM). **Seti**, Bajhang, Saipal, 30 July 1976, *H. Tabata, K. R. Rajbhandari & K. Tsuchiya 9162* (KATH).

140b. *Pedicularis klotzschii* subsp. *lutescens* (Prain) Husain *et al.*, Genus *Pedicularis* L. (Scrophulariaceae) in India (A revisionary study), 199. 2010. ≡ *Pedicularis macrantha* Klotzsch ex Klotzsch & Garcke var. *lutescens* Prain, *J. Asiat. Soc. Beng.* 58(2): 267. 1889. Type: India, Uttarakhand, Kumaon, Darma, Valley Niptschang, 4267–4572 m, Aug. 1886, *Duthie 5845* [**lectotype designated here:** BM; isoelectotype: K].

Leaves pinnatisect. Flowers cream with purple-falcate upper lip; beak of galea abruptly tapering; middle lobe of labium narrower than lateral lobes. Figure 45(2)–65.

Phenology: flowering from July to August.

Habitats: on moist slopes in gullies and also on the moist plain; 3600–5000 m.

Distribution: **endemic**; U Ganga & Indus, W Nepal, C Nepal, E Nepal [Map 45(2)–140].

U GANGA & INDUS: Ralam Valley, 3670 m, *Strachey & Winterbottom, no more detailed information* (BM); near Lebang Glacier, 4266–4600 m, 3. Aug. 1886, *J. F. Duthie 5845* (K).

W NEPAL: Karnali, Dolpa, Jangla Bhanjyang, 3800 m, 28 June 1973, *S. Einarsson, L. Skärby & B. Wetterhall 1232* (BM); Karnali, Jumla, 2270 m, 8 June 1966, *J. D. A. Stainton 5419* (BM); Karnali, Mugu, Rara, 3670 m, 20 June 1983, *H. Tabata, D. P. Joshi, K. Tsuchiya et al. 13267* (BM). **Seti**, Bajhang, Saipal, 4550 m, 20 Aug. 1954, *J. E. M. Arnold 146* (BM). **C NEPAL: Dhawalagiri**, Baglung, Dhorpata, 2880 m, 24 Aug. 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams 3995* (BM).

Ser. 50. Bicornutae

Ser. Bicornutae R. R. Mill, *Edinb. J. Bot.* 67: 185. 2010.

Petiolate or the uppermost ones subsessile. Corolla lip with two large semicircular lateral lobes rotated and with one of the lateral lobes wholly or partly hiding galea, margin densely but minutely ciliate, or glabrous; galea twisted at base, with resupinate anther case and shallowly sigmoid beak. Capsule obliquely lanceolate-ovoid to ovoid, adaxial side curved distally or convex, apex apiculate or abruptly acuminate.

Two species; both in the Pan-Himalaya.

- 1a. Corolla galea not corkscrew-like at base; beak of galea red and different from the rest of corolla; upper cauline leaves sessile 141. *P. elephantoides*
 1b. Corolla galea tightly twisted at base like a corkscrew; beak of galea yellow and same colour as the rest of corolla; all cauline leaves petiolate 142. *P. bicornuta*

141. *Pedicularis elephantoides* Benth., *Scroph. Ind.* 53. 1835; Maximowicz, *Mél. Biol.* 12: 785. 1888; Prain, *Ann. Roy. Bot. Gard. Calc.* 3: 117. 1890; Pennell, *Monogr. Acad. Nat. Sci. Philad.* 5: 145. 1943; Tsoong, *Acta Phytotax. Sin.* 3: 279, 320. 1955; U. Dhar & P. Kachroo, *Alpine Fl. Kash. Himal.* 238. 1983. Type: “Kashmir, Royal, Sedgwick! (R. E)”.

Kashmir, above Tragbal, 3352 m (11000ft), *B. B. Osmastor 68* (**neotype designated here:** K).

Erect herbs, 15–40 cm tall, robust. Stems pubescent, hairy, stout. Radical leaves pinnatifid, petiole 5–11 cm long; leaf blade linear-oblong, 10–12 cm long, glabrous; segments 12–20 pairs, with several pairs of sharply dentate lobes.

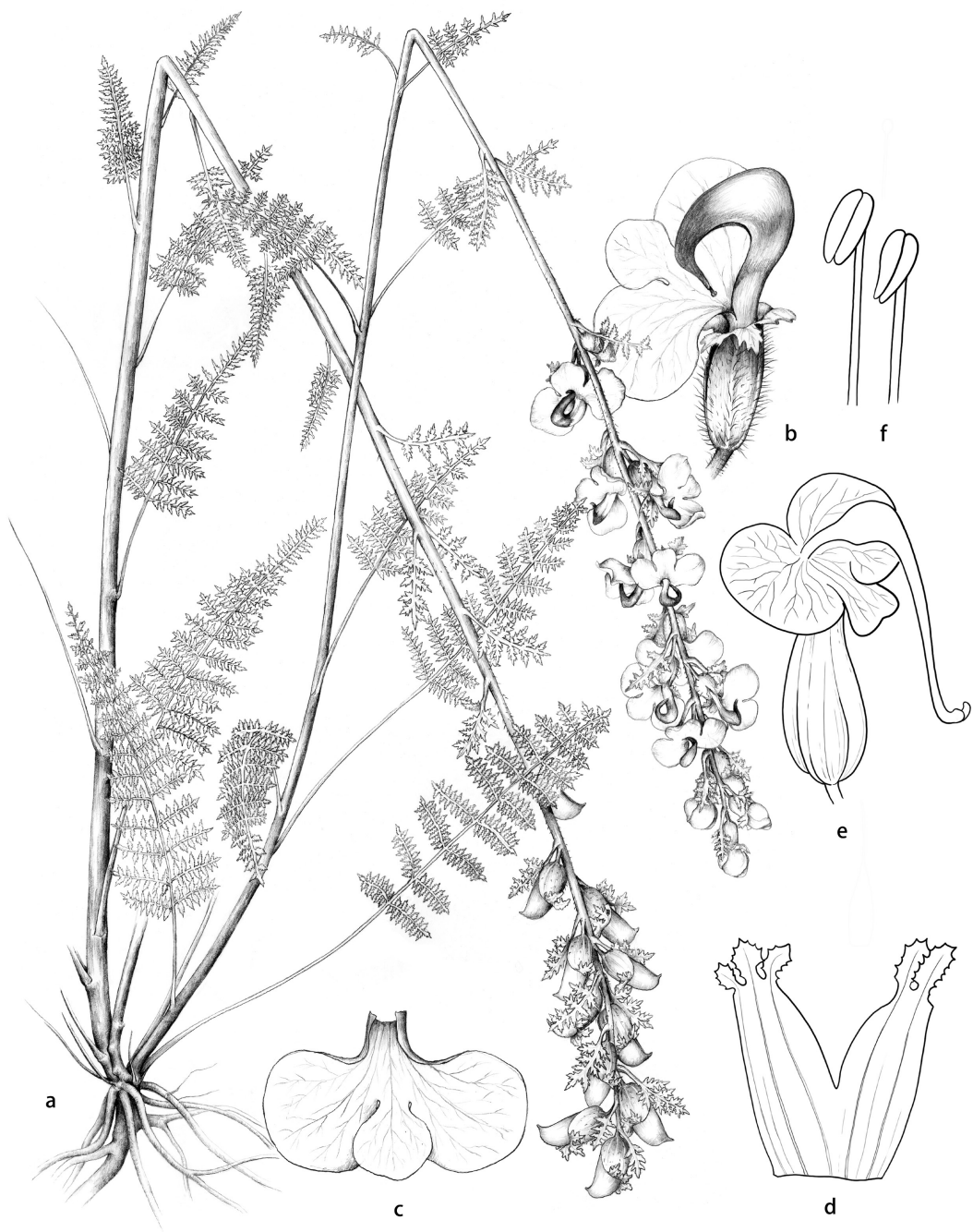


Figure 45(2)–65: *Pedicularis klotzschii* subsp. *lutescens* (Prain) Husain *et al.* a, habit; b, flower; c, corolla lip. Drawn by A.-L. LI. *Pedicularis elephantoides* Benth. d-f: d, calyx; e, corolla; f, stamen. A.-L. LI modified from C. J. MAXIMOWICZ [*Mél. Biol.* 12: 785, figure 4. 1888].

Inflorescences dense racemose or interrupted below, elongated, occupying most of stout stem; pedicels 3–6 mm long; bracts 7–10 mm long, linear. Calyx 15–20 mm long, inflated, glabrous, strongly nerved, densely reticulate between nerves; 5-toothed, double-dentate. Corolla cream-yellow or labium-yellow with purple galea; tube 11–25 mm long, contorted, glabrous, often shorter than or sometimes exceeding calyx; galea long-beaked, basal part 3 mm long, twisted, incurved, slightly inflated; beak 15–18 mm long, projecting, ascending, exerted beyond deeply cleft lower lip, slender, flexuous, apex reflexed; lower lip 20–25 mm wide, lateral lobes ovate, half wider than median lobe. Filaments all glabrous. Figure 45(2)–65.

Phenology: flowering from July to September.

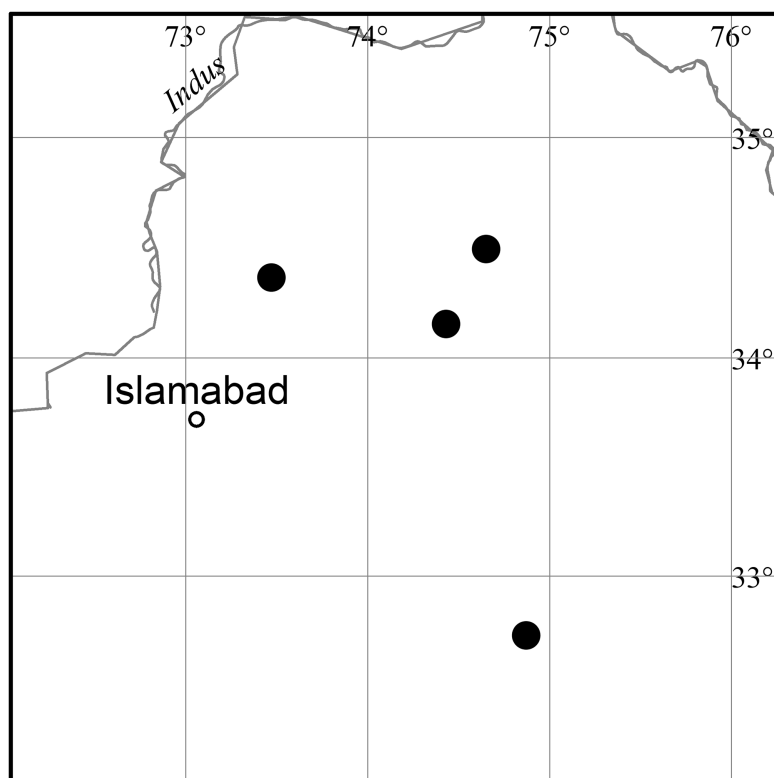
Habitats: damp ground in woods and amongst scrub; 2600–3800 m.

Distribution: N Pakistan, Jammu & Kashmir [Map 45(2)–141].

Notes: Bentham made a very brief description of *P. elephantoides* Benth. based on two specimens collected in Kashmir in 1885. Prain stated that it is closely allied to *P. bicornuta* Klotzsch but differs in having a much longer and quite undivided beak, and it is possibly a hybrid of *P. bicornuta* Klotzsch and *P. megalantha* D. Don. Here a new type collected from Kashmir (*B. B. Osmastor 68*) is designated as a neotype.

N PAKISTAN: Azad Kashmir, Muzaffarabad, Pir Chanasi, 2900 m, 3 Sept. 1907, *H. Singh* 1808 (DD). **Jammu & Kashmir:** Gulmarg, 2590 m, 30 July 1922, *B. O. Cwlenling* 513 (K). **Jammu,** Sunthan, 2600 m, 23 July 1956, *G. Saran & Party* 30342 (LWG). **Tragbal,** 3352 m, 1928, *B. B. Osmastor 68* (K).

142. *Pedicularis bicornuta* Klotzsch, in Klotzsch & Garcke, Bot. Ergebn. Reise Waldemar 109. 1862; Mill, Edinb. J. Bot. 68: 127–129. 2011. Type: types collected by Hoffmeister in 1846



Map 45(2)–141: *Pedicularis elephantoides* Benth.

were destroyed, probably between Kedarnath and upper Kunawar [Lectotype designated by R. R. Mill (2010: 186): the illustration of *Pedicularis bicornuta* in Klotzsch & Garcke, op. cit., t. 61. 1862; figure 1A)]. Epitype: Pakistan, Khot An, N of Mastuj between Turikho and Mastuj rivers, 3352 m, 11 July 1958, *J. D. A. Stainton 2854* [epitype designated by Mill (2010: 186): E].

Pedicularis eximia G. Watt, J. Linn. Soc. Bot. 18: 381. 1881. Type: India, Himachal Pradesh, Pangi, Chumba State, Chenab River, southern aspect, 2591–2743 m, 25 July 1878, *J. Ellis snr. s.n. (hb. G. Watt 97B)* [lectotype designated by Mill (2010: 186): E].

Erect or sub-erect, robust, 6–50 cm tall. Stems thick, stout, ridged. Petiole of basal leaves 3.5–6 cm long, hairy; leaf blade linear or linear-oblong, surface sparsely pubescent, pinnatifid; segments 10–20 pairs, rounded, crenate, dentate margins; cauline leaves alternate, hairy. Inflorescences raceme or terminal spikes, 7–20 cm long; pedicels 3–10 mm long; bracts 10–12 mm long, linear, lobulate-dentate in upper region. Calyx 15–20 mm long, broadly oblong, 5-lobed; lobes 3–5 mm long, base narrow, erect, dentate. Corolla yellow to golden-yellow, with a white tube and beak, almost twice as long as calyx, throat contorted; tube 18–28 mm long, 1.5 times as long as calyx; galea slender; beak coiled S-shaped, or spirally curved, with a slender, deeply bifid, deflexed tip; lower lip spreading, ciliate, median lobe slightly smaller than lateral. Filaments all glabrous. Ovary 6–7 mm, long 3 mm wide, lance-shaped. Figure 45(2)–66. **Chromosomes:** $n = 7$.

Phenology: flowering from June to August.

Habitats: meadows and moist slopes, under *Salix* trees; 2400–4500 m.

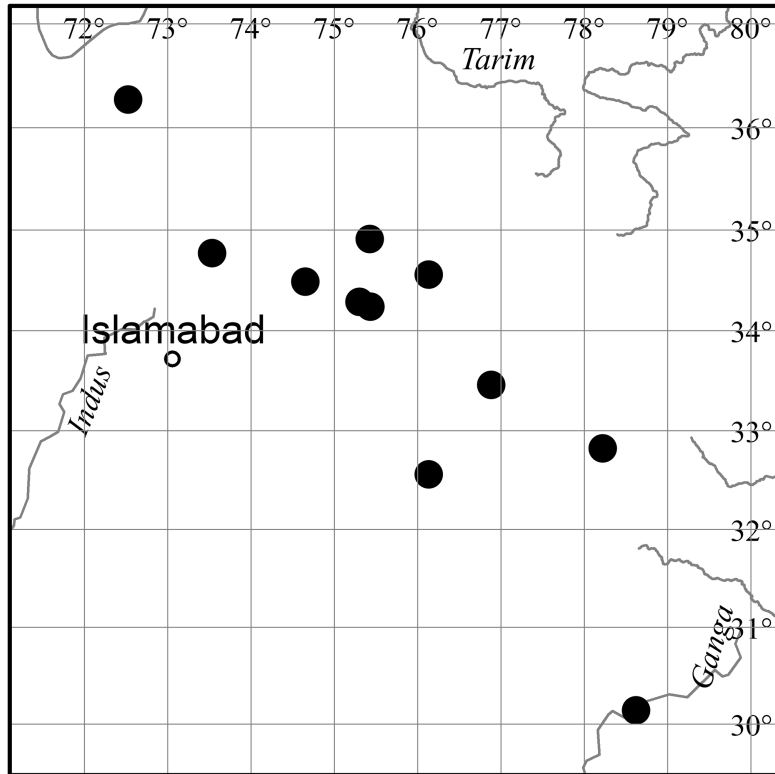
Distribution: N Pakistan, Jammu & Kashmir, U Ganga & Indus [Map 45(2)–142]; also in other regions of Pakistan and E Afghanistan.

Notes: Mill (2010. *Edinb. J. Bot.* 67: 186) described *P. bicornuta* var. *adenocalyx* R. R. Mill as new and stated that it “differs from *Pedicularis bicornuta* var. *bicornuta* in calyx tube and teeth covered with dense short-glandular hairs as well as longer eglandular-pilose indumentum.” Type: Pakistan, B-8 Kashmir, Sonamarg, 3200 m, at the edge of stream, flowers yellow, 5 Aug. 1965, *J. D. A. Stainton 5031* (holotype: BM).

N PAKISTAN: **Baltistan**, Deosai plains, rocky meadows between Satpara Pass and Kharpel, 3352 m, 6 Aug. 1955, *G. L. Webeter & E. Nasir 6386* (Musei Hist. Natur. Vindob). **Hazara**, Kagan, 13 Aug. 1897, *J. F. Duthie 22943* (K). **Chitral**, Mastuj, 3350 m, 11 July 1958, *J. D. A. Stainton 2854* (E00417602). **Jammu & Kashmir:** **Baltal**, 2743–3962 m, 28 Sept. 1948, *J. J. Pedicularis 25* (K000196145). **Padum**, Valley bottom, along better-drained banks of irrigation channels, 14 July 1981, *M. Grace, E. Bailey, D. Bull et al. 27* (K). **Sonamarg**, 3200 m, 34°20' N, 75°20' E, at the edge of the stream, 5 Aug. 1965, *J. D. A. Stainton 5031* (BM000885877). **Tragbal**, 3352 m, 1928, *B. B. Osmastor 52* (K). **U Ganga & Indus:** **Chamba**, 3050–3650 m, Aug. 1880, *Robert Ellis s.n.* (K). **Tehri Garhwal**, 3180 m, 15 Aug. 1975, *F. Herbiere Billet & J. Leonard 6554* (K). **Lahul & Spiti**, 3352 m, 12 June 1941, *N. L. Bor 12668* (E00644121); Himachal Pradesh, Pangi, 3350–3960 m, *G. Watt 49A* (E00273625).



Figure 45(2)–66: *Pedicularis bicornuta* Klotzsch. a-b, habit; c, calyx, and ovary; d, stamen. A.-L. LI modified from KLOTZSCH & GARCKE [*Bot. Ergeb. Reise Pr. Waldemar*: 109, figure 61. 1862].



Map 45(2)-142: *Pedicularis bicornuta* Klotzsch

Ser. 51. *Pumiliones*

Ser. *Pumiliones* Prain, Ann. Roy. Bot. Gard. Calc. 3: 69. 1890. Type: *Pedicularis przewalskii* Maxim.

Herbs, some stemless, pubescent. Leaves in a rosette; leaf blade narrowly oblong, more or less entire, or mostly pinnatifid. Calyx tube often 5-lobed. Corolla tube very long; galea beaked; lower lip spread.

One species; in the Pan-Himalaya and adjacent regions.

Notes: Prain established series *Pumiliones*, which includes two species (*P. przewalskii* Maxim. and *P. bella* Hooker f.). Yamazaki (2003. J. Jap. Bot. 78: 201) described *P. lobatorostrata* T. Yamaz. as new based on one collection from Qinghai, which is here treated as a new synonym of *P. przewalskii* Maxim. Molecular phylogenetic results reveal that the two species do not form reciprocal sister clades, although individuals of each species form a monophyletic clade. Morphologically, the corolla of *P. bella* is dark-purple throughout or some with a pale-yellow tube, purple and falcate galea, S-shaped beak, and white lower lip upward and enclosing galea and beak. The corolla of *P. przewalskii* is often purple-red, with galea bent at a right angle apically, crested in front, straight beak, and spreading lower lip. The great difference between the two taxa, as well as evidence of molecular data, support that they belong to different series. Hence, we here retain *P. przewalskii* in the series *Pumiliones* and transfer *P. bella* to the series *Bellae*.

143. *Pedicularis przewalskii* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersb. 24: 55. 1878; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 351. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 201. 1998. \equiv *Pedicularis przewalskii* var. *typica* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 112. 1949. Type: China, Gansu, "Terra Tangutorum", July 1872, *Pl. a N. M. Przewalski s.n.* (holotype: LE; isotypes: P).

Pedicularis przewalskii subsp. *hirsuta* (H. L. Li) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 352. 1963. **syn. nov.** \equiv *Pedicularis przewalskii* var. *hirsuta* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 113. 1949. Type: China, Yunnan, Yongning, Wunha Shan, May 1932, *J. F. Rock 24224* (holotype: US).

Pedicularis przewalskii subsp. *microphyton* (Bureau & Franch.) P. C. Tsoong, in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 353. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 202. 1998. **syn. nov.** \equiv *Pedicularis microphyton* Bureau & Franch., J. Bot. (Morot) 5: 107. 1891. \equiv *Pedicularis przewalskii* var. *microphyton* (Bureau & Franch.) H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 114. 1949. Type: China, Sichuan, Kangding to Litang/Batang "Province de Setchuen, entre Batang et Litang, sur les gazons secs et sur les coteaux avant Ta-tzien-lou". [**lectotype designated here:** P(P02977046); isolectotype: P(P02977047)].

Pedicularis przewalskii subsp. *australis* (H. L. Li) P. C. Tsoong, Acta Phytotax. Sin. 3: 277. 1955; Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 352. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 202. 1998. **syn. nov.** \equiv *Pedicularis przewalskii* var. *australis* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 113. 1949. Type: China, Yunnan, Dêqên, "Pei-ma shan, Mekong-Salween Divide, southeast of Atuntsi", 4420 m (14500 ft), May–June 1932, *J. F. Rock 22840* (holotype: US; isotype: E).

Pedicularis lobatorostrata T. Yamaz., J. Jap. Bot. 78: 201. 2003. **syn. nov.** Type: China, Maduo,

near the Bayanka-La Mountain, 4586 m, 14 Aug. 2002, *G. Miehe, Sonamco & K. Koch. 02-23-10* [holotype: TI].

Herbs perennial, 6–12 cm tall, slightly black when dry. Roots numerous, fascicled, and more or less fusiform. Stems often cespitose, 1–3 cm tall. Leaves mostly basal; petiole 0.1–2.5 cm long, glabrous; leaf blade lanceolate-linear, 1.5–4 cm long, 3–8 mm wide, adaxially glabrous to densely pubescent, sometimes glandular-pubescent, pinnatifid; segments 9–30 pairs, crenate-dentate. Inflorescences centrifugal, 3- to more than 20-flowered. Calyx 8–11 mm long, 2/5 cleft anteriorly; lobes 5 (occasionally 2 or 3, two lateral ones more or less united and posterior one inconspicuous), serrate apically, long-ciliate. Corolla purple-red throughout or with yellowish-white throat or white to cream-purple beak, lower lip purple-red, white to pale-yellow; tube 30–40 mm long, long-pubescent; galea bent at a right angle apically, crested or not in front; beak straight, 5–6 mm long, slender, deeply 2-cleft with linear lobes; lower lip more or less equal in size, middle lobe rounded to emarginate. Filaments all pubescent. Capsule obliquely oblong. Figure 45(2)–67. **Chromosomes:** $2n = 16$.

Phenology: flowering from June to August.

Habitats: alpine meadows; 4000–5300 m.

Distribution: M Yarlung Zangbo, L Yarlung Zangbo, Tangut, N Hengduan, S Hengduan [Map 45(2)–143]; also in other regions of Gansu, Qinghai, and Sichuan Provinces, China.

Notes: In *Fl. Reipubl. Popularis Sin.* and *Fl. China*, several subspecies were recorded, including *P. przewalskii* subsp. *hirsuta* (H. L. Li) P. C. Tsoong, *P. przewalskii* subsp. *microphyton* (Bureau & Franch.) P. C. Tsoong, and *P. przewalskii* subsp. *australis* (H. L. Li) P. C. Tsoong. These subspecies are mainly distinguished by the size of leaf blade, the presence or absence of pubescence on leaf back, and the number of calyx dentate (2-3 vs. 5). Extensive field and specimen investigation reveal that colors of corolla (galea, beak, and lower lip) and the presence or absence of pubescence vary within or among populations. Hence, these subspecies are here treated as new synonyms of *P. przewalskii*.

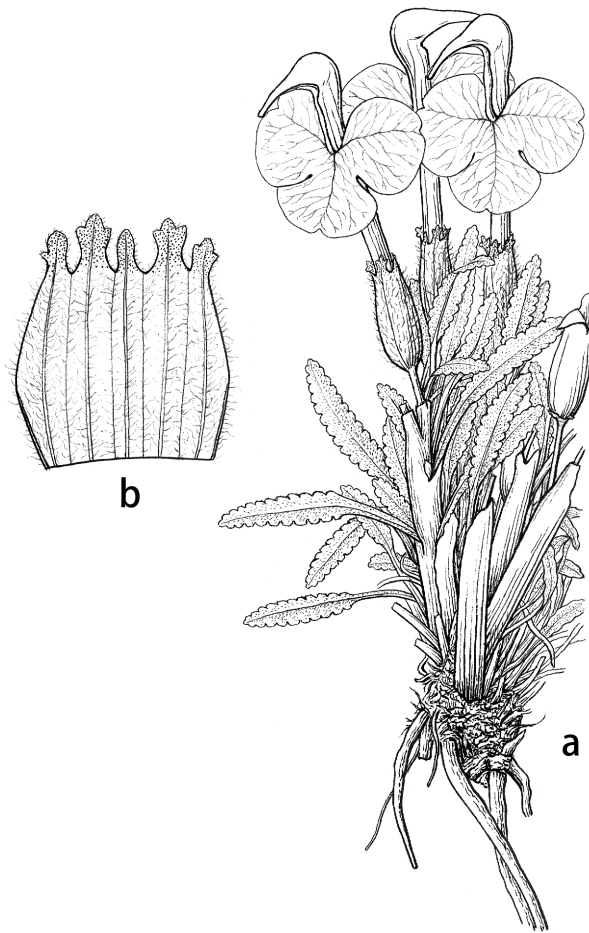
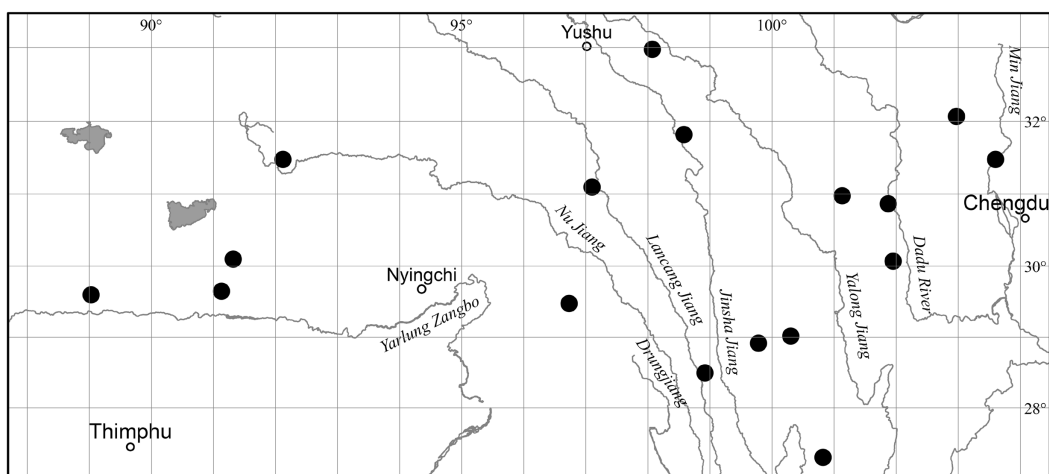


Figure 45(2)–67: *Pedicularis przewalskii* Maxim. a, habit; b, calyx. Drawn by Z.-H. WU [*Fl. Reipubl. Popularis Sin.* 68: 351, figure 81: 5-6. 1963].

Yamazaki described *P. lobatorostrata* T. Yamaz. as new based on a collection from Qinghai, China. He placed it in the series *Longiflorae* and stated that “This species resembles *Pedicularis latituba* Bonati (Ser. *Longiflorae*), but differs from it by the deeply bilobed galea”. However, we find that *P. lobatorostrata* T. Yamaz. is congruent with some syntypes of *P. przewalskii* Maxim. Hence, *P. lobatorostrata* T. Yamaz. is here treated as a new synonym of *P. przewalskii*. Our molecular phylogenetic results reveal that individuals of different populations of *P. przewalskii* Maxim. form a well-supported clade where

P. lobatorostrata T. Yamaz. is nested, supporting our taxonomic treatment.

M YARLUNG ZANGBO: Lhasa, 3962–4267 m, 25 June 1943, *F. Ludlow & G. Sherriff* 9707 (PE); **Lhünzhub**, 4724 m, 24 July 1942, *F. Ludlow & G. Sherriff* 8875 (PE). **Namling**, Qunmuo, 4800–4900 m, 30 July 1972, *Beijing Botanical Institute (PE)* 863 (PE). **L YARLUNG ZANGBO:** Rawu, 5000 m, 16 July 1975, *C. Y. Wu & S. K. Chen* 75-843 (PE). **TANGUT:** Dêgê, Que-cr Shan, 4710 m, 9 Aug. 2000, *F. S. Yang* 2068 (PE). **Nagqu**, 4300–4600 m, 12 Aug. 1976,



Map 45(2)-143: *Pedicularis przewalskii* Maxim.

Qinghai-Xizang Exped. Nagqu group 10853 (PE). **Qamdo**, 4200 m, 18 July 1976, *Qinghai-Xizang Exped. 12591* (PE). **Sêrxü**, Hongqi, 4110 m, 22 July 2004, *Y. H. Wu 29523* (HNWP). **N HENGDUAN: Danba**, Qianning to Dawu, 3700 m, 27 June 1965, *Y. T. Zhao & K. Y. Lang 52* (PE). **Dawu**, Balei, Dapao Shan, 4200 m, 11 June 1991, *J. S. Yang 91-298* (IBSC). **Heishui**, Fenshuiling, 4300 m, 1 July 1959, *South-to-North Water Divers. Proj. Exped. 01474* (SZ); Heishui, 4320 m, 1 July 1959, *S. Jiang 01474* (PE). **Wenchuan**, Balang Shan, 3850 m, 18 Aug. 1982, *K. Y. Lang & L. Q. Li 1167* (PE). **S HENGDUAN: Daocheng**, Bowa Shan, 4570 m, 3 July 1982, *X. H. Hu 28973* (CDBI). **Dêqên**, Baimangxue

Shan, 4300 m, 10 July 1989, *C. M. Zhang 89047* (SAGB); Dêqên, Baimangxue Shan, 4300 m, 1990, *Y. Fei et al. 005* (KUN); Dêqên, Baimangxue Shan, 4500 m, 30 June 2001, *F. S. Yang Y0010* (PE); Dêqên, Baimangxue Shan, 4500–4700 m, 13 July 1981, *Qinghai-Xizang Exped. 2370* (PE). **Kangding**, Zheduo Shan, 3800 m, 27 May 1973, *Qinghai-Xizang Exped. 73-13* (KUN); Kangding, Gongga Shan, Moxi, 4721 m, 16 Aug. 2017, *W. B. Ju & C. C. Zheng THP-KD-6202* (CDBI). **Ninglang**, Yongning, Mount Wuaha, 4110 m (13500 ft), May 1932, *Rock, J. F. 24224* (E, US). **Xiangcheng**, Wuming Shan, 4500 m, 24 July 2001, *F. S. Yang Y0067* (PE).

Ser. 52. Bellae

Ser. Bellae F. S. Yang, **ser. nov.**

Herbs less than 10 cm tall, pubescent. Leaves in a rosette; leaf blade oblong, more or less entire, or mostly pinnatifid. Corolla tube two times longer than calyx; galea S-shaped; lower lip more or less enclosing galea.

One species; endemic to the Pan-Himalaya.

144. *Pedicularis bella* Hook. f., Fl. Brit. India 4: 313. 1885; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 353. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 202. 1998. \equiv *Pedicularis bella* var. *typica* H. L. Li., Proc. Acad. Nat. Sci. Philad. 101: 110. 1949. Type: India, Sikkim, Kongra Lama, 4876 m (16000 ft), *J. D. H (Hooker) Pedicularis 22* [holotype: K; isotype: S11-639].

Pedicularis bella subsp. *holophylla* (C. Marquand & Airy Shaw) P. C. Tsoong, Acta Phytotax. Sin. 3: 277. 1955; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 354. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 202. 1998. **syn. nov.** \equiv *Pedicularis bella* var. *holophylla* C. Marquand & Airy Shaw, J. Linn. Soc. Bot. 48: 211. 1929. Type: China, Tibet, Lhünzê, Tang La, 3657–3962 m (12000–13000 ft), 24 July 1917, *F. Kingdon-Ward 5942* [holotype: K].

Herbs annual, barely 10 cm tall, not black when dry. Roots long conical, more or less woody. Stems 0.1–3 cm tall, numerous, caespitose, white-pubescent. Leaves mostly basal; petiole 0.5–2 cm long, sheathlike dilated at base, slightly pubescent; leaf blade ovate-lanceolate, 1–1.5 cm long, 3–6 mm wide, pinnatifid or entire; segments 3–9 pairs, crenate-dentate, abaxially whitish-pubescent, adaxially densely pubescent. Flowers axillary, 1–14; pedicels 3–7 mm long, with densely long-whitish pubescence. Calyx 12–15 mm long, ca. 5 mm wide, densely white-pubescent, 1/3 cleft anteriorly; lobes 5, unequal in size. Corolla dark-purple throughout or some with a pale-yellow tube, purple galea, and white lower lip; tube 25–35 mm long, pubescent; galea falcate; beak more or less S-shaped, 6–8 mm long; lower lip

20–24 mm wide, middle lobe oblong-ovate, much smaller than lateral pair. Filaments all pubescent. Capsule obliquely oblong, ca. 2 times as long as calyx. Figure 45(2)–68.

Phenology: flowering from June to July.

Habitats: meadows, steep rocky slopes among dwarf *Rhododendron*, cliff faces; 3600–4900 m.

Distribution: endemic; Sikkim & Darjeeling, Bhutan, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra [Map 45(2)–144].

Notes: Tsoong described several varieties and forms as new under *P. bella* subsp. *holophylla* P. C. Tsoong. Our molecular phylogenetic results reveal that all individuals of *P. bella* form a well-supported clade.

SIKKIM & DARJEELING: Sikkim, Kongra Lama, 4876 m. *J. D. Hooker Pedicularis 22* (K); Sikkim, Zemu Glacier, Momay Samdong, 4876 m, 11 Sept. 1947, *G. H. Cave 146/47* (E). **BHUTAN:** Thimphu, Limce tongu Basin, 4400 m, July 2000, *S. Miehe & G. Miehe 00-213-02* (TI). **M YARLUNG ZANGBO:** Lhünzhub, 4724 m, 28 July 1942, *F. Ludlow & G. Sherriff 8903* (E). Nêdong, Zedang to Lhünzê, 4800 m, 13 Aug. 1977, *B. Z. Guo & W. Y. Wang 22382* (HNWP). **L YARLUNG ZANGBO:** Gyaca, Tsangpo tributary, 4950 m, 2 Aug. 1994, *B. Dickore 10451* (TI). **Mainling,** 3962 m, 9 July 1938, *F. Ludlow, G. Sherriff & G. Taylor 5185* (E). **Nyingchi,** Sejila Shan, 4600 m, 25 July 1979, *Tibetan Team 999* (HNWP). **YARLUNG ZANGBO-BRAHMAPUTRA:** Mêdog, Cubumbu La, 3810 m, 2 June 1938, *F. Ludlow, G. Sherriff & G. Taylor 3946* (E). **Lhünzê,** Tang La, 3650–3960 m, 24 July 1917, *F. Kingdon-Ward 5942* (K).

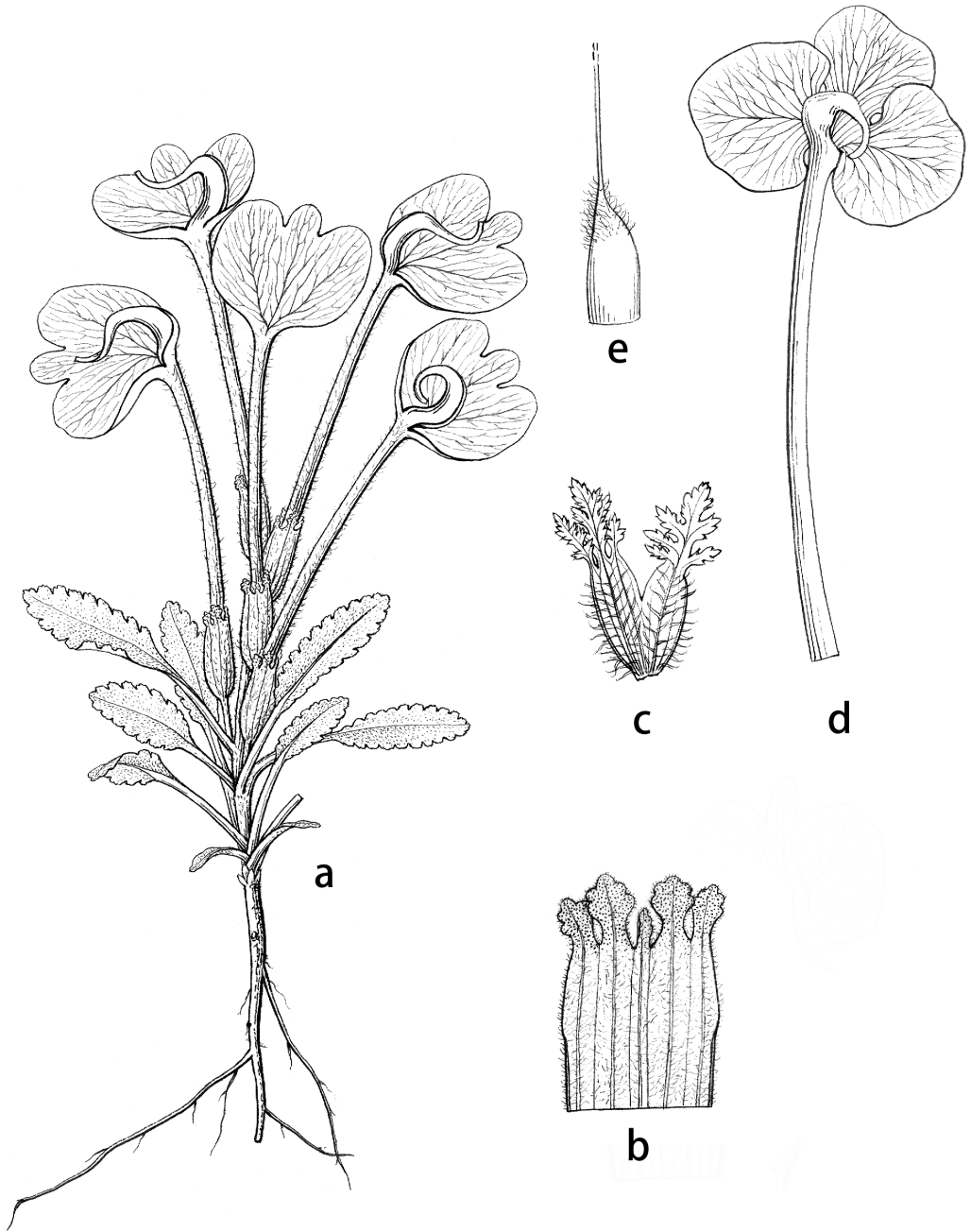
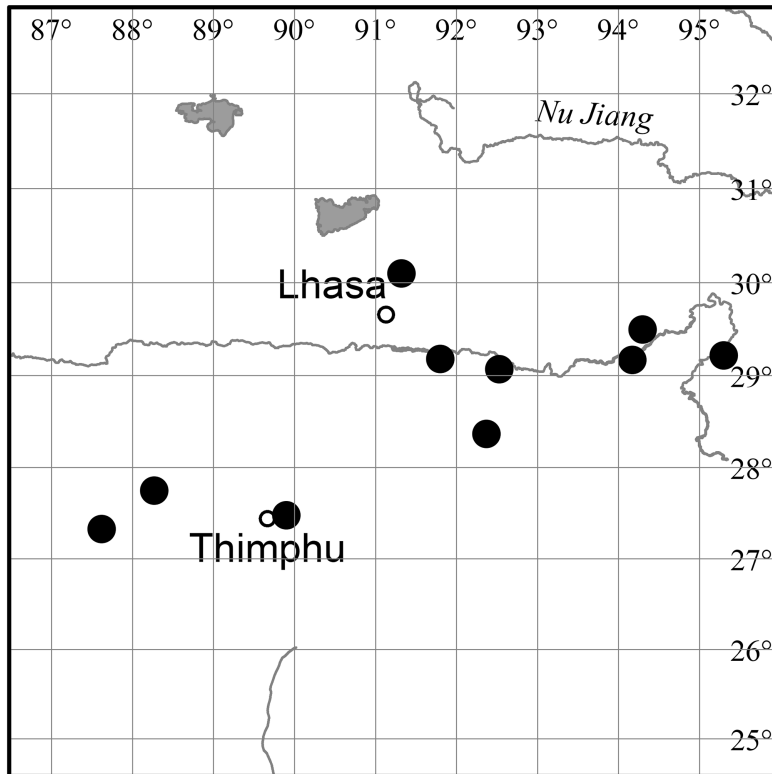


Figure 45(2)–68: **Pedicularis bella** Hook. f. a-b: a, habit; b, calyx. Drawn by Z.-H. WU [*Fl. Reipubl. Popularis Sin.* 68: 353, figure 81: 3-4. 1963]. **Pedicularis tricolor** Hand.-Mazz. c-e: c, calyx; d, corolla; e, ovary. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 361, figure 82: 5-7. 1963].



Map 45(2)-144: *Pedicularis bella* Hook. f.

Ser. 53. Longiflorae

Ser. Longiflorae Prain, Ann. Roy. Bot. Gard. Calc. 3: 67. 1890.

Basal leaves often persistent, long-petiolate; cauline leaves alternate, numerous; blade lanceolate-oblong, often pinnatipartite to pinnatisect. Inflorescences centrifugal. Calyx lobes 2, 3 (or sometimes 5), unequal in size. Corolla tube very long, more than 2 times as long as calyx; galea beaked; lower lip often spreading.

About 20 species; 18 in the Pan-Himalaya (11 endemics).

Notes: The series *Longiflorae* Prain is characterized by short stems, basal leaves, and long corolla tube. Molecular phylogenetic results indicate that species of this series form a moderately supported clade.

1a. Leaf segments 3–6 (sometimes –10) pairs; corolla tube 18–22 mm long..... 145. *P. punctata*

1b. Leaf segments more than 6 pairs; corolla tube 25–80 mm long.

2a. Corolla yellow throughout or with red galea and white lower lip margins; corolla galea more or less coiled but not twisted.

- 3a. Corolla yellow, with red/maroon galea and white/ivory margin on lower lip; leaf segments narrow, 1–3 mm wide..... 146. *P. tricolor*
- 3b. Corolla usually yellow throughout, sometimes with maroon spots on lower lip or galea; leaf segments usually 2–5 mm wide.
- 4a. Leaves pinnatisect; corolla tube 25–30 mm long 147. *P. croizatiana*
- 4b. Leaves pinnatifid to pinnatipartite, some merely undulate-lobed; corolla tube more than 40 mm long.
- 5a. Corolla galea crested in front; corolla tube less than 3 times as long as calyx; calyx lobes 3 148. *P. cranolopha*
- 5b. Corolla galea not crested in front; corolla tube 3–10 times as long as calyx; calyx lobes usually 2.
- 6a. Corolla galea bent at a right angle, galea beak 12–15 mm long.....
..... 149. *P. armata*
- 6b. Corolla galea curving gradually, galea beak 6–10 mm long.
- 7a. Lobes of corolla lip emarginate; galea beak 2 cleft at apex; plants glabrescent 150. *P. longiflora*
- 7b. Lobes of corolla lip rounded, not emarginate; galea beak entire at apex; plants pubescent.
- 8a. Herbs 6–8 cm tall; leaf blade linear-oblong, undulate-lobed; segments subrounded, shallowly undulate-dentate 151. *P. bidentate*
- 8b. Herbs 10–30 cm tall; leaf blade lanceolate-oblong to linear-oblong, pinnatifid; segments ovate, margin double dentate 152. *P. chinensis*
- 2b. Corolla purple, with purple galea; galea twisted.
- 9a. Middle lobe of corolla lip emarginate to deeply 2-lobed.
- 10a. Beak of corolla less than 6 mm long, more or less semicircular; leaves pinnatipartite to pinnatisect..... 153. *P. latituba*
- 10b. Beak of corolla 8–15 mm long, usually S-shaped; leaves pinnatisect.
- 11a. Calyx 5–6 mm long, lobes 2; corolla tube less than 26 mm long; plants often with short-creeping stems..... 154. *P. humilis*
- 11b. Calyx more than 10 mm long, lobes 2 or 3(–5); corolla tube more than 30 mm long; plants erect.
- 12a. Beak of galea 11–15 mm long; filaments all pubescent..... 155. *P. sigmoidea*
- 12b. Beak of galea less than 10 mm long; filaments 2 pubescent, 2 glabrous.
- 13a. Proximal part of galea erect and distinctly auriculate dentate on each side of margins..... 156. *P. siphonantha*
- 13b. Galea strongly twisted at proximal part, without auriculate teeth on each side of the margins.
- 14a. Petioles and stems densely long-villose; calyx-tube about 6–8 mm long 157. *P. dolichosiphon*
- 14b. Petioles and stems glabrous to sparsely pubescent; calyx-tube about 10–13 mm long.
- 15a. Middle lobe of lower lip spread; corolla tube cylindroid 158. *P. delavayi*
- 15b. Middle lobe of lower lip folded; corolla tube ridged..... 159. *P. milliana*

9b. Middle lobe of corolla lip entire, truncate, or rounded.

16a. Corolla white, some with purple galea.

17a. Calyx lobes 3–5; corolla tube 5–6 times as long as calyx; filaments 2 pubescent, 2 glabrous 160. *P. leptosiphon*

17b. Calyx lobes 2; corolla tube 8–9 times as long as calyx; filaments all pubescent..... 161. *P. paxiana*

16b. Corolla red, rose, to purple throughout (corolla of *P. fastigiata* is rose with a deep red galea).

18a. Corolla tube 35–40 mm long; beak of galea semicircular; filaments all glabrous.....162. *P. fastigiata*

18b. Corolla tube 60–110 mm long; beak of galea S-shaped; anterior 2 filaments pubescent apically.....163. *P. tenuituba*

145. *Pedicularis punctata* Decne, Jacq. Voy. Bot. 117. 1844; Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 154. 1943. Type: Jammu & Kashmir, Gombour, *s.d. Jacquemont 1026* [lecto-type designated by Garg & Singh (2020: 88): P(P02977057); isolectotypes: P(P02977058, P02977066, P02977067, P02977071)].

Pedicularis kaghanensis T. Yamaz., J. Jap. Bot. 68: 148. 1993. **syn. nov.** Type: Pakistan, N Pakistan, Hazara, Kagan Valley, 2650 m, 29 July 1990, *U. Schickhoff 1171* (holotype: TI).

Erect or ascending herbs, 6–35 cm tall. Stems usually several, ridged, sparsely pubescent, few to many from the roots, slender and leafy. Basal leaf blade pinnatifid, linear-oblong to ovate-oblong; segments 3–6 pairs; teeth acute or somewhat rounded; cauline leaves alternate; blade sessile or subsessile, blade oblong to elliptic; lobes narrow crenate-serrate. Inflorescences axillary. Flowers pedicellate, bracteolate; pedicels 1–3 mm long, hairy. Calyx 7–11 mm long, sparsely hairy, bilobed, each lobe with crested dentate lobules, longitudinally nerved, nerves forked into dentate lobes, a tooth with pointed tips. Corolla purple (sometimes white to light-pink), throat of labium white; tube 18–22 mm long, 2–4 times calyx length, slender, finely to densely hairy; beak twisted, 5–7 mm long; tip deeply notched, circular; lower lip 8–13 mm long and 10–15 mm wide, 3-lobed, middle lobe smaller, margin hairy. Filaments 2 sparse hairs, 2 glabrous.

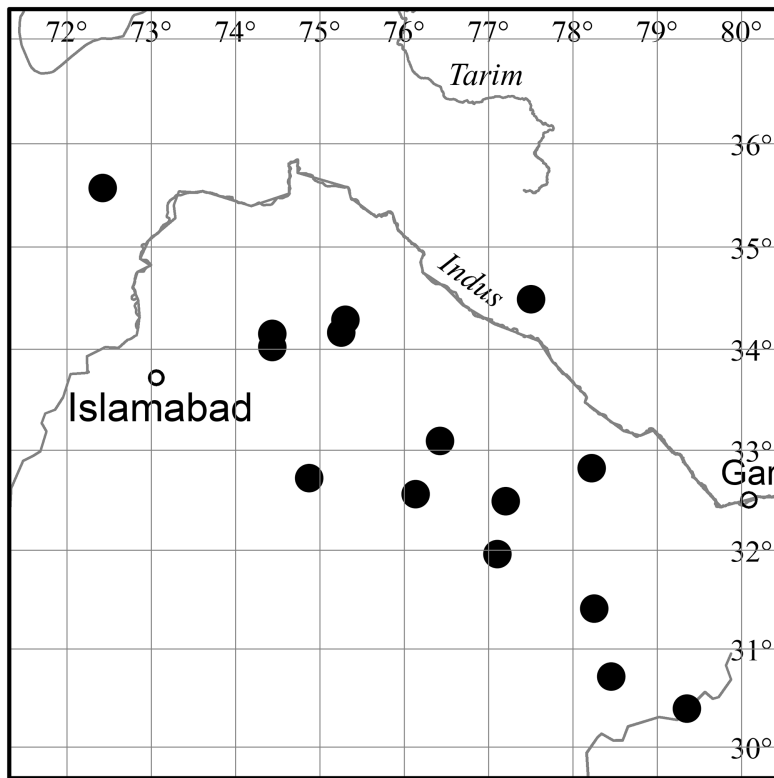
Phenology: flowering and fruiting from June to September.

Habitats: along running streams on mountain slopes; 1800–4550 m.

Distribution: N Pakistan, Jammu & Kashmir, U Ganga & Indus [Map 45(2)–145]; also in other parts of Afghanistan.

Notes: Yamazaki stated that *P. kaghanensis* T. Yamaz. resembles *P. hookeriana* Wall. ex Benth. but differs in having more lobed leaf segments, densely pilose calyx, and pilose anterior filaments. Mill (2001) noted on the type specimen that it is a new synonym of *P. punctata* Decne. After examination of types and more herbarium specimens, we agree with Mill that *P. kaghanensis* should be treated as a synonym of *P. punctata* Decne.

N PAKISTAN: Swat, Kalam, along the trail by Swat river, near Kalam, 25 miles above Bahrein, 1800–2100 m, 19 Aug. 1952, *R. J. Rodin 5616* (K). **JAMMU & KASHMIR:** **Gulmarg**, Khillar Margs, 2500 m, 31 Aug. 1972, *M. A. Rau 50287* (BSD). **Jammu**, Sinthon, 3300 m, 23 July 1957, *G. Saran & Party 30326* (LWG). **Ladak**, Pilung chho, 20 July 1976, *B. M. Wadhwa 58802* (BSD). **Liddar Valley**, 3000 m, 6 July 1902, *J. R. Drummond 14130* (BM). **Sonamarg**, 10 Aug. 1987, *B. M. Wadhwa, S. K. Murti & P. C. Pant 85204* (BSD). **Tangmarg**, along Firozpur nala, 29 June 1956, *Kaul & Party 23472* (LWG). **U GANGA & INDUS:** **Chamba**, Bindrabam, 2500 m, 17 July 1964, *N. C. Nair 32504* (BSD); Chamba, Sach Pass, 2700–4000 m, 6 Sept. 1895, *J. H. Lace 1228* (E00645118). **Chamoli**, Bagra Pass, Sept. 1993, *Bipin Balodi 82640* (BSD). **Gondla**, 3500 m, 28 June 1958,



Map 45(2)-145: *Pedicularis punctata* Decne

M. A. Rau 5955 (BSD); Gondla, 3500 m, 27 June 1958, *M. A. Rau* 5955 (BSD). **Kalpa**, Bashahr, 2725 m, 31 Aug. 1963, *N. C. Nair* 30299 (BSD). **Kilar**, 2625 m, 18 July 1964, *N. C. Nair* 32626 (BSD). **Kulu**, near the summit of Rohtang Pass, 4300 m, Aug. 1978, *C. D. Sayers* 3641 (BM); **Lahul-Spiti**, on way from Koksar to Rohtang, 16 Sept. 2001, *T. Husain & T. S. Rana* 222141 (LWG). **Uttarkashi**, on way to Barasu Pass, 21 Aug. 1996, *Bipin Balodi* 92221 (BSD).

146. *Pedicularis tricolor* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 59: 250. 1922; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 361. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 204. 1998. Type: China, NW Yunnan, Shangri-la (Zhongdian), "Prope pagum Dschungdien (Chungtien), in regionis temperatae et frigide temper, pratis siccis supra vi-

cum Baoschi." 3400–3700 m, 17 Aug. 1915, *H. R. E. von Handel-Mazzetti* 7526 (holotype: WU; isotypes: P, E).

Pedicularis zhongdianensis H. P. Yang, Acta Bot. Yunnan. 6: 277. 1984; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 204. 1998. **syn. nov.** Type: China, Yunnan, Shangri-la (Zhongdian), in *Pinus yunnanensis* forests, 3300 m, 19 Aug. 1981, *K. Y. Zhao* 762 [holotype: PE(00032313)].

Pedicularis cranolopha var. *garnieri* Bonati, Notes Bot. Gard. Edinb. 13: 144. 1921; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 361. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 204. 1998. Type: China, Yunnan, Shangri-la, Baimaxue Shan, 3657 m (12000 ft), Aug. 1914, *G. Forrest* 13187 (holotype: E).

Herbs annual, less than 5 cm tall. Stems single to several, unbranched, central stem erect, outer stems procumbent, longer, glabrous. Basal leaves numerous; petiole 1.5–4 cm long; leaf blade lanceolate, 2.5–4.5 long and 0.7–1.2 cm wide, glabrous, abaxially sparsely white-scurfy, pinnatipartite to pinnatisect; segments 11–14 pairs, lanceolate, incised-dentate; cauline leaves usually 2, pseudo-opposite. Inflorescences racemose; bracts leaflike; pedicels 2–8 mm long, glabrous. Calyx tube ovate, 8–12 mm long, 1/2 to 4/5 cleft anteriorly, densely long-white pubescent; lobes 2 or 3, unequal in size, lateral lobes leaflike. Corolla yellow, with more or less maroon galea, and white/ivory margin on lower lip; tube 30–50 mm long, pubescent at base; galea more or less crested, beak circular, 7–9 mm long; lower lip 14–17 mm long, 25–30 mm wide, glabrous, middle lobe emarginate, lateral lobes rounded or emarginate. Filaments all pubescent. Figure 45(2)–68. **Chromosomes:** $2n = 16$.

Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; 3000–3600 m.

Distribution: endemic; N Hengduan, S Hengduan [Map 45(2)–146].

Notes: Bonati described *P. garnieri* as new based on a collection (*R. Soulié 3763*) from Kangding, Sichuan, China. When he examined another collection (*G. Forrest 13187*) from Shangri-la (Zhongdian, Yunnan), he then treated *P. garnieri* Bonati as a variety of *P. cranolopha* Maxim. (var. *garnieri* Bonati). However, the two collections from different sites are quite different and the latter (*G. Forrest 13187*) matches well *P. tricolor* Hand.-Mazz. In addition, Tsoong in *Fl. Reipubl. Popularis Sin.* (1963. 68: 362) described *P. tricolor* var. *aequiretusa* P. C. Tsoong as new because it differs from the typical plants in emarginate lobes of corolla lip. Field investigation and specimen examination confirm that it is difficult to distinguish two varieties by the subtle difference, and *P. tricolor* var. *aequiretusa* is here treated as a new synonym.

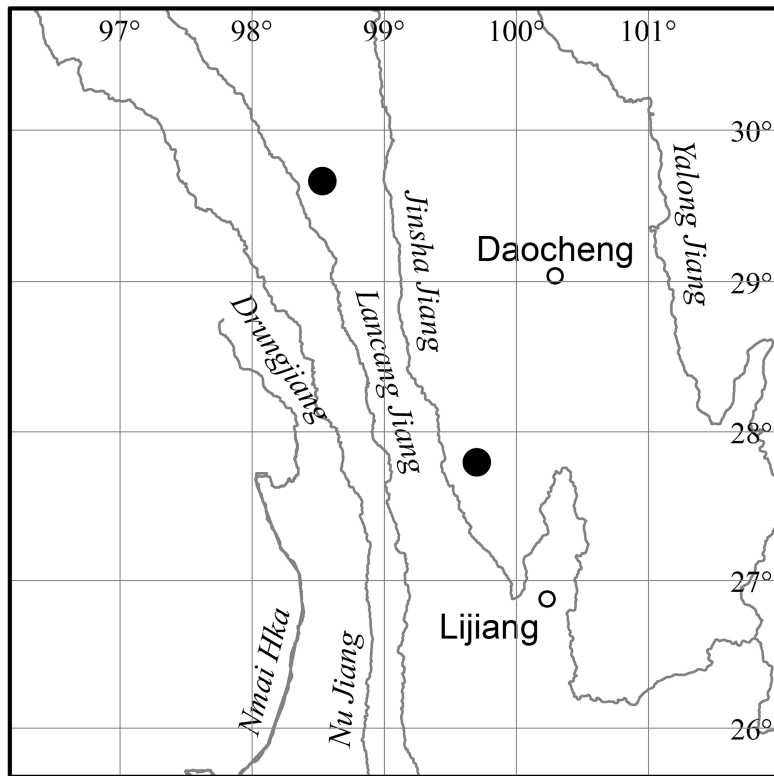
Yang described *P. zhongdianensis* H. P. Yang as new based on one collection from Shangri-la (Zhongdian) and stated that it resembles *P. megalochila* H. L. Li and *P. megalantha* D. Don.

However, these two species (*P. megalochila* H. L. Li and *P. megalantha* D. Don.) belong to the series *Megalanthae* Prain, which are distributed in the Himalayas and are characterized by five-lobed calyx and large lower lip enclosing galea. The lower lip of *P. zhongdianensis*, by contrast, is smaller and never encloses galea, and the calyx has three lobes. All these characters of *P. zhongdianensis* point to the series *Longiflorae*. After examinations of types and herbarium specimens, we find that *P. zhongdianensis* matches well *P. tricolor* Hand.-Mazz., both distributed in Shangri-la of the Hengduan Mountains. Our molecular phylogenetic results reveal that *P. tricolor* Hand.-Mazz. is closely related to *P. cranolopha* Maxim. and *P. croizatiana* H. L. Li, but species relationships are poorly resolved.

N Hengduan: Markam, near the city, 3900 m, 20 Aug. 2001, *F. S. Yang Y0192* (PE).
S HENGDUAN: Shangri-la (Zhongdian), Wufeng Shan, 3300 m, 31 July 1937, *T. T. Yü 12541* (IBSC, PE); Shangri-la (Zhongdian), near the city, 3300 m, 23 Aug. 2001, *F. S. Yang Y0204* (PE); Shangri-la (Zhongdian), Napahai, 3280 m, 24 Aug. 1989, *Z. D. Fang 1330* (SABG); Shangri-la (Zhongdian), Jiantang, Alpine Botanic Garden, 3378 m, 3 Sept. 2009, *F. G. He & A. F. Xie Zhwy-269* (SABG).

147. Pedicularis croizatiana H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 187. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 357. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 203. 1998. Type: China, Sichuan, Muli, “mountains between the Litang and Shou-Chu Rivers, between Wa-Erh-Dje and Garu”, 3700 m, July-Aug. 1928, *J. F. Rock 16899* (holotype: PH; isotypes: E, US).

Herbs perennial, 5–20 cm tall, slightly black when dry. Stems usually numerous, unbranched, ascending or procumbent, and densely pubescent. Leaves alternate, sometimes pseudo-opposite; petiole 1–2.5 cm long, pubescent; leaf blade lanceolate-linear to more or less ovate-oblong, 2–4.5 cm long, 5–10 mm wide, glabrous except for pubescent midvein, pinnatisect; segments 9–12 pairs, ovate-triangular to oblong-lanceolate, margin double-dentate. Flowers axillary; bracts



Map 45(2)-146: *Pedicularis tricolor* Hand.-Mazz.

pubescent; pedicels 1–1.8 mm long, long-pubescent. Calyx 10–13 mm long, 1/3 cleft anteriorly, long-pubescent; lobes 2 or 3, unequal in size, posterior one smallest, lateral pair incised double-dentate. Corolla yellow, 30–40 mm long; tube 25–30 mm long, sparsely pubescent; galea falcate apically, conspicuously crested in front; beak more or less coiled, 5–6 mm long; lower lip 9–15 mm long, 15–21 mm wide, ciliate, lobes more or less equal in size emarginate. Filaments densely pubescent apically. Figure 45(2)–69.

Phenology: flowering from July to August.

Habitats: *Pinus* forests, alpine meadows; 3700–4200 m.

Distribution: M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S Hengduan [Map 45(2)–147]; also distributed in Qinghai and Gansu Provinces, China.

Notes: *Pedicularis croizatiana* H. L. Li resembles *P. tricolor* Hand.-Mazz. and *P. cranolopha* Maxim. but differs notably in longer flower pedicels, shorter corolla-tube, and more or less emarginated lateral lobes of corolla lip. Our molecular data support a close relationship between these three species in the phylogeny of *Pedicularis*.

M YARLUNG ZANGBO: Lhasa, hills N of Lhasa, 3960 m, 31 Aug. 1943, *F. Ludlow & G. Sherriff* 9908 (PE). **L YARLUNG ZANGBO:** **Gongbo'gyamda**, 4200 m, 30 Aug. 1974, *Qinghai-Xizang Exped. 74-2010* (PE, HNWP); Gongbo'gyamda, Pikang, 23 July 1974, *Qinghai-Xizang Exped. 74-3705* (PE); Gongbo'gyamda, 318 Road to Nyingchi, 4259 m, *X. C. Chen et al. 5985* (HNWP). **YARLUNG ZANGBO-BRAHMAPUTRA:** **Zayü**, guyu, 3800 m, 2 Sept. 1983, *B. S. Li, Z. C. Ni & S. Z. Cheng* 07277 (PE).

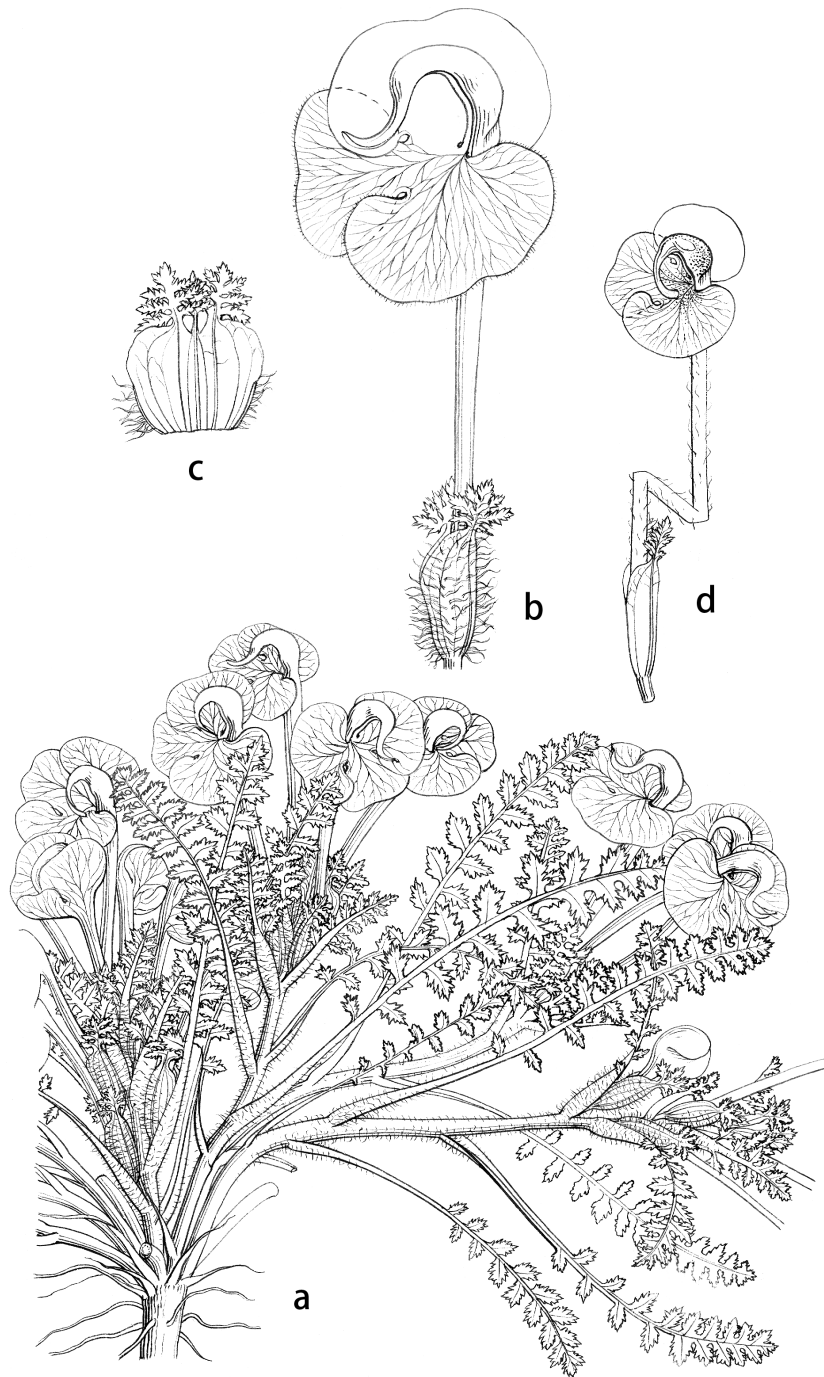
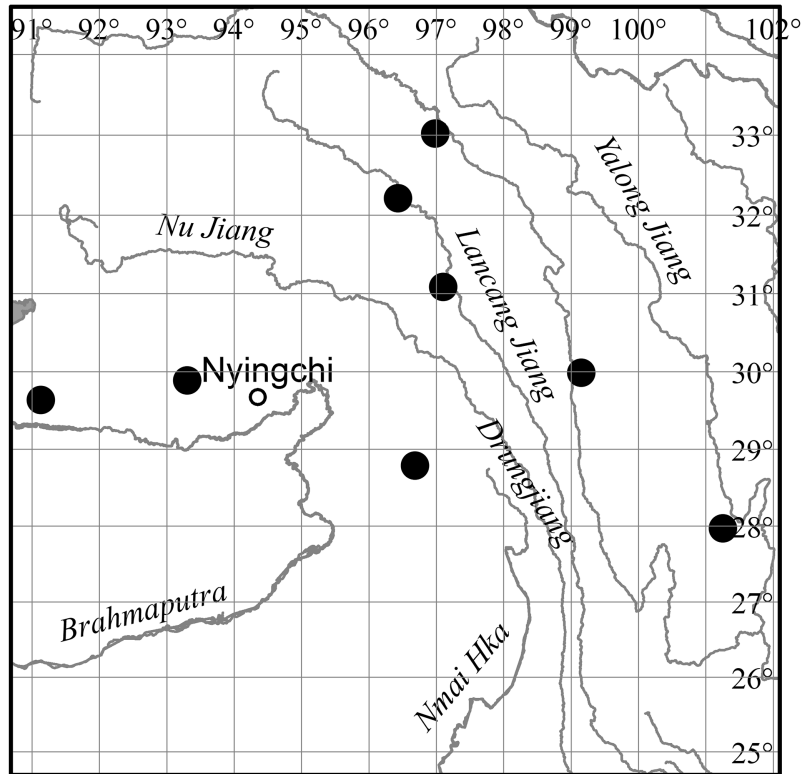


Figure 45(2)–69: *Pedicularis croizatiana* H. L. Li. a-c: a, habit; b, flower; c, calyx. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 357, figure 82: 1-3. 1963]. *Pedicularis cranolopha* H. L. Li. d, flower. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 357, figure 82: 4. 1963].



Map 45(2)-147: *Pedicularis croizatiana* H. L. Li

TANGUT: Nangqên, just W of Jiangxi Forrest Station on W side of the Zi Qu, SE of Mozhong, 3450–3550 m, 32°5' N, 97° E, 18 Aug. 1996, *T. N. Ho, B. Bartholomew, M. Watson et al.* 2536 (BM, E, HNWP, MO, PE). **Qamdo**, Northeast of Xiawu, on the south side of the Pass between Zhubgyugoia and Xiawu, on road between Madoi and Yushu, 4020 m, 32°12' N, 97°26' E, 13 Aug. 1996, *T. N. Ho, B. Bartholomew, M. Watson et al.* 1725 (BM, E, HNWP, MO, PE). **Yushu**, SE of the Baitang river basin in a valley that runs down to the Tongtian river, 3700 m, 32°45' N, 97°21' E, 18 Aug. 1996, *T. N. Ho, B. Bartholomew, M. Watson et al.* 1993 (BM, E, HNWP, MO, PE); Yushu, Xiao Surmang town between Jerkug and the Xizang border, 3600–3900 m, 30 Aug. 1996, *T. N. Ho et al.* 2355 (HNWP). **N Hengduan: Batang**, the road to Litang direction, 3340 m, 30 July 2006, *D. E. Boufford et al.* 35462 (PE). **S HENGDUAN: Muli**, mountains between

the Litang and Shou-Chu rivers, between Wa-Erh-Dje and Garu, 3700 m, July-Aug. 1928, *J. F. Rock* 16899 (KUN).

148. *Pedicularis cranolopha* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 24: 55. 1878; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 358. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 204. 1998. = *Pedicularis cranolopha* var. *typica* Prain, Hk. Icon. Plant. 23: 1894. pl. 2208 A. Type: China, Gansu, "In Chinae prov. Kansu, confinibus australibus jugi fl. Tetung comitantis, nec non, ex collectore, circa templum Tschobsen (Przewalski)", 1–13 June 1872, *N. M. Przewalski s.n.* (Herbarium horti Petropolitain 229), with a line drawing of corolla [holotype: LE; isotype PE(00031357)].

Pedicularis garnieri Bonati, Bull. Soc. Bot. France 55: 243. 1908. Type: China, Sichuan,

Yargong, June 1904, *R. soulié* No 3763 (holotype: P).

Herbs perennial, 5–23 cm tall, more or less pubescent, not black when dry. Stems usually cespitose, spreading, unbranched, with 1 or 2 lines of hairs. Basal leaves sometimes withering early; petiole 1–3 cm long; leaf blade oblong-lanceolate to lanceolate-linear, 3–6 cm long, 1.5 cm wide, pinnatisect; segments 8–15 pairs, ovate to lanceolate-oblong, pinnatifid to double-dentate; cauline leaves alternate or sometimes proximal ones pseudo-opposite. Inflorescences racemose, few-flowered; bracts leaflike. Calyx 12–20 mm long, 2/5–1/2 cleft anteriorly, glabrous or slightly pubescent; lobes 3, subequal to unequal, posterior ones sometimes smallest, entire, lateral pair leaflike. Corolla yellow, 35–50 mm long, pubescent; tube less than 3 times as long as calyx; galea falcate apically; beak slightly semicircular, 7–8 mm; lower lip 12–15 mm long, 15–20 mm

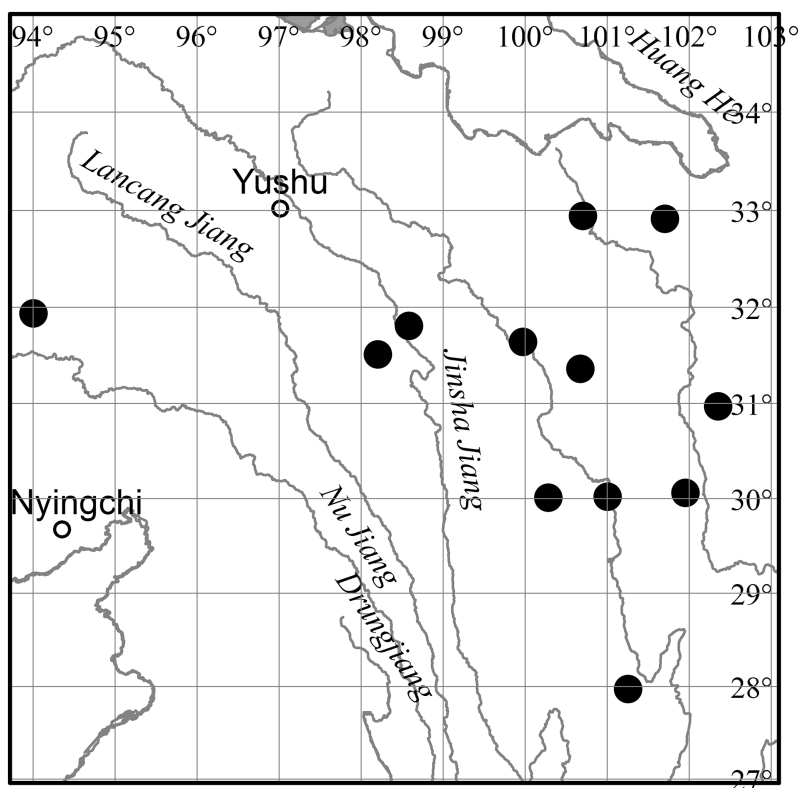
wide, densely ciliate, middle lobe emarginate. Filaments densely pubescent. Figure 45(2)–69.

Phenology: flowering from June to July.

Habitats: alpine meadows; 2600–4200 m.

Distribution: Tangut, N Hengduan, S Hengduan [Map 45(2)–148]; also in other regions of Gansu, Qinghai, and Sichuan Provinces of China.

Notes: When Bonati described *P. garnieri* as new he listed one collection with information “Yargong (R. Soulié) No. 3763, Juillet 1904”. Here one sheet in the herbarium P is selected as lectotype. *Pedicularis cranolopha* Maxim. includes a variety *longicornuta* Prain, which could be distinguished by a thin and long falcate on galea. Our molecular phylogenetic results reveal that ten accessions of *P. cranolopha* Maxim. are clustered into one clade, where individuals of *P. tricolor* Hand.-Mazz. and *P. croizatiana* H. L. Li



Map 45(2)–148: *Pedicularis cranolopha* Maxim.

are nested. Morphological and molecular data reveal a rapid diversification of these species.

TANGUT: **Aba**, Xia Aba, 3100 m, 28 June 1983, *K. Y. Lang et al. 2061* (PE). **Baima**, valley south of Baima along Makehe river, steep hillside with scrub cover, 3305 m, 32°47' N, 100°47' E, 9 July 2000, *Sino-Brit. Qinghai Alp. Gard. Soc. Exped. (SQAE) 837* (E00554632, HNWP). **Dêgê**, 3000 m, 27 July 1959, *S. Jiang & C. L. Jin 02452* (PE). **Garzê**, Luoguoliangzi, 3750 m, 3 Aug. 2001, *F. S. Yang Y0173* (PE); Garzê, Jiabula Shan, 4350 m, 31 July 2001, *F. S. Yang Y0107* (PE). **N HENGDUAN:** **Baqên**, 4000–4200 m, 20 Aug. 1976, *Qinghai-Xizang Exped. 11066* (PE). **Jomda**, 3600 m, 22 July 1976, *Qinghai-Xizang Exped. 12430* (PE). **Litang**, 4000–4200 m, 10 Aug. 1983, *Hengduan Shan Veg. Exped. 4938* (PE); Litang, near the city, 3800 m, 25 Sept. 1995, *J. Q. Liu et al. 305* (HNWP). **Luhuo**, 3000 m, 10 July 1952, *P. C. Tsoong 5023* (PE). **Xiaojin**, 3100 m, 13 July 1957, *J. Zhou 0203* (PE); Xiaojin, Xiaoxiaogou, 3300 m, 18 July 1958, *X. S. Zhang & Y. X. Ren 5932* (PE). **Yajiang**, E slope of Jianziwan Shan, 3200–3500 m, 7 Aug. 1983, *K. Y. Lang et al. 2930* (PE). **S HENGDUAN:** **Kangding**, Waze, 3512–3593 m, 4 Aug. 2017, *Q. Yu et al. THP-KD-3743* (CDBI); Kangding, Yala, Erdaoqiao, 3774–4156 m, 19 June 2017, *Y. L. Peng et al. THP-KD-1470* (CDBI); Kangding, Shade, 3600 m, 4 Aug. 1982, *K. Y. Lang et al. 1007* (PE); Kangding, near the city of Kangding, 2750 m, 28 July 2000, *F. S. Yang 20347* (PE); Kangding, 2700–4100 m, *A. E. Pratt 167* (purchased in Dec. 1890) (K); Kangding, Liubamuji, 3700 m, 1 Aug. 1981, *Q. Q. Wang 28661* (CDBI). **Muli**, the Third Distr., 4000 m, 13 Sept. 1983, *Qinghai-Xizang Exped. 14038* (PE).

149. *Pedicularis armata* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 24: 56. 1878; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 366. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 205. 1998. Type: China, Gansu, “Tangutorum (prov. Kansu), 14–16 July 1872”, *Przewalski s.n.* [holotype: LE].

Pedicularis longiflora var. *hongyuanensis* Y. Tang, Novon 8(4): 455. 1998; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 205.

1998. **syn. nov.** Type: China, Sichuan, Hongyuan, near Waqie, dry slope meadows, ca. 3450 m, July 1996, *Y. Tang, L. M. Macior & J. Chen 9622* (holotype: CDBI).

Pedicularis armata var. *trimaculata* X. F. Lu in T. N. Ho, B. Bartholomew & M. G. Gilbert, Novon 6: 190. 1996; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. **syn. nov.** Type: China, Qinghai, Henan autonomous county, Serlong, Xiazetan. 3200–3310 m, 2 Sept. 1990, *Y. H. Wu 7464* (holotype: HNWP).

Herbs perennial, 8–16 cm tall, not black when dry. Stems usually tufted, central stem erect, outer stems ascending to procumbent, usually longer than central stem, and densely fine-pubescent. Basal leaf petiole 1.5–4 cm long; cauline leaf petiole barely 1–2 cm long, narrowly winged, white long-ciliate; blade linear-oblong, 2–4 cm long, 4–10 mm wide, adaxially densely pubescent along midvein, abaxially glabrous but with sparsely scurfy dots, pinnatifid; segments 4–9 pairs, triangular-ovate to ovate, margin double-dentate. Flowers axillary; pedicels 0.5–1 cm long, densely pubescent. Calyx 16–20 mm long; tube cylindric, 1/3 cleft anteriorly, densely pubescent, reticulate-veined; lobes 2, more or less palmately 3–5 divided. Corolla yellow throughout or lower lip with 3 crimson or maroon spots, pubescent, 50–90 mm long; galea bent rectangularly in middle; beak pointed forward, slender and sigmoid, 12–15 mm long; lower lip large, 20–26 mm wide, long ciliate. Filaments densely pubescent. Figure 45(2)–70.

Phenology: flowering and fruiting from July to September.

Habitats: alpine meadows in moist areas or sunny slopes and in turf; 3000–4000 m.

Distribution: N Hengduan [Map 45(2)–149]; also in other parts of Qinghai and Gansu Provinces, China.

Notes: When Maximowicz described *P. armata* Maxim. as new, he provided the type information “In China prov. Kansu, in pratis ejusdem jugi frequens (Przewalski)” and stated that they were brought from another collector, without field

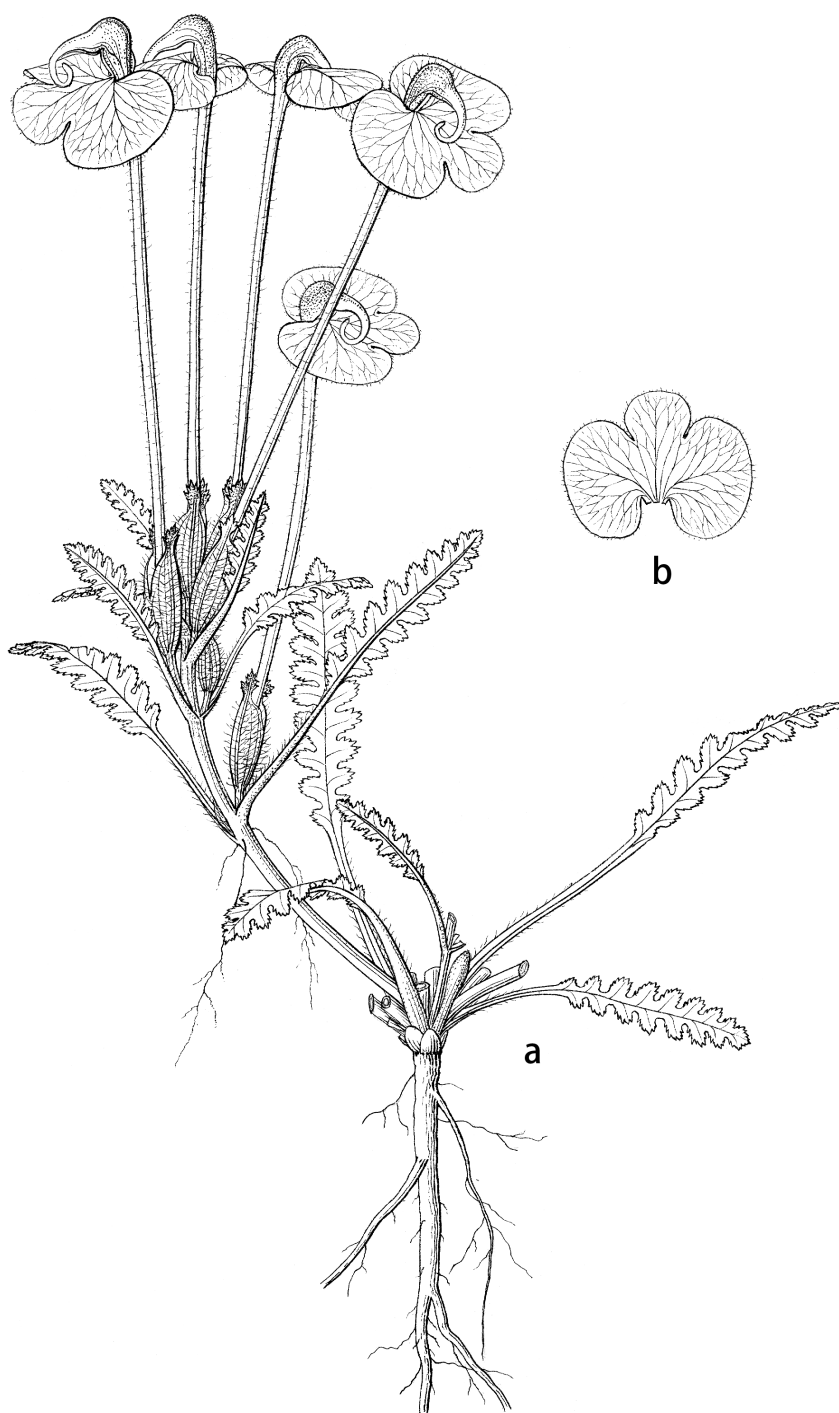
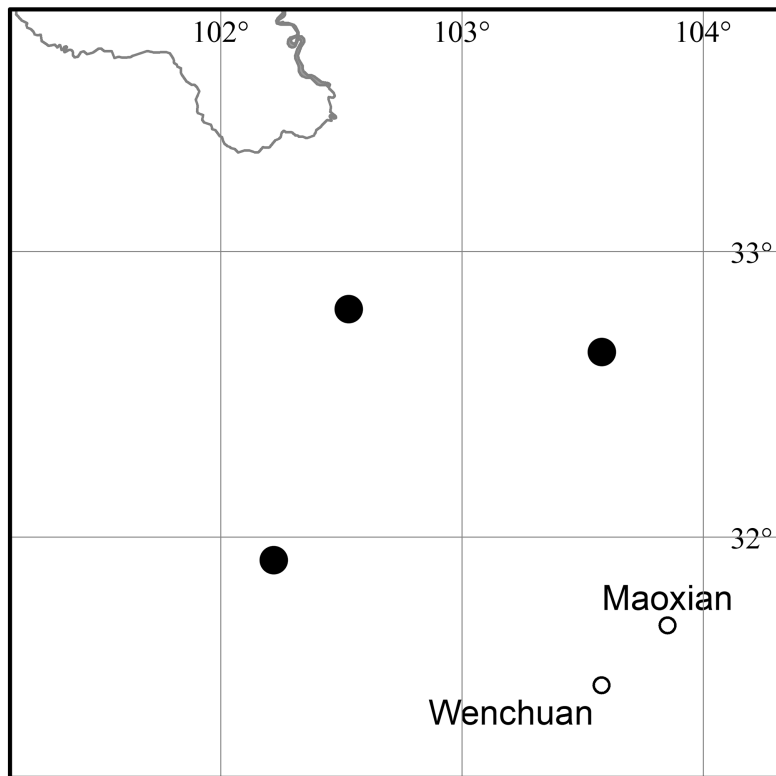


Figure 45(2)–70: *Pedicularis armata* Maxim. a, habit; b, corolla lip. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 365, figure 84: 1-2. 1963].



Map 45(2)-149: *Pedicularis armata* Maxim.

information about flower color. Lu described a variety *P. armata* var. *trimaculata* X. F. Lu as new based on several collections from Gansu and Qinghai Provinces, China. He stated that “This variety is distinguished from *P. armata* var. *armata* by the lower lip of the corolla as in a galea, with three crimson or maroon, linear or narrowly elliptic spots”. Our extensive field investigations find that crimson or maroon spots on corolla are present in all populations of *P. armata* Maxim., and some of these spots have faded in herbarium specimens. Additionally, Tang described *P. longiflora* var. *hongyuanensis* Y. Tang as new, and he stated that “The most striking difference is the presence in variety *hongyuanensis* of three red spots on the lower lip, one on the upper lip, and two on the lateral sides”. Our field investigation at the type location confirms that the spots are maroon rather than red and *P. longiflora* var. *hongyuanensis* Y. Tang is readily identified as *P.*

armata Maxim. by its galea being bent rectangular in middle, its beak extending forward, long, slender and sigmoid. Hence, *P. longiflora* var. *hongyuanensis* and *P. armata* var. *trimaculata* are here treated as new synonyms of *P. armata* Maxim. Our molecular phylogenetic results reveal that three individuals of *P. armata* Maxim., together with *P. bidentata* Maxim. and *P. decorissima* Diels (a new synonym of *P. paxiana* H. Limpr.), form a well-supported clade.

N HENGDUAN: **Barkam (Tsipula)**, 4000 m, 2 Aug. 1922, *H. Smith 4166* (PE). **Hongyuan**, Waqie pasture, 3500 m, 21 Aug. 1975, *Y. C. Tang, J. M. Xu & K. Y. Pan 5* (PE); Hongyuan, Yakou Shan, 4080 m, 20 Aug. 2000, *F. S. Yang 2107* (PE); Hongyuan, Longriba, ca. 3400 m, 30 July 1989, *Q. S. Zhao 0178* (SZ). **Songpan**, road from Chuanzhusi to Hongyuan, moorland plateau, moorland and bog, 3660 m, 32°54' N, 103°15' E, *Sino-Brit. Qinghai Alp. Gard. Soc.*

Exped. (SQAE) 639 (GB, HNWP, WSY); Songpan, Kakagou, 3400 m, 31 July 2002, *X. M. Gao MI20* (PE).

150. *Pedicularis longiflora* Rudolph, Mém. Acad. Imp. Sci. Saint.-Pétersb. Hist. Acad. 4: 345. 1811; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 364. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 205. 1998. Type: Russia, Siberia, Leningrad, “Habitat, teste el. Adams, comite peregrinatoris nostri per plures regiones, ad lacum Baicalensem”, collected in 1809 (no more detailed information) (syntype: LE).

Pedicularis longiflora var. *tubiformis* (Klotzsch) P. C. Tsoong, Bull. Brit. Mus. (Nat. Hist.) Bot. 1: 7. 1955; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 365. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 205. 1998. **syn. nov.** ≡ *Pedicularis tubiformis* Klotzsch, in Klotzsch & Garcke, Bot. Ergebn. Reise Waldemar 106. 1862. The exact localities are unknown, but his collections were made in the Himalayas from Garhwal to Bashahr. Type: Illustration [lectotype designated by Garg & Singn (2020: 86): Illustration, Klotzsch in Bot. Ergebn. Reise Waldemar [Klotzsch & Garcke]: pl. 57. 1862].

Pedicularis longiflora auct. non Rudolph: Bonati, Bull. Herb. Boiss. Ser. 2, 7: 541. 1907.

Pedicularis longiflora var. *yinshanensis* Z. Y. Chu & Y. Z. Zhao, Acta Sci. Nat. Univ. Intramongol. 19: 175. 1988; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 205. 1998. **syn. nov.** Type: China, Inner Mongolia, Yinshan, 2100 m, 5 Aug. 1986, *Z. Y. Chu 86-380* [lectotype designated here: HIMC(HIMC0031668); isoelectotypes: HIMC(HIMC0031669, 0031670, 0031671)].

Herbs annual, 10–20 cm tall. Stems usually short, and glabrescent. Basal leaves in a rosette; petiole 1–2 cm long, sparsely long-ciliate; leaf blade lanceolate to narrowly oblong, glabrous on both surfaces, pinnatifid to pinnatipartite; segments 5–9 pairs, margin double-dentate; cauline leaves alternate or pseudo-opposite, with shorter petiole. Flowers axillary; pedicels

short. Calyx tubular, 11–15 mm long, 2/5 cleft anteriorly, glabrous except for ciliate lobes; lobes 2 or 3, more or less palmatipartite. Corolla yellow, 40–80 mm long, some with a narrow maroon stripe on each anterolateral ridge of palate; galea gradually curving into beak; beak semicircular, 5–8 mm long, 2-cleft at apex; lower lip 9–13 mm long, 12–22 mm wide, long-ciliate, all lobes emarginate. Filaments all densely pubescent. Capsule lanceolate, 18–22 mm long, 7 mm wide. Seeds narrowly ovoid, ca. 2 mm. Figure 45(2)–71. **Chromosomes:** 2n = 16.

Phenology: flowering and fruiting from July to October.

Habitats: alpine meadows, along streams, springs; 2100–5300 m.

Distribution: Jammu & Kashmir, U Ganga & Indus, U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, Sikkim & Darjiling, Bhutan, M Yarlung Zangbo, L Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, N Hengduan, S Hengduan [Map 45(2)–150]; also in other regions of Gansu, Qinghai Provinces of China, and in Kazakstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Uzbekistan.

Notes: *Fl. China* and *Fl. Reipubl. Popularis Sin.*, *P. longiflora* Rudolph includes two varieties (var. *longiflora* and var. *tubiformis*) and they are thought to be distinguished by with or without maroon stripes on the lower lip of the corolla. However, earlier literature described that these two varieties both have maroon stripes on the lower lip and they differ in the length of calyx teethes, the width of lower lip, and maroon stripes. Zhao and Chu described *P. longiflora* var. *yinshanensis* Z. Y. Chu & Y. Z. Zhao as new based on collections from Inner Mongolia, and they stated that it differs from the typical *P. longiflora* in two maroon stripes on lower lip and pseudo-opposite cauline leaves. Our extensive field population investigations (2008. Mol. Ecol. 17: 5135–5145) and specimen examination found that nearly all individuals from different populations have two or three maroon stripes on the corolla, and individuals with and without maroon stripes co-exist in a few populations. Also, upper cauline leaves are often pseudo-opposite.

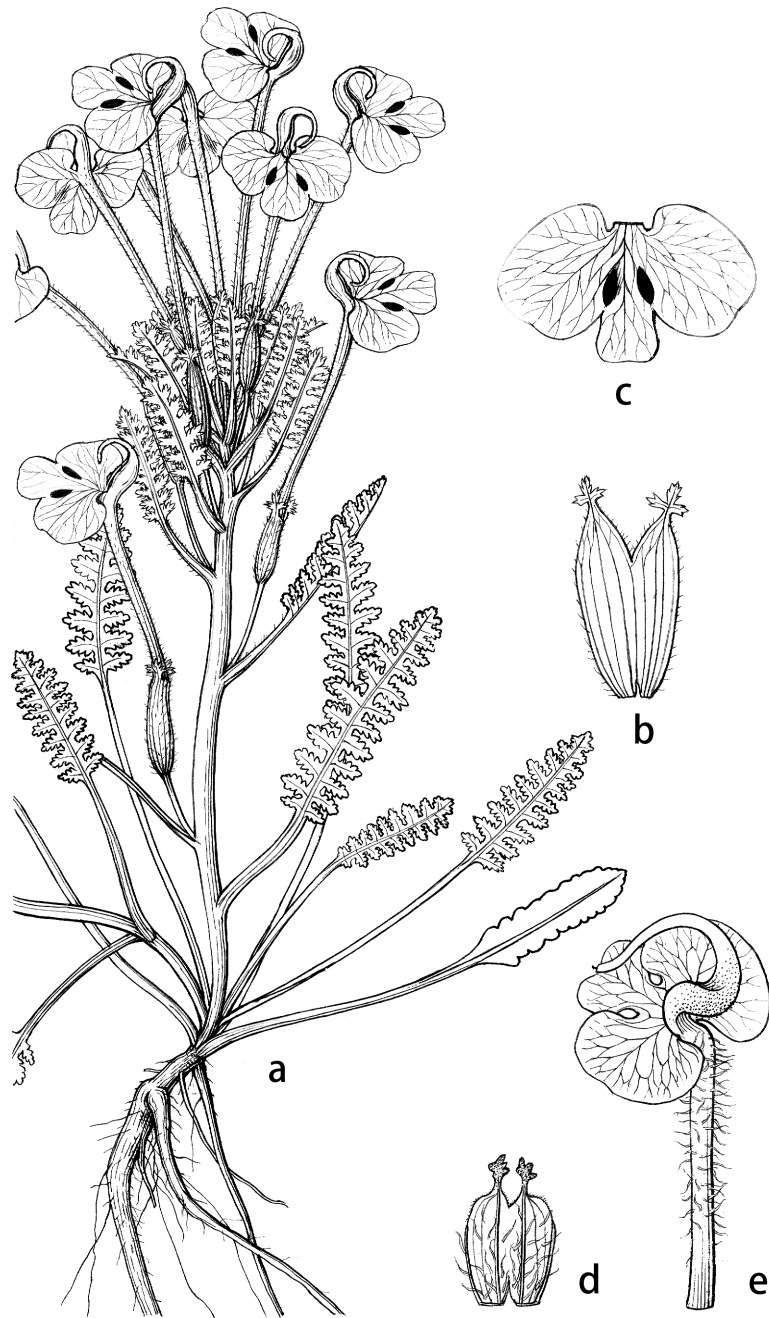
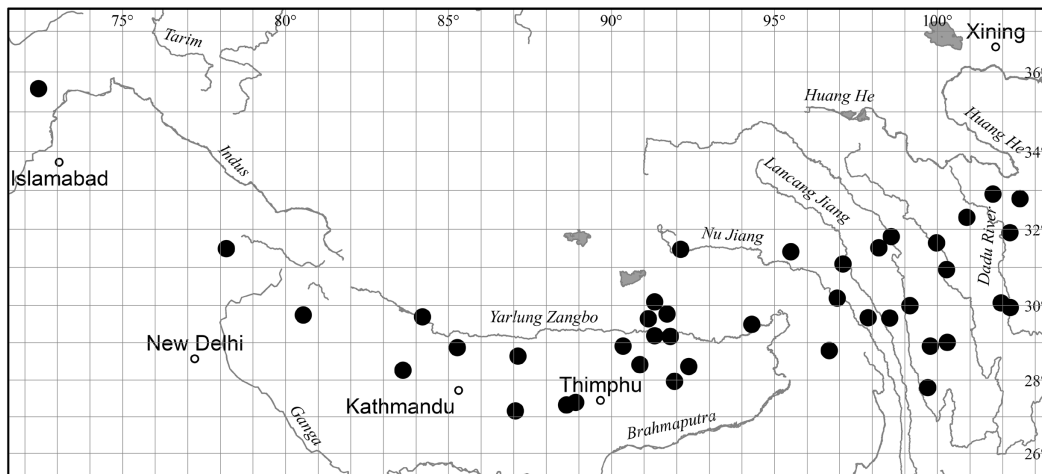


Figure 45(2)–71: ***Pedicularis longiflora*** Rudolph. a-c: a, habit; b, calyx; c, corolla lip. Drawn by W.-J. JU for *P. longiflora* var. *tubiformis* (Klotz.) P. C. Tsoong. [*Fl. Reipubl. Popularis Sin.* 68: 364, figure 83: 1-3. 1963]. ***Pedicularis humilis*** Bonati. d-e: d, calyx; e, corolla. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 368, figure 86: 4-5. 1963].



Map 45(2)-150: *Pedicularis longiflora* Rudolph

Hence, *P. longiflora* subsp. *tubiformis* (Klotzsch) Pennell and *P. longiflora* var. *yinshanensis* are here treated as new synonyms of *P. longiflora* Rudolph. Besides, Tang *et al.* [1998. Novon 8(4): 455] described a new variety *P. longiflora* var. *hongyuanensis*, but our field investigation and specimen examination confirm that it should be *P. armata* Maxim. (see discussion under *P. armata* Maxim.). Results of population genetic analyses on range-wide sampling show that all populations of this species form a well-supported monophyletic clade (2008. Mol. Ecol. 17: 5135–5145).

JAMMU & KASHMIR: Ladak, above Tsakzhum Tso, 5830 m, 23 July 1931, *Walter Koelz 2415c* (DD). **U GANGA & INDUS:** **Baspa Valley**, Chitkal, 4166 m, 17 July 1939, *G. Sherriff 1436* (BM). **U YARLUNG ZANGBO:** **Gyirong** (Keylong), 4100 m, 28 July 1975, *Qinghai-Xizang Exped. 7080* (PE); Gyirong (Keylong), 3025 m, 10 Sept. 2007, *L. T. Cheng & X. M. Tian LJQ07062* (HNWP); Gyirong (Keylong), 4558 m, 17 Sept. 2018, *T. Zhang et al. 18CS17742* (KUN). **Tingri**, 4599 m, 12 Sept. 2011, *D. C. Wang et al. YangYP-Q-5110* (KUN). **Zhongba**, to Payang town, 4730 m, 23 Aug. 2017, *Y. He & D. H. Liu BNU2017XZ067* (BNU). **W NEPAL:** **Karnali**, Mugu, 3300 m, 1983, *H. Tabata et al. 17476* (KYO). **C NEPAL:** **Dhawalagiri**, Baglung, 3800 m, 1954, *J. D. A. Stainton et al. 8428* (BM). **E NEPAL:**

Sagarmatha, Thosa Kharka-Beni Kharka, 3600–4300 m, 1985, *H. Ohba et al. 8581088* (TI). **SIKKIM & DARJEELING:** **Sikkim**, Gangtok, 3 Sept. 2003, *P. Agnihotri 222284* (LWG). **M YARLUNG ZANGBO:** **Lhasa**, Daxika, 4500 m, 31 Aug. 1965, *Y. T. Zhang & K. Y. Lang 2248* (PE00119929); Lhasa, Duilong, 4215 m, 5 Sept. 2011, *Y. P. Yang et al. YangYP-Q-5068* (KUN). **Lhozhag**, Se District, Lapu hot spring, 4019 m, 19 Aug. 2013, *Y. S. Chen 13-1569* (PE). **Lhünzhub**, Jiangxia wetland, 3740 m, 11 Sept. 2008, *Y. P. Yang et al. YangYP-Q-1043* (KUN). **Maizhokunggar**, Zhaxigang, Mencha village, 3603 m, 4 Aug. 2014, *X. C. Chen 5737* (HNWP). **Nagarzê**, 4460 m, 16 Aug. 2008, *Zhaxiciren, Zhongyang Y198* (KUN). **Nêdong**, Yaduila Shan, 4019 m, 28 Aug. 2017, *PE-Xizang Exped. 5339* (PE). **Yadong**, Pali, 4300 m, *Qinghai-Xizang Exped. 74-2732* (PE); Yadong, Lakangbu, Upper Kangbu, 4000 m, 24 Aug. 2013, *Y. S. Chen et al. 13-2110* (PE). **Zhanang**, A-zha, Zonggongbu, 4270 m, 26 Aug. 2017, *PE-Xizang Exped. 5297* (PE). **L YARLUNG ZANGBO:** **Nyingchi**, Sejila Shan, 3971 m, 17 Sept. 2017, *PE-Xizang Exped. 6858* (PE02330825–PE02330827); Nyingchi, Sejila Shan, 3074 m, 14 Oct. 2009, *J. Luo et al. LiuJQ-09XZ-398* (KUN); Nyingchi, 4200 m, 8 Aug. 1983, *B. S. Li, Z. C. Ni & S. Z. Cheng06258* (PE). **YARLUNG ZANGBO-BRAHMAPUTRA:** **Cona**, 4280 m, 21 Aug.

1975, *Qinghai-Xizang Suppl. Exped.* 751493 (PE); Cona, Mama, 3967 m, 10 Sept. 2011, *J. Luo & L. Lin, LiuJQ-11XZ-109* (KUN). **Lhünzê**, Zhari, Qusang village, 4323 m, *PE-Xizang Exped.* 6166 (PE). **Zayü**, Sangjiu, 3100 m, 1 Aug. 1973, *Qinghai-Xizang Exped.* 73-519 (PE). **TANGUT: Aba**, SE of the city of Aba on highway 302, 3715 m, 10 Aug. 2007, *D. E. Boufford et al.* 39373 (PE). **Baxoi**, Ranwu, 3935 m, 30 July 2008, *Y. H. Zhang et al. SunH-07ZX-1655* (KUN); *Baxoi*, Bangda, 1488 km of 214 Road, 4114 m, 14 Sept. 2008, *T. Zhang et al. 08CS695* (KUN). **Dêngqên**, 4500 m, 22 July 2016, *S. Li 20167263* (BNU). **Dêgê**, Que-er Shan, 4500 m, 8 Sept. 2000, *F. S. Yang 2069* (PE). **Garzê**, Jiabula Shan, 4470 m, 31 July 2001, *F. S. Yang Y0102* (PE); Garzê, direction to Dêgê, 3500 m, 6 Aug. 2000, *F. S. Yang 2054* (PE); Garzê, Zhuodala Shan, 3600 m, 1 Aug. 2001, *F. S. Yang Y0124* (PE). **Jomda**, W of Pass at Zonglayi Shan on road (Highway 317) from Jomda to Qamdo, 4325–4435 m, 4 Aug. 2004, *D. E. Boufford et al.* 31726 (KUN). **Nagqu**, near Jimtso village, Kormang, Nachu county, Nachu Pret, 4469 m, 31 July 2002, *Giail Beng 2002-135* (KUN). **Qamdo**, Kajila Shan, 4600 m, 13 Aug. 2001, *F. S. Yang Y0173* (PE); Qamdo, Tuoba, 3900 m, 8 Aug. 1976, *Qinghai-Xizang Exped.* 12647 (HNWP). **Zamtang**, NW of the city of Zamtang on road toward Sêrtar, 3570 m, 5 Aug. 2007, *D. E. Boufford et al.* 39102 (PE). **N HENGDUAN: Barkam**, SE of the city of Aba on highway 302, 3535 m, 12 Aug. 2007, *D. E. Boufford et al.* 39557 (PE). **Batang**, 3500 m, 28 July. 1983, *K. Y. Lang, L. Q. Li & Y. Fei 2397* (PE). **Hongyuan**, Sizhai swamp, 3660 m, 29 Sept. 2015, *S. Z. Li et al. 9-2-2-6* (IGA). **Markam**, near the city, 3800 m, 20 Aug. 2001, *F. S. Yang Y0194* (PE). **Xinlong**, 65 km to Garzê county, 3150 m, 9 Sept. 2010, *J. H. Chen et al. YangYP-Q-3023* (KUN); Xinlong, Tongxiao, 4180 m, 26 July 2010, *D. C. Zhang XL-2-2-5* (IGA). **Zogang**, Dongda Shan, 4700 m, 2 Aug. 2008, *B. Xu et al. SunH-07ZX-1479* (KUN). **S HENGDUAN: Daocheng**, Sela, Bowa vallige, 4302 m, 11 Sept. 2009, *X. D. Li & J. Li 388* (KUN); Daocheng, Haizi Shan, 4450 m, 24 July 2001, *F. S. Yang Y0080* (PE). **Kangding**, Paoma Shan, 2600 m, 28 July 2001, *F. S. Yang Y087* (PE); Kangding, Zheduo Shan, 4150 m, 30 July 2001, *F. S. Yang Y0090* (PE); Kangding, Zheduo Shan, 4000 m, 28 Aug. 1963, *K. C. Kuan, W. T. Wang et al. 1024* (PE). **Luding**, Waze, 3648 m, 10 Aug. 2010, *J. I. Jeon et al. SI1321* (PE). **Shangri-la** (Zhongdian), Tianbao Shan, 3870 m, 5 July 2001, *F. S. Yang Y0022* (PE); Shangri-la (Zhongdian), Napahai, 3300 m, 5 July 2001, *F. S. Yang Y0026* (PE). **Xiangcheng**, Wuming Shan, 4500 m, 24 July 2001, *F. S. Yang Y0064* (PE).

151. *Pedicularis bidentata* Maxim., *Bull. Acad. Imp. Sci. Saint-Pétersb.* 32: 533. 1888; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 365. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 205. 1998. Type: China, Sichuan, “monte Kungala (Potanin, 1885, specc. 2)” (no detailed information), *G. N. Potanin s.n.* (holotype: LE).

Herbs 6–15 cm tall, gray-pubescent throughout. Roots fusiform, slender. Stems nearly absent, tufted. Leaves basal; petiole 2–5 cm long; leaf blade linear-oblong, 3–7 cm long, 0.8–2 cm wide, base attenuate, undulate-lobed; segments subrounded, shallowly undulate-dentate. Flowers axillary, 2–10; pedicels short. Calyx cylindrical, 1.5–2 cm long, with reticulate veins; lobes 2, elliptic, 5–7 mm long, incised-serrate. Corolla yellow; tube 45–75 mm long, 2–3 mm wide, more than 4 times as long as calyx, pubescent; galea curving downward into a horseshoe-shape; beak nearly straight, 5–7 mm, as long as galea; lower lip 14–17 mm long 20–25 cm wide, middle lobe rounded, 6–8 mm long, 7–9 mm wide, 1/3 as large as lateral lobes. Filaments all pubescent.

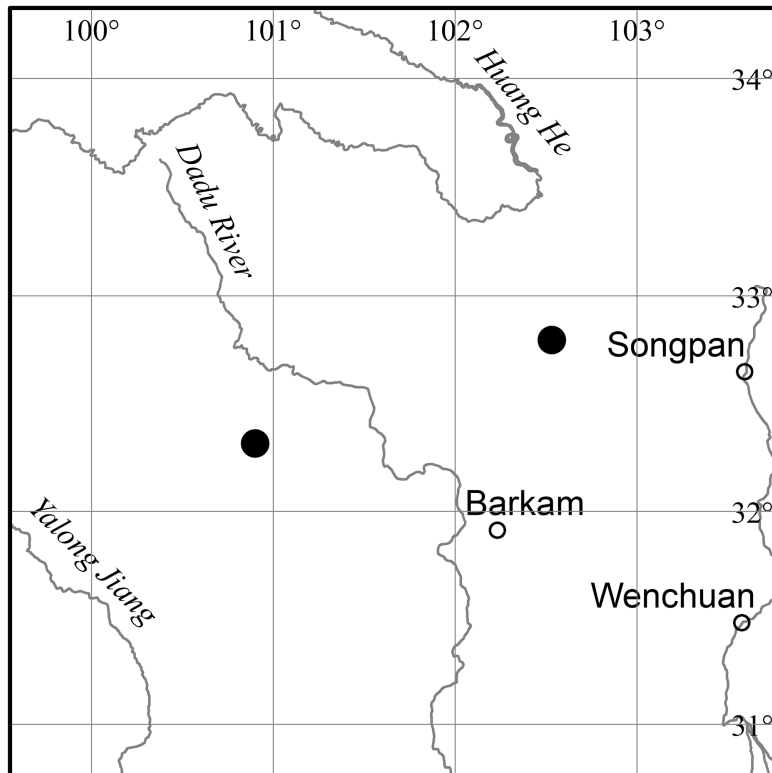
Phenology: flowering from July to August.

Habitats: alpine moist meadows, along streams; 3250–4500 m.

Distribution: endemic; Tangut, N Hengduan [Map 45(2)–151].

Notes: Our molecular phylogenetic results reveal that *P. bidentata* Maxim. is closely related to *P. armata* Maxim. and *P. paxiana* H. Limpr.

Tangut: Zamtang, NW of the city Zamtang on road toward Sêrtar county along the Ri-Ke River in Shangdu-ke on Zamtang Gangshan-lu (road no. 33), meadow, shrubs thickets and forest of



Map 45(2)-151: *Pedicularis bidentata* Maxim.

Abies, 32°20'36" N, 100°46'08" E, 3570 m, 5 Aug. 2007, D. E. Boufford et al. 39088 (P04407388). **N HENGDUAN:** Hongyuan, Rangkou, 3250 m, 28 Aug. 1989, Q. S. Zhao 1010 (PE).

152. *Pedicularis chinensis* Maxim., Bull. Acad. Imp. Sci. Saint-Petersb. 24: 57. 1878; Li, Proc. Acad. Nat. Sci. Philad. 101: 191. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 362. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 204. 1998. Type: China, Gansu, precise location unknown, collected in 1875, *Piasezki s.n.* (lectotype designated by Ivanica (1970: 186) LE).

Herbs annual, up to 30 cm tall, not black when dry. Stems single to several, erect or outer stems ascending to procumbent, sometimes branched apically, with lines of hairs or glabrescent. Leaves basal and on stem; petiole up to 4 cm long, distal ones shorter, long-pubescent; leaf blade lanceolate-oblong to linear-oblong,

4–7 cm long, 1–1.8 cm wide, glabrous on both surfaces, pinnatifid; segments 7–13 pairs, ovate, margin double-dentate. Inflorescences long-racemose; bracts leaflike, densely ciliate. Pedicel up to 1 cm long, pubescent. Calyx tubular, 15–18 mm long, densely pubescent, sometimes with purplish dots, 2/5 cleft anteriorly; lobes 2, leaflike, incised-double dentate. Corolla yellow; tube 30–50 mm long, pubescent; galea slightly bent apically, forming nearly a circle, not crested; beak semicircular, 8–10 mm long; lower lip wider than long, 15–22 mm wide, lobes rounded, densely ciliate. Filaments densely pubescent. Capsule oblong-lanceolate, ca. 19 mm long, 7 mm wide. Figure 45(2)–72.

Phenology: flowering and fruiting from July to October.

Habitats: alpine meadows; moist places, rocky slopes, forests; 1700–3700 m.

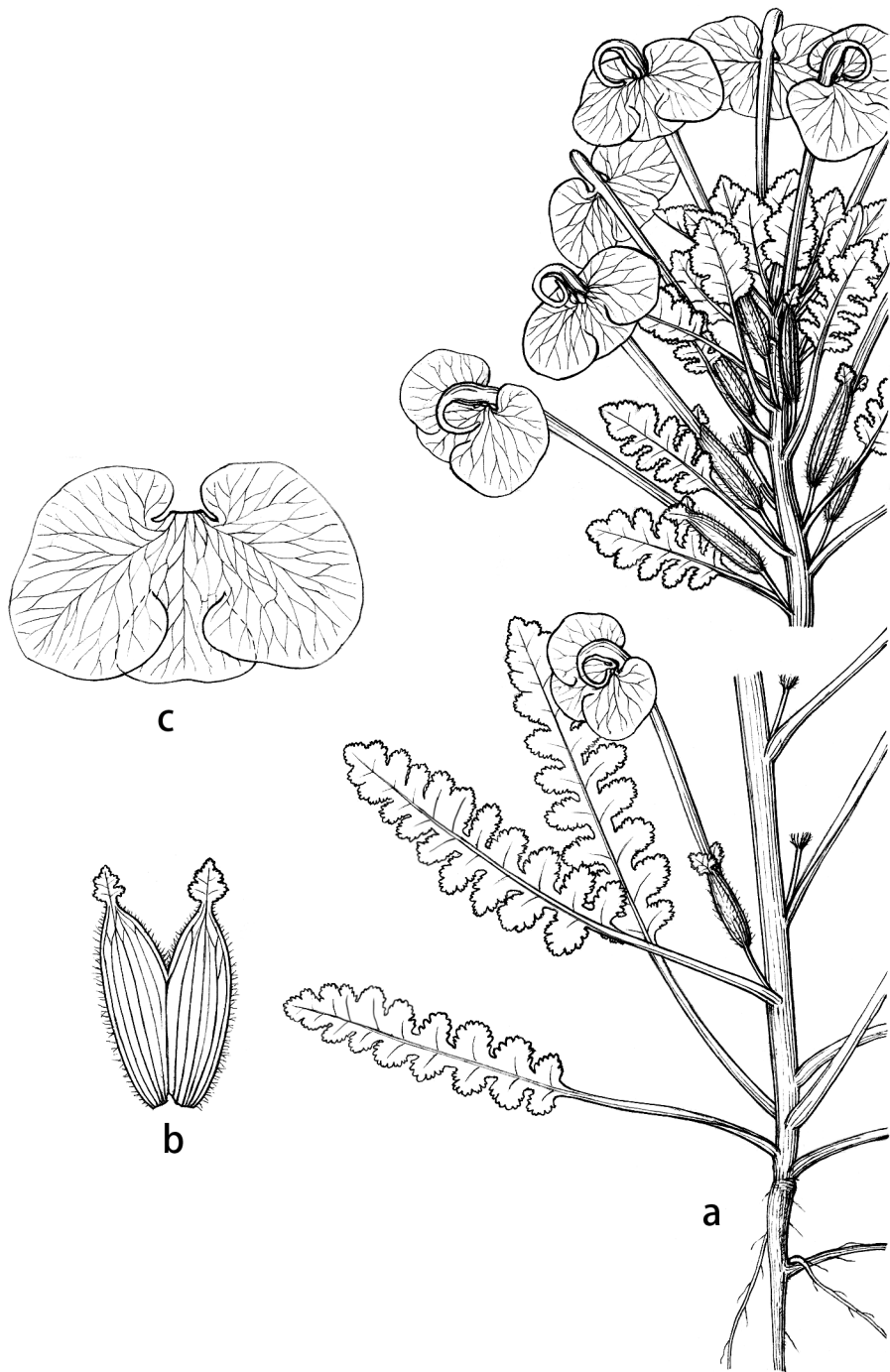
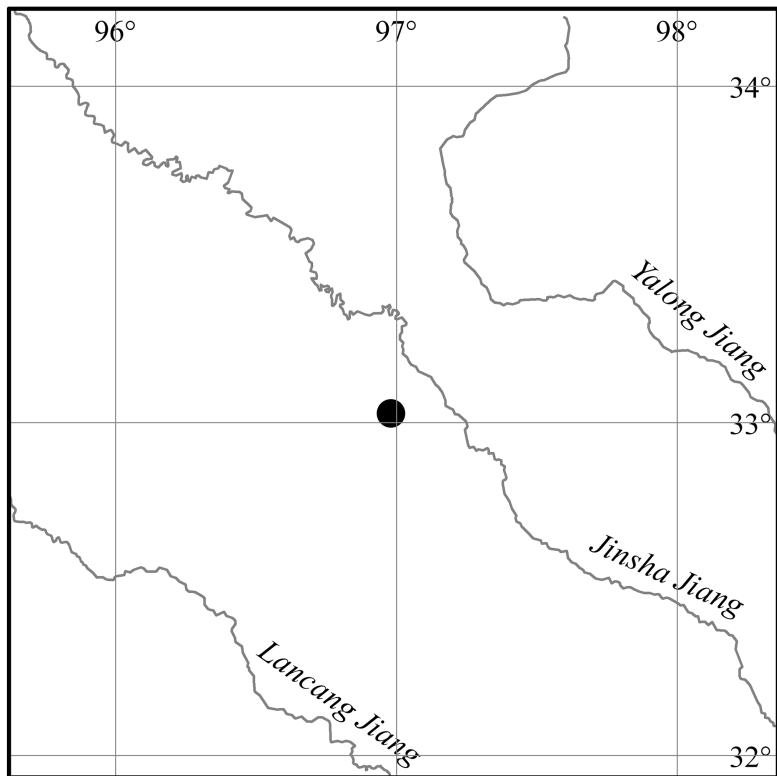


Figure 45(2)–72: **Pedicularis chinensis** Maxim. a, habit; b, calyx; c, corolla lip. Drawn by W.-J. JU [*Fl. Reipubl. Popularis Sin.* 68: 362, figure 83: 4-5. 1963].



Map 45(2)-152: *Pedicularis chinensis* Maxim.

Distribution: Tangut [Map 45(2)-152]; also in NE Qinghai, SW Gansu, Hebei, Inner Mongolia, Shaanxi, and Shanxi Provinces, China.

TANGUT: Yushu, Jiangxi, E of Jiangxi Forest Station, on E side of Ziqu, SE of Mozhong, 3620 m, 29 Aug. 1996, *T. N. Ho (HNWP)*, *B. Bartholomew (CAS)*, *M. Watson (E)* and *M. Gilbert (MO at BM)* 2647 (PE).

153. *Pedicularis latituba* Bonati, Bull. Soc. Bot. France 55: 243. 1908. Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 367. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. Type: China, Sichuan, Yajiang, collected in 1903, *J. A. Soulié* 3754 (holotype: P).

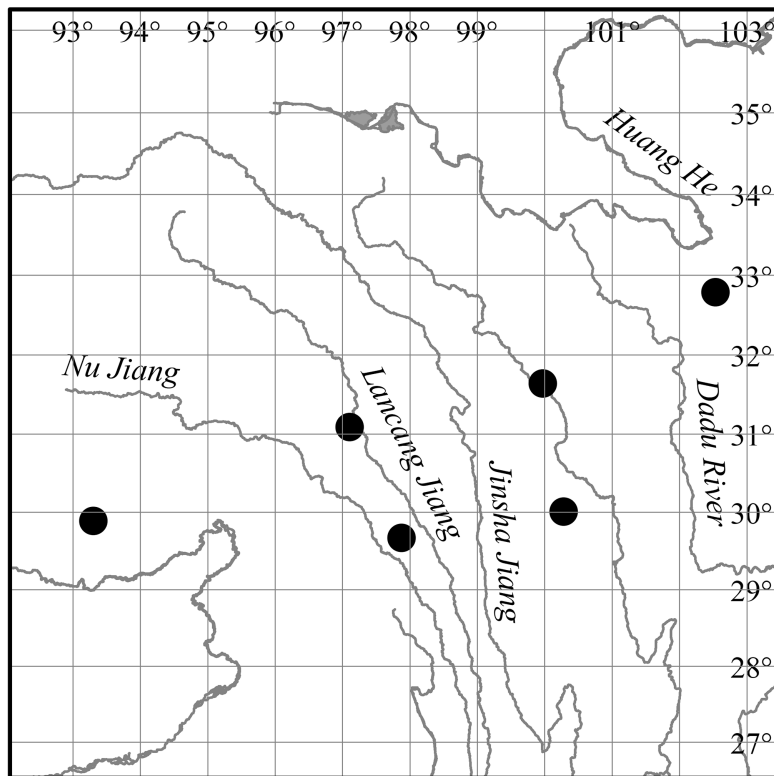
Herbs perennial, barely 10 cm tall, black when dry or not. Stems 1 to several, 1–5 cm, with lines of hairs. Basal leaves usually in a rosette; petiole 1–2 cm long, winged, pubescent; leaf blade lanceolate-oblong, 1–3 cm long, gla-

brescent on both surfaces, pinnatipartite to pinnatisect; segments 5–11 pairs, triangular-ovate to ovate; cauline leaves alternate, sometimes pseudo-opposite on lateral branches. Flowers few, axillary, dense; pedicels 1–2 cm long, with 2 lines of dense hairs. Calyx more or less tubular, 1/3–1/2 cleft anteriorly; tube 8–10 mm long; lobes (2 or) 3, deeply pinnatipartite. Corolla purple-red; tube 30–50 cm long, 2–3 mm wide, purple-pubescent; galea twisted falcate, more or less crested in front; beak more or less semicircular, 4–6 mm long; lower lip 8–10 mm long, 15–20 mm wide, short-ciliate, lobes emarginate. Filaments all pubescent.

Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows, along streams; 3250–4600 m.

Distribution: endemic; L Yarlung Zango, N Hengduan [Map 45(2)-153].



Map 45(2)-153: *Pedicularis latituba* Bonati

Notes: Bonati stated that *P. latituba* Bonati is similar to *P. siphonantha* D. Don but differs from it in having relatively larger corolla tube (3–4 cm long and 2 mm wide), longer flower pedicels (2 cm long), and villose filaments. He was not sure whether *P. latituba* Bonati belongs to the series *Longiflorae* or *Muscicolae*. Our molecular phylogenetic results support that it belongs to the series *Longiflorae*, and a close relationship between *P. latituba* Bonati and *P. cranolopha* Maxim. is also supported.

L YARLUNG ZANGBO: **Gongbo'gyamda**, "Pasum La. Drukla Chu", 4260 m, 30°28' N, 93°22' E, Aug. 1938, *F. Ludlow, G. Sherriff & G. Taylor 6895* (BM, PE); Gongbo'gyamda, 4500 m, 3 Aug. 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 15542* (PE). **TANGUT:** **Garzê**, Jiabula Shan, 4000 m, 2 Aug. 2001, *F. S. Yang Y0129* (PE). **Qamdo**, Kajila Shan, 4500 m, 13 Aug. 2001, *F. S. Yang, Y0178* (PE). **N HENGDUAN:** **Hongyuan**, Rangkou, ca. 3250 m, 27 July 1989, *Q. S. Zhao*

1010 (SZ). **Litang**, Dongshandi, 4300 m, *Hengduan Shan Veg. Exped. 4959* (PE00119662). **Zogang**, Dongdala Shan, 5000 m, 19 Aug. 2001, *F. S. Yang Y0188* (PE).

154. *Pedicularis humilis* Bonati, Notes Roy. Bot. Gard. Edinb. 13: 106. 1921; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 368. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. Type: China, Yunnan, "Shweli-Salween Divide", 3050 m, July 1913, *G. Forrest 11969* (holotype: E; isotype: PH).

Herbs perennial, 5–15 cm tall. Roots numerous, and fusiform. Stems numerous, creeping, slightly branched or unbranched, glabrescent. Basal leaf petiole 1–2 cm long, glabrous; leaf blade 1–2.5 cm long, 5–10 mm wide, pinnatisect; segments 5 or 6 pairs, ovate, pinnatifid, incised-dentate; cauline leaves alternate or rarely more or

less opposite, similar to basal leaves but smaller and shorter petiole; bracts leaflike. Flowers axillary; pedicels erect, 3–10 mm long, glabrous. Calyx 5–6 mm long, membranous, puberulent when young, glabrescent, deeply cleft anteriorly; lobes 2, palmately cleft distally, ciliate. Corolla rose; tube 20–35 mm long, pubescent; galea twisted at base, glandular-pubescent, slightly crested; beak S-shaped, slender, 7–8 mm long; lower lip 9–10 mm long, 12–20 mm wide, lobes emarginate, densely ciliate. Filaments 2 pubescent, 2 glabrous. Figure 45(2)–71.

Phenology: flowering and fruiting from July to August.

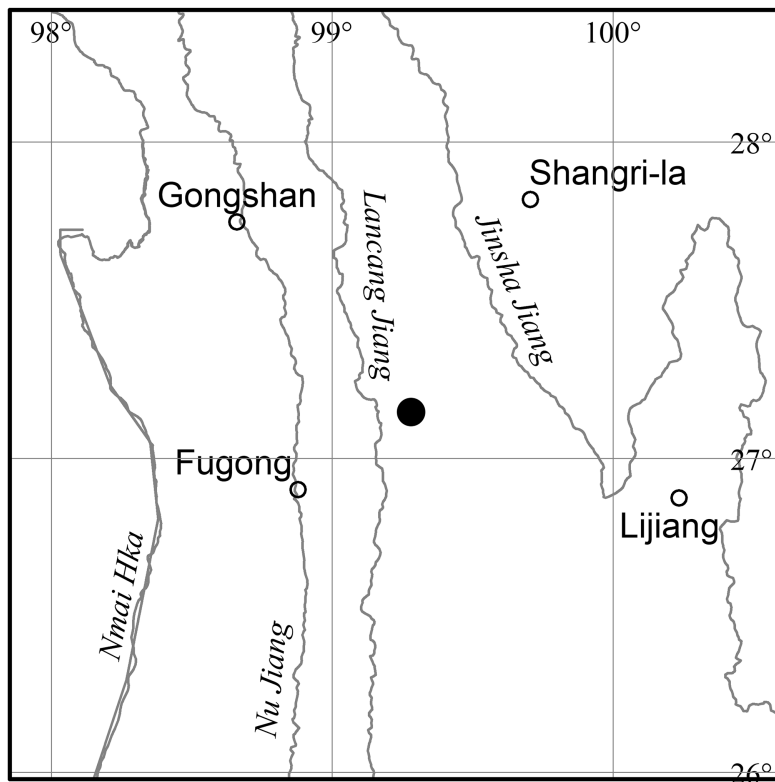
Habitats: alpine meadows, along streams; 3000–3100 m.

Distribution: S Hengduan [Map 45(2)–154]; also in other regions of Yunnan, China.

S HENGDUAN: Weixi (Shweli-Salween Divide), precise location unknown, 3050 m, July 1913, *G. Forrest 11969* (UC, PE).

155. *Pedicularis sigmoidea* Franch. ex Maxim., *Bull. Acad. Imp. Sci. Saint-Petersb.* 32: 535. 1888; Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 372. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 207. 1998. Type: China, Yunnan, Heqing, “monte Koua-la-po”, 3000m, (Delavay!), 26. Aug. 1884, *Plantes de Chine* (Province du Yun-Nan), *J. M. Delavay 960* [[**lectotype designated here:** LE; isolectotypes: E, K, LE]].

Herbs perennial, usually 10–30 cm tall, stout, and slightly black when dry. Stems numerous, central one erect, outer stems procumbent to ascending, usually longer, striate, more or less pubescent. Leaves mostly cauline, usually



Map 45(2)–154: *Pedicularis humilis* Bonati

pseudo-opposite to pseudo-whorled; proximal petiole 1.5–2.5 cm long, narrowly winged, pubescent; leaf blade ovate-lanceolate to linear-lanceolate, 3–5 cm long, 1.6 cm wide, adaxially pubescent, abaxially sparsely long-pubescent along veins, densely gray-scurfy throughout, pinnatisect; segments 5–11 pairs, ovate to lanceolate, pinnatifid, incised double-dentate. Inflorescences 2/3–5/6 as long as stems; flowers numerous, dense apically; bracts leaflike. Calyx 1–1.6 cm long, ca. 1/2 cleft anteriorly, pubescent; lobes 3, pinnatifid more or less palmately lobed, posterior one smallest. Corolla purple-red; tube slender, 32–55 mm long, 1–2 mm wide, densely pubescent; galea strongly twisted apically; beak bent upward, S-shaped, 10–15 mm long; lower lip 12–15 mm long, 18–24 mm wide, densely ciliate, middle lobe shallowly 2-lobed. Filaments densely pubescent. Figure 45(2)–73.

Phenology: flowering and fruiting from July to September.

Habitats: open stony pastures; 3000–3600 m.

Distribution: endemic; S Hengduan [Map 45(2)–155].

Notes: Our molecular phylogenetic results reveal that there is no clear species boundary between *P. sigmoidea* Franch. ex Maxim. and *P. dolichosiphon* (Hand.-Mazz.) H. L. Li.

S HENGDUAN: **Heqing**, Koua-la-po, 3000 m, 26 Aug. 1884, *J. M. Delavay 960* (K); Heqing, Machang, Baimu Shan, 1 Aug. 1929, *C. H. Ching 23494* (PE). **Yulong** (Lijiang), 3600 m, 17 Sept. 1914 (purchased from the Arnold Arboretum, Harvard University, 1916), *C. Schneider 3082* (K).

156. *Pedicularis siphonantha* D. Don, Prodr. Fl. Nepal. 95. 1825; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 373. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 207. 1998. ≡ *Pedicularis siphonantha* D. Don var. *typica* Prain, Ann. Bot. Gard. Calc. 3: 114. 1890. Type: Nepal, Gosain Than, *Wallich cat. n. 417* [lectotype designated by Garg & Singh (2020: 91): K; isolectotypes E(E00273576); P(P02968617)].

Pedicularis hookeriana Wall. ex Benth., Scroph. Ind. 53. 1935, Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 155. 1943; Yamazaki in Hara *et al.*, Enum. Fl. Pl. Nepal 3: 123. 1982. **syn. nov.** Type: China, Tibet, 3350–4870 m, *N. Wallich cat. 421* [lectotype designated by Garg & Singh (2020: 84): K; isolectotype: CAL].

Pedicularis pseudohookeriana T. Yamaz., J. Jap. Bot. 78: 78. 2003. **syn. nov.** Type: Bhutan, Bumthang, between Gorsuem Tsochen Chen, 3300 m, 22 June 2000, *G. Miede & S. Miede 00-118-04* [holotype: TI].

Pedicularis tsoongii T. Yamaz., J. Jap. Bot. 45: 174. 1970. **syn. nov.** Type: Nepal, Nr. Balangra Pass, 3810 m, 21 July 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 2557* (holotype: BM).

Pedicularis quxiangensis H. P. Yang, Bull. Bot. Res., Harbin 2: 137. 1982. **syn. nov.** Type: China, Tibet, Nyalam, Qu country, 3400 m, 1 Sept. 1981, *C. Ni et al. 1921* [holotype: PE(0033012)].

Pedicularis himalaica Klotzsch ex Klotzsch & Garcke, Bot. Ergebn. Reise Waldemar 107. 1862. Type: Himalaya, “Dr. Hoffmeister fand diese Art im Himalaya”, it has not been seen. Based on Pennell (1943), the collections were made in the Himalayas from Garhwal to Bashahr, but records and exact localities of types were lost due to the violent death of Dr. Hoffmeister in the field. Some specimens identified as *P. himilaica* Klotzsch collected from Bashahr were examined. Type: Illustration [lectotype designated by Gary & Singh (2020: 84): Illustration, Klotzsch in Bot. Ergebn. Reise Waldemar (Klotzsch & Garcke): pl. 58. 1862].

Herbs perennial, low to tall. Roots 15–40 cm long, usually cylindrical. Stems single and more or less erect, or sometimes numerous, and outer stems procumbent, striate, glabrescent. Leaves basal and cauline; petiole usually 2–5 cm long, winged, glabrescent or sparsely long-pubescent; leaf blade lanceolate-oblong to linear-oblong, rarely ovate-elliptic, 1–7 cm long, 0.7–3 cm wide, adaxially sparsely pubescent, abaxially sparsely long-pubescent along midvein, pinnatisect;

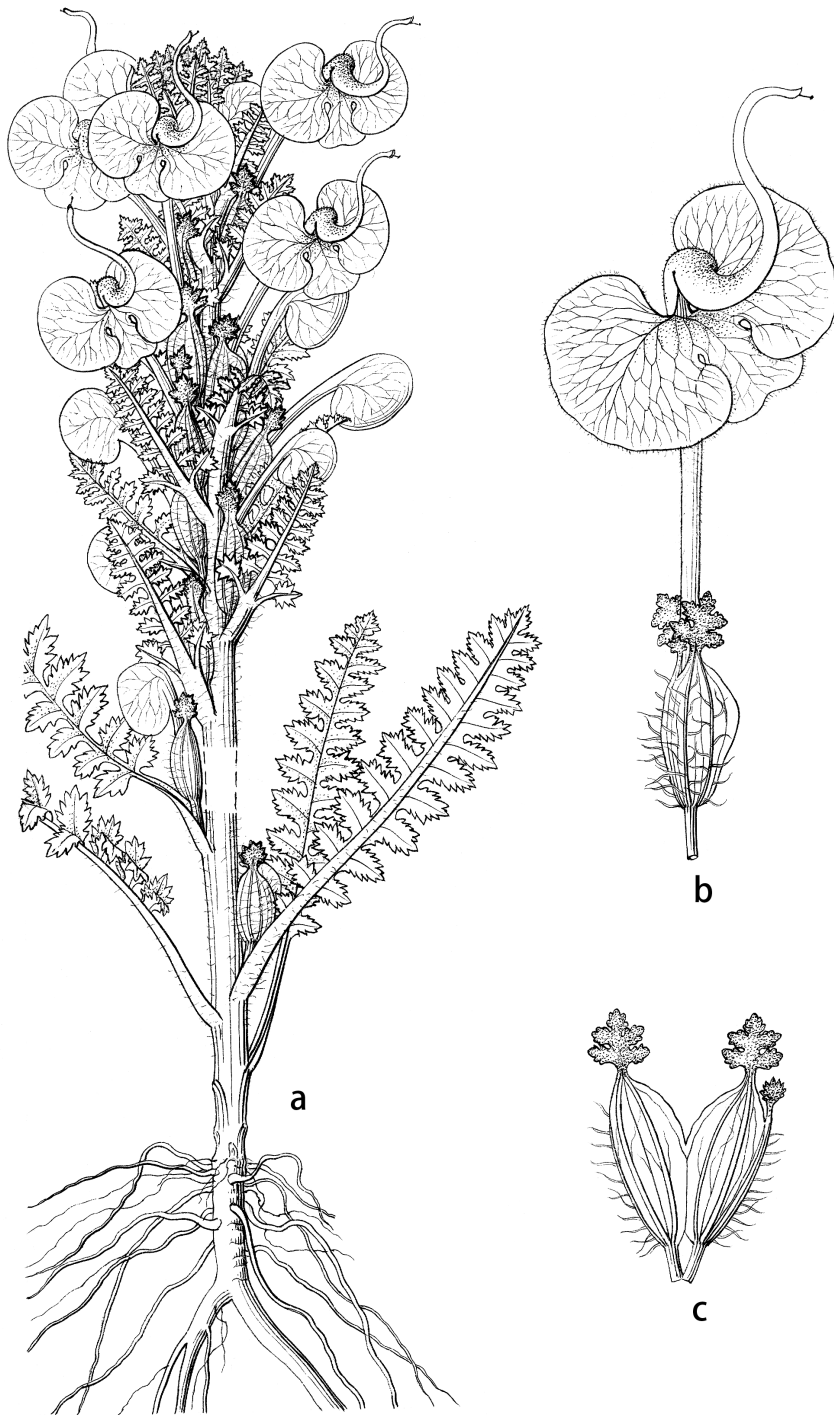
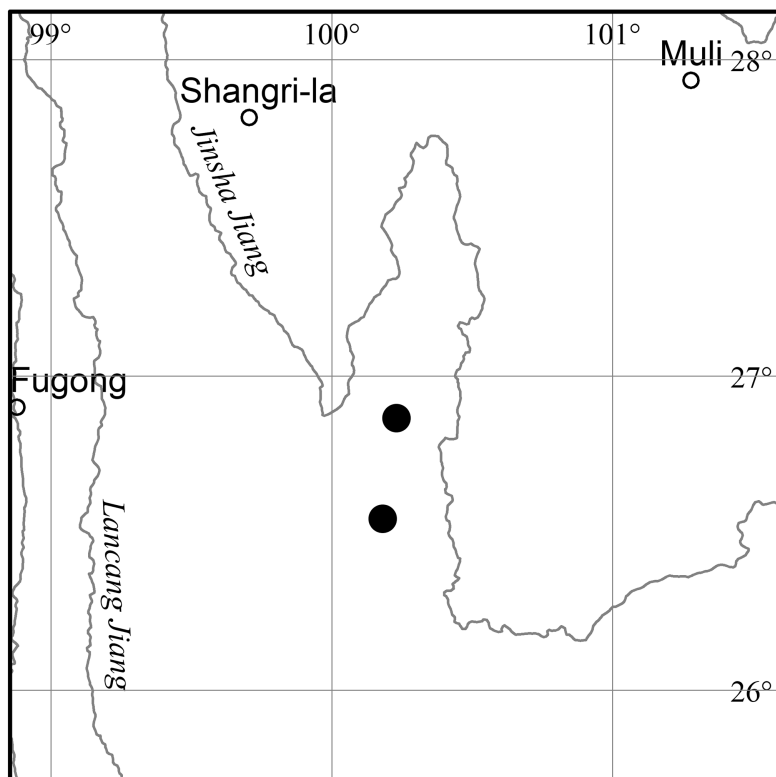


Figure 45(2)–73: *Pedicularis sigmoidea* Franch. ex Maxim. a, habit; b, flower; c, calyx. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 372, figure 87: 1-3. 1963].



Map 45(2)-155: *Pedicularis sigmoidea* Franch. ex Maxim.

segments 5–15 pairs, somewhat lanceolate to broadly ovate or triangular, pinnatifid, or double-dentate. Flowers axillary, dense; bracts leaflike, glabrescent, or long ciliate. Calyx pubescent; tube 10–12 mm long, 1/3 cleft anteriorly; lobes 2, 3, or 5), posterior one smallest. Corolla rose-red, or sometimes white; tube 40–70 mm long, finely pubescent; galea strongly twisted apically, with or without a conspicuously auriculate protrusion; beak semicircular or slightly S-shaped, 8–11 mm long, slender; lower lip 11–15 mm long, 15–18 mm wide, lobes emarginate or shallowly 2-lobed. Filaments anterior 2 pubescent (or all glabrous). Capsule ovoid-oblong. Figure 45(2)–74. **Chromosomes:** $2n = 16$.

Phenology: flowering and fruiting from July to September.

Habitats: alpine meadows, swampy places; 3000–5000 m.

Distribution: endemic; U Ganga & Indus, U Yarlung Zangbo, W Nepal, C Nepal, E Nepal, Sikkim & Darjeeling, M Yarlung Zangbo, Yarlung Zangbo-Brahmaputra, Tangut, U Irrawaddy [Map 45(2)–156].

Notes: *Fl. Reipubl. Popularis Sin.* (1963. 68: 373–375) and *Fl. China* (1998. 18: 207) recorded two varieties: *P. siphonantha* var. *siphonantha* and *P. siphonantha* var. *delavayi* (Franch.) P. C. Tsoong. Results of molecular data (Yu *et al.* 2018. PLoS ONE 13: e0200372) indicated that the two varieties are nested in different clades. Examinations of herbarium specimens find that they should belong to different species. The typical *P. siphonantha* D. Don originally collected by Wallich in Nepal occurs in the Himalayas, and plants in the Hengduan Mountains referred to this species should be recovered as *P. delavayi* Franch. ex Maxim.

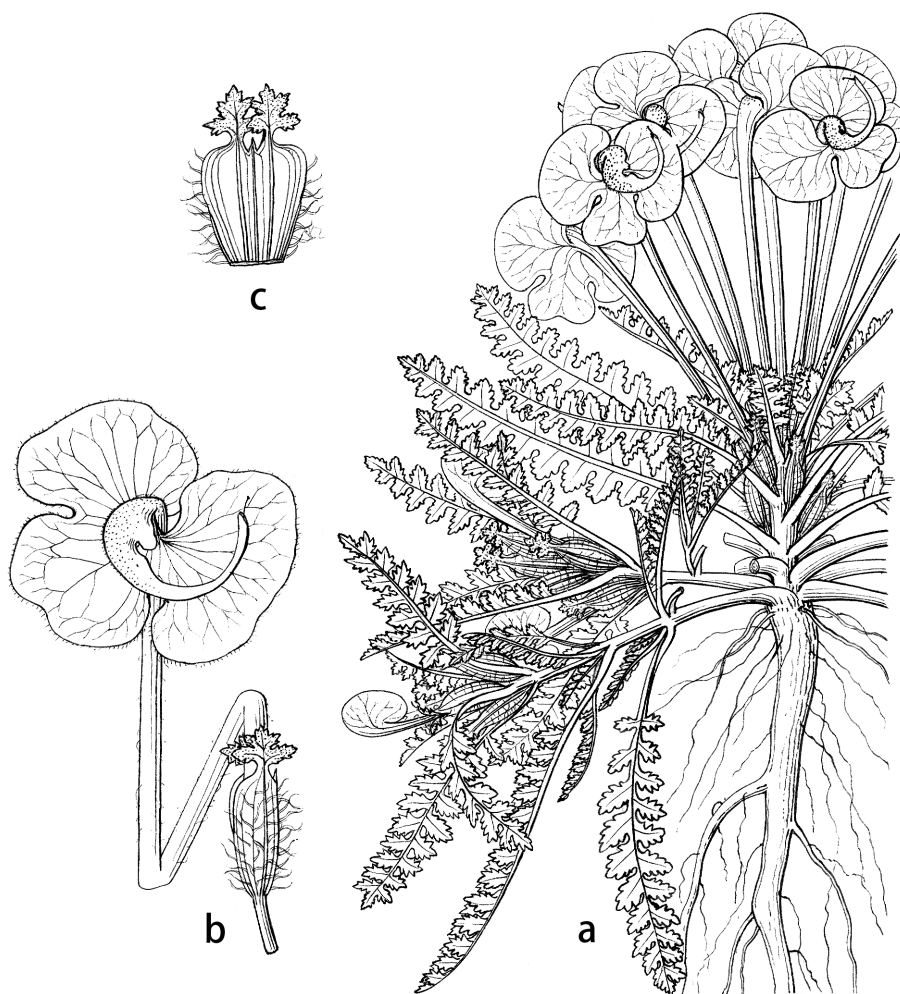
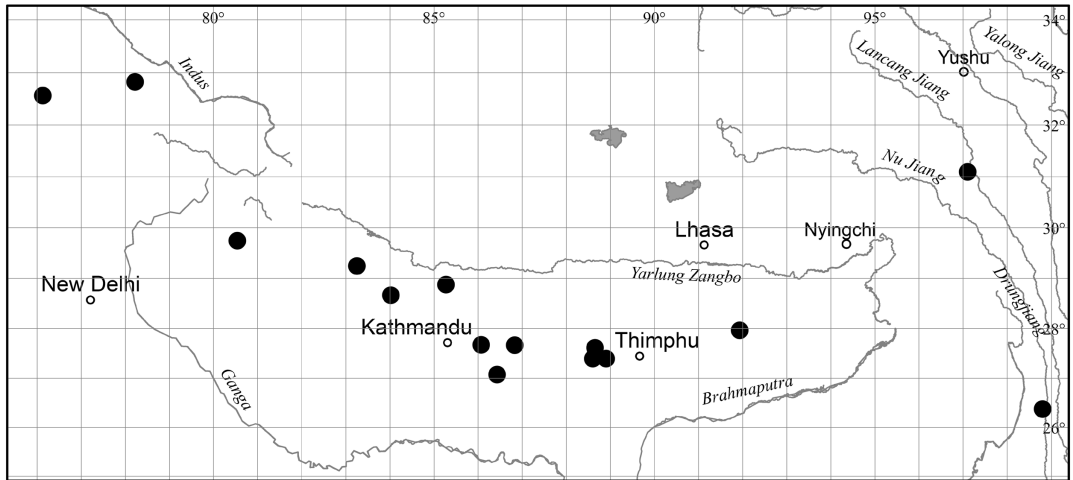


Figure 45(2)–74: *Pedicularis siphonantha* D. Don. a, habit; b, flower; c, calyx. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 373, figure 87: 4-6. 1963].

Yamazaki [1970. *J. Jap. Bot.* 45(6): 174] described *P. tsoongii* T. Yamaz. as new based on two collections from Nepal, but he (Yamazaki. 1988. *The Himalayan Plants.* 1: 91–161) also stated that “*P. tsoongii* is probably the same with *P. siphonantha* var. *prostrata* Bonati ex W. W. Smith or *P. siphonantha* subsp. *prostrata* (Bonati ex W. W. Smith) P. C. Tsoong. They seem to be an ecological form of *P. siphonantha*”. Here *P. tsoongii* T. Yamaz. and *P. siphonantha* subsp. *prostrata* (Bonati ex W. W. Smith) P. C. Tsoong are treated as new synonyms of *P. siphonantha*

D. Don, based on an examination of types and more specimens. Our molecular phylogenetic results show that 13 accessions of *P. siphonantha* D. Don are clustered in a well-supported clade, where several close relative species are nested.

Yamazaki (1975. *Univ. Mus. Univ. Tokyo. Bull.* 8: 102) stated that many intermediate forms between *P. siphonantha* D. Don and *P. hookeriana* Wall. ex Benth. are distributed in Central and Eastern Nepal, and results of the molecular phylogenetic analysis indicate that *P. hookeriana*



Map 45(2)-156: *Pedicularis siphonantha* D. Don

is nested within the clade of *P. siphonantha*. Here, *P. hookeriana* is merged into *P. siphonantha* based on more specimen examination. Field investigation found that the corollas of some individuals are white.

U GANGA & INDUS: **Chamba:** between Alwar and Sach Pass, 4000–5000 m, 30 Aug. 1896, *G. A. Gammie 18368* (DD). **Lahul & Spiti,** Koksar, 3300 m, 2 July 1938, *N. L. Bor 12130* (DD). **U Yarlung Zangbo:** **Gyirong** (Keylong), 3500 m, 30 June 1941, *N. L. Bor 16942* (DD). **W NEPAL:** **Karnali,** Dolpa, Jangla Bhanjyang, 3900 m, open grassy mountain side, 18 June 1973, *S. Einarsson, L. Skärby & B. Wetterhall 917* (BM); Karnali, Mugu, 4150 m, 1983, *H. Tabata et al. 22652* (KYO). **C NEPAL:** **Bagmati,** Rasuwa, Chilime, 3500 m, 13 July 1970, *H. Kanai & P. R. Shakya 670475* (TI). **Gandaki:** Manang, Sabji Khola, 3790 m, 15 July 1950, *D. G. Lowndes 1022* (BM). **Janakpur,** Dolakha, Beding, 3600–4050 m, 4 Sept. 1983, *H. Ohba, H. Kanai, M. Wakabayashi et al. 8331810* (BM). **E NEPAL:** **Sagarmatha,** Solukhumbu, Khonglemo Deorali, 4350 m, 22 Aug. 1985, *H. Ohba, M. Wakabayashi, M. Suzuki et al. 8581077* (E, TI). **SIKKIM & DARJEELING:** **Gangtok,** Changu, 4000 m, 27 Sept. 1913, *R. E. Cooper 966* (BM). **Lachung,** Yumthang, 28 July 1997, *S. S. Dash, A. Naity & D. D. Bahali 18587* (BSHC). **M YARLUNG ZANGBO:**

Yadong, Duila to Pali, 4200 m, 20 July 1953, *P. C. Tsoong 5742* (PE); Yadong, 23 July 1952, 4300 m, *P. C. Tsoong 5915* (PE); Yadong, 3300 m, 24 July 1960, *G. X. Fu 00991* (PE); Yadong, Pali, Lila Shan, 4300 m, 8 Sept. 1974, *Qinghai-Xizang Exped. 2654* (HNWP); Yadong, A-sang vallige, 4 June 1977, *Y. Feng 77018* (HNWP). **YARLUNG ZANGBO-BRAHMAPUTRA:** **Cona,** Nayong lake, 4680 m, 17 July 1975, *C. Y. Wu & S. K. Chen 75-900* (PE); Cona, near the city of Cona, 4320 m, Oct. 1974, *Qinghai-Xizang Exped. 2914* (PE); Cona, Boshan Pass, 4500 m, 18 July 1975, *C. Y. Wu 75-788, C. Y. Wu 75-988* (HNWP); Cona, 3500 m, 16 Aug. 1977, *B. Z. Guo & W. Y. Wang 23002* (HNWP); Cona, Nariyong Lake, 3500 m, 17 July 1975, *C. Y. Wu et al. 75-900* (HNWP). **TANGUT:** **Qamdo,** 3700–3900 m, the road from Qamdo to Jomda, 29 July 2009, *D. E. Boufford et al. 41291* (PE). **U IRRAWADDY:** **Chimili Valley,** 3050 m, 31 July 1919, *R. Farrer 1140* (E).

157. *Pedicularis dolichosiphon* (Hand.-Mazz.) H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 199. 1949 \equiv *Pedicularis siphonantha* D. Don var. *dolichosiphon* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 60: 117. 1923; Symb. Sin. 7: 865. 1936. Type: China, Sichuan, Muli, “Supra monasterium Muli in pineto-quercetis apertis regionis

temperatae ad pascuum Djatsiila”, 3425 m, 3 Aug. 1915, *H. R. E. von Handel-Mazzetti* 7391 [holotype: WU(WU0060200)].

Pedicularis variegata H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 193. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 369. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. **syn. nov.** Type: China, Sichuan, Muli, “Mountains between Wa-Erh-Dje and Muli Gomba”, 4150 m, Aug. 1928, *J. F. Rock* 16927 (holotype: PH; isotype: US).

Perennial, subcaulescent, or short-stemmed. Roots simple, straight, long, and slightly thickened. Leaves alternate to sub-opposite, petiole 1–3.5 cm long, slightly winged, densely villose; blade ovate to oblong-ovate, 1.5–4 cm long and 1 cm wide, slightly pubescent to glabrate, pinnatisect; segments 8–13 pairs, oblong, obtuse, 1.5–3 mm wide, slightly narrowed at base, pinnatifid, serrate. Flowers axillary and compactly arranged

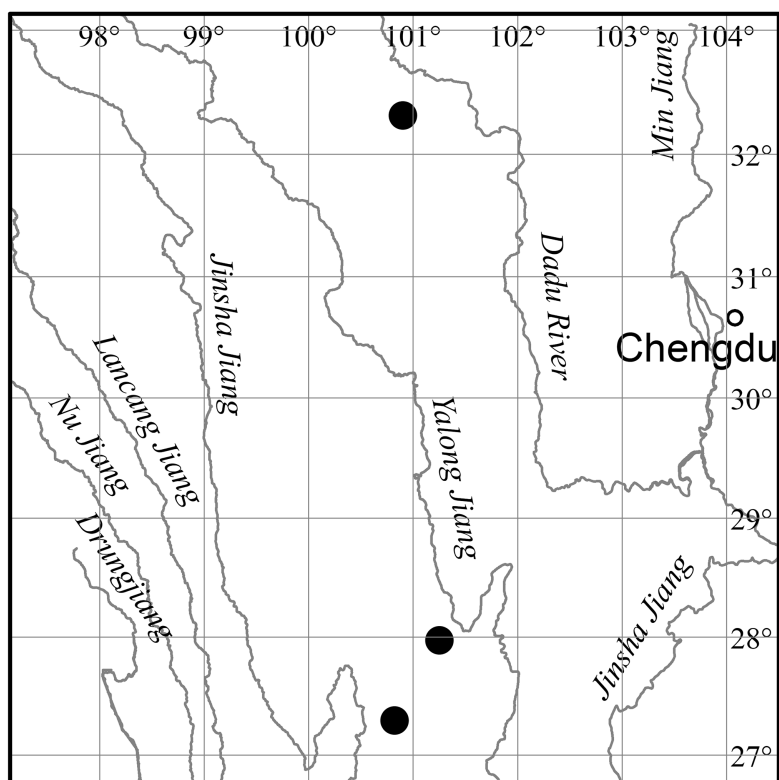
toward the distal part of stem, sessile to subsessile. Calyx campanulate, 6–8 mm long, enlarged apically, sparsely long-pubescent, deeply cleft anteriorly; lobes 3, unequal in size, lateral pair larger, margin double-dentate. Corolla white, rose to purple; tube about 30–60 mm long, erect, sparsely hairy externally; galea strongly twisted, glandular-pubescent, inconspicuously crested; beak S-shaped, 9–10 mm long; lower lip 12–15 mm long, 15–20 mm wide, margins finely ciliate, lateral lobes orbicular, median emarginate to shallowly bilobed; filaments 2 villose, 2 glabrous.

Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows; 3400–4200 m.

Distribution: endemic; Tangut, S Hengduan [Map 45(2)–157].

Notes: Handel-Mazzetti described *P. siphonantha* D. Don var. *dolichosiphon* Hand.-Mazz. as new based on a collection from Muli,



Map 45(2)–157: *Pedicularis dolichosiphon* (Hand.-Mazz.) H. L. Li

Sichuan, China. Li stated that it is closely related to *P. delavayi* Franch. ex Maxim. but distinguishable, and thus he elevated it as a species [*P. dolichosiphon* (Hand.-Mazz.) H. L. Li]. This species was neglected in *Fl. Reipubl. Popularis Sin.* (Tsoong, 1963) and *Fl. China* (Yang *et al.*, 1998). Li also described *P. variegata* H. L. Li as new based on another collection from Muli, Sichuan. These two “species” [*P. dolichosiphon* (Hand.-Mazz.) H. L. Li and *P. variegata* H. L. Li] from the same site are similar and are mainly different in corolla color. Hence, *P. variegata* H. L. Li is here treated as a new synonym of *P. dolichosiphon* (Hand.-Mazz.) H. L. Li.

Tangut: Zamtang, NW of the city Zamtang on road toward Sêrtar along the Ri-Ke river in Shangdu-ke on Zamtang xiandaogangshan-lu (road no. 33), 3570 m, meadow, shrub thickets and forest of *Abies*, 5 Aug. 2007, *D. E. Boufford et al.* 39088 (P04407388). **S HENGDUAN: Muli**, 3425 m, 3 Aug. 1915, *H. R. E. von Handel-Mazzetti* 7391 (WU); Muli, Kangwu, 21 Aug. 1983, *Qinghai-Xizang Exped.* 13224 (PE00123183). **Ninglang**, Cuiyu, 3462 m, 22 Sept. 2019, *X. X. Zhu et al.* ZXX191444 (KUN).

158. *Pedicularis delavayi* Franch. ex Maxim., *Bull. Acad. Imp. Sci. Saint-Petersb.* 32: 531. 1888. ≡ *Pedicularis siphonantha* var. *delavayi* (Franch. ex Maxim.) P. C. Tsoong in Chien & Chun, *Fl. Reipubl. Popularis Sin.* 68: 374. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), *Fl. China* 18: 208. 1998. Type: China, Yunnan, Lijiang, 4000 m, 14 Aug. 1884, *J. M. Delavay* [holotype: LE; isotypes: K, P].

Herbs perennial, 5–15 cm tall. Roots 5–10 cm long, strongly fusiform. Stems very short, usually glabrescent. Leaves basal and cauline; petiole usually 2–4 cm long, winged, glabrescent or sparsely long-pubescent; leaf blade lanceolate-oblong to linear-oblong, rarely ovate-elliptic, 1–3.5 cm long, 0.5–1.5 cm wide, adaxially sparsely pubescent, abaxially sparsely long-pubescent along midvein, pinnatifid to pinnatisect; segments 6–8 pairs, somewhat lanceolate to broadly ovate or triangular. Flowers axillary, dentate; bracts leaflike, glabrescent or long ciliate. Calyx pubescent; tube 10–13 mm

long, 1/3 cleft anteriorly; lobes 3 (sometimes 5), posterior one smallest. Corolla purple to purple-red; tube 40–70 mm long, finely pubescent; galea strongly twisted apically; beak semicircular or slightly S-shaped, 9–12 mm long, slender; lower lip 10–15 mm long, 14–18 mm wide, lobes obviously 2-lobed. Filaments anterior 2 densely hairy distally and posterior 2 glabrous. Capsule ovoid-oblong. **Chromosomes:** 2n = 14.

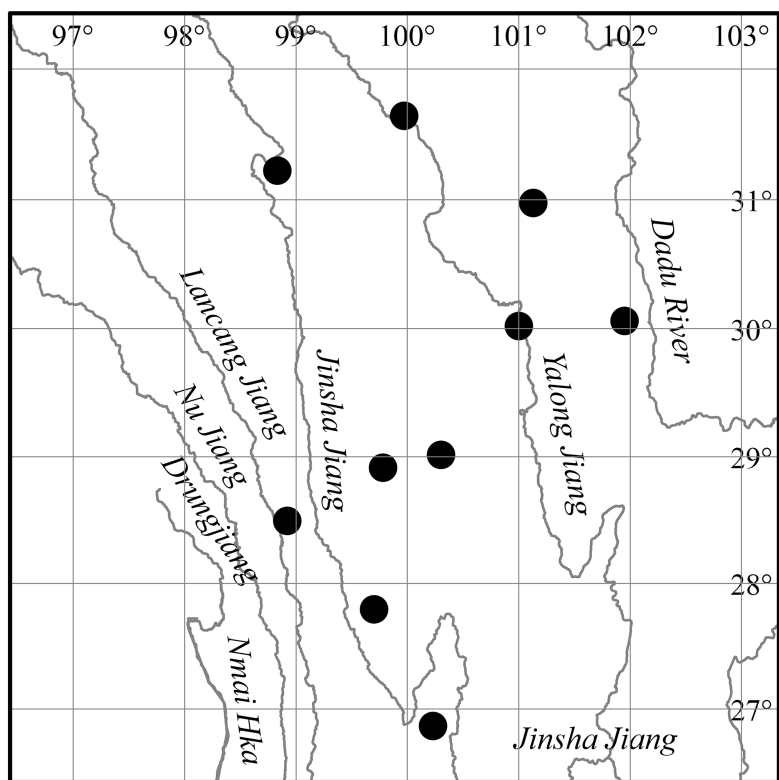
Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; 3000–4600 m.

Distribution: endemic; Tangut, N Hengduan, S Hengduan [Map 45(2)–158].

Notes: *Pedicularis delavayi* Franch. ex Maxim. was originally described as having 5 calyx teeth. However, both types and later collections show that the calyx-teeth of *P. delavayi* are 2 or 3 but sometimes maybe 5. As Yu *et al.* (2018. *PLoS ONE* 13: e0200372) stated, many plants in the Hengduan Mountains identified as *P. siphonantha* var. *delavayi* (Franch. ex Maxim.) P. C. Tsoong should be *P. delavayi* Franch. ex Maxim. Results of molecular phylogenetic analysis support that *P. delavayi* Franch. ex Maxim. should be separated from typical *P. siphonantha* D. Don.

TANGUT: Garzê, Jiabula Shan, 4470 m, 31 July 2001, *F. S. Yang* Y0104 (PE); Garzê, Gan-bai road, 4020 m, 24 Aug. 2006, *D. E. Boufford et al.* 37222 (PE). **N HENGDUAN: Baiyü**, Gan-bai road, 4255 m, 20 Aug. 2006, *D. E. Boufford et al.* 36879 (PE); **Dawu**, SE of the city of Danba on the road (highway 303) to Dawu and Dangding, 3680 m, 25 July 2007, *D. E. Boufford et al.* 38181 (PE). **Yajiang**, between the cities of Yajiang, 3850–3870 m, 4 Aug. 2006, *D. E. Boufford et al.* 35674 (PE). **S HENGDUAN: Daocheng**, Haizi Shan, 4200 m, 31 July 2000, *F. S. Yang* 2042 (PE); Daocheng, S of Daocheng Bawu vallige, 3900 m, 28 Aug. 2013, *D. E. Boufford et al.* 43296 (PE); Daocheng, Wongtula, 3900 m, 21 Aug. 1937, *T. T. Yü* 12825 (PE). **Dêqên**, Baimaxue Shan, 4400 m, 17 Sept. 2008, *Q. S. Yang et al.* ZhouZK-07ZX-0412 (KUN); Dêqên, Baimaxue Shan, 3900 m, 30 June 2001, *F. S. Yang* Y0004 (PE); Dêqên, Baimaxue Shan, 4400 m, 8 July 1983,



Map 45(2)-158: *Pedicularis delavayi* Franch. ex Maxim.

Hengduan Shan Veg. Exped. 4496 (PE). **Kangding**, Tagong, 3750 m, 2 Aug. 2006, C. Wang, no record number (BNU0012130, 0012143); Kangding, Zheduotang, 3360 m, 26 July 2000, F. S. Yang Y2023 (PE); Kangding, Yala, Dapao Shan, 3768–4150 m, 16 July 2017, Y. L. Peng et al. THP-KD-3482 (CDBI); Kangding, Zheduo Shan, 3930–4278 m, 13 July 2017, Q. Yu & X. X. Zhou THP-KD-4185 (CDBI); Kangding, Mugecuo, 2873–3770 m, 19 July 2017, Q. Yu & X. X. Zhou THP-KD-4646 (CDBI); Kangding, Er-tai-zi, 3600 m, 22 Sept. 1995, J. Q. Liu et al. 294 (HNWP); Kangding, Cheto La, 4100 m, 3 Aug. 1934, H. Smith 11021 (PE). **Shangri-la** (Zhongdian), Tuanjie to Xiaotianchi, 2950 m, 20 June 2017, D. H. Liu 170060 (PE); Shangri-la (Zhongdian), Geza, Hongshan, 3926 m, 21 Aug. 2011, J. Cai et al. 11CS3266 (KUN); Shangri-la (Zhongdian), Niru vallige to Shudu Lake, 3297 m, 16 Aug. 2011, J.

Cai et al. 11CS3212 (KUN); Shangri-la (Zhongdian), Daxue Shan, 4200 m, 23 July 2001, F. S. Yang Y0052 (PE); Shangri-la (Zhongdian), near the city of Zhongdian, 3400 m, 5 July 2001, F. S. Yang Y0025 (PE); Shangri-la (Zhongdian), Yak Cheese Farm, Langdu, 3856 m, 4 Aug. 2010, T. Zhang et al. 10CS2227 (KUN); Shangri-la (Zhongdian), Jiantang, Alpine Botanic Garden, 3378 m, 23 July 2008, X. Hai & A. F. Xie HX2008-160 (SABG); Shangri-la (Zhongdian), Habaxue Shan, 3950 m, 31 Aug. 1962, *Zhongdian Team* 1676 (PE). **Xiangcheng**, vicinity of the town of Rede Rizhao Shenshan from gorge behind Silong village, 3600–3850 m, 16 July 2004, D. E. Boufford et al. 30695 (KUN); Xiangcheng, Wuming Shan, 4120 m, 24 July 2020, F. S. Yang Y2023 (PE); Xiangcheng, Dumuling, 4230 m, 27 June 1960, KUN Institute, CAS 9641 (PE, KUN). **Yulong** (Lijiang), 3000 m, July 1935, C. W. Wang 71127 (PE).

159. *Pedicularis milliana* W. B. Yu, D. Z. Li & H. Wang, PLoS ONE 13. e0200372. 2018. Type: China, Yunnan, Shangri-la, Xiaozhongdian, Tianbao Shan, 3687 m, 22 July 2010, *W. B. Yu, W. Jiang, Y. Luo et al. HW10095* [holotype, KUN; isotype: KUN].

Perennial herbs, low to tall, black or not when dry. Roots usually cylindric. Stems solitary, erect, or sometimes numerous, and outer stems procumbent, striate, pubescent, or sparsely pubescent. Leaves basal and cauline; petiole of basal leaves 15–30 mm long, petiole of cauline leaves 10–25 mm long, winged, sparsely long-pubescent; leaf blade lanceolate-oblong to linear-oblong, 10–60 mm long, 7–16 mm wide, abaxially sparsely long-pubescent along midvein, furfuraceous, adaxially glabrescent or sparsely pubescent, pinnatisect; segments 6–15 pairs, somewhat lanceolate to broadly ovate or triangular, pinnatifid, or double-dentate. Flowers axillary, dense, sometimes interrupted at basal

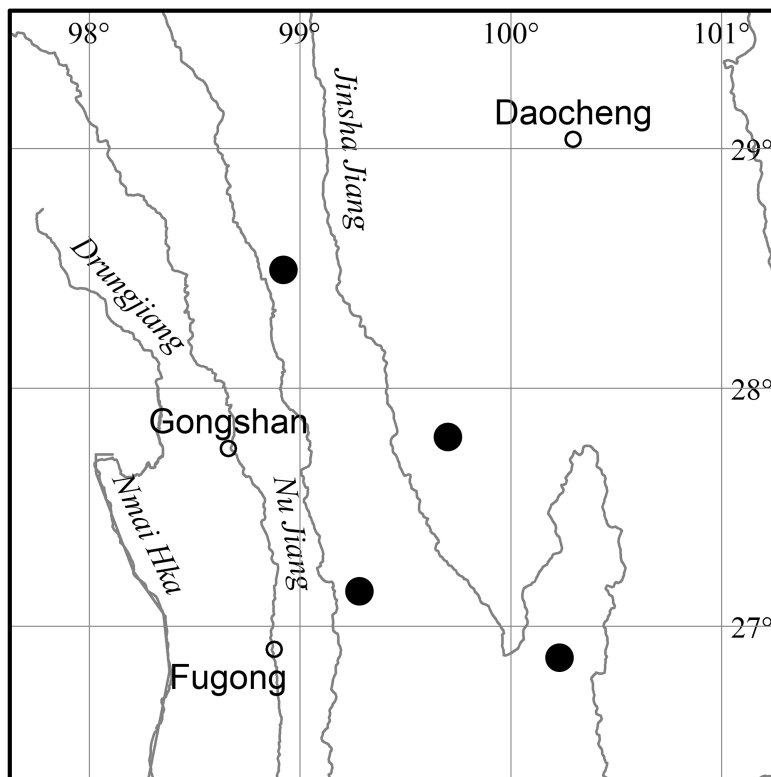
position; bracts leaflike, glabrescent, or long ciliate. Calyx pubescent; tube 9–12 mm long, 1/4–1/3 cleft anteriorly; lobes 3, lateral lobes larger and leaflike, posterior one smallest. Corolla rose-red; tube 40–80 mm long, finely pubescent; galea strongly twisted apically, without a conspicuously auriculate protrusion; beak semicircular or slightly S-shaped, 9–11 mm long, slender; lower lip lobes 3, ciliate, 11–15 mm long, 15–20 mm wide, 2 lateral lobes larger, slightly incurved at upper margin, middle lobe slightly smaller, emarginate, 2-lobed. Filaments anterior 2 pubescent. Capsule ovoid-oblong, 15–20 mm long.

Phenology: flowering from June to August.

Habitats: grasslands of mountain streams, margins of low shrubs; 3000–4000 m.

Distribution: endemic; S Hengduan [Map 45(2)–159].

S HENGDUAN: Dêqên, *S. D. Zhang & H. J. He 08836* (KUN); Dêqên, *W. B. Yu*



Map 45(2)–159: *Pedicularis milliana* W. B. Yu

et al. 2014123 (KUN). **Shangri-la** (Zhongdian), HW10122 (KUN); Shangri-la (Zhongdian), HW10141 (KUN); Shangri-la (Zhongdian), HW10156 (KUN); Shangri-la (Zhongdian), HW10163 (KUN); Shangri-la (Zhongdian), *W. B. Yu et al.* 2014099 (KUN). **Weixi**, *Hengduan Shan. Exped. 01644, 3104* (PE). **Yulong** (Lijiang), *W. B. Yu et al.* LIDZ1580 (KUN); Yulong (Lijiang), *YWB-003* (KUN).

160. *Pedicularis leptosiphon* H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 194. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 370. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. Type: China, Sichuan, Muli, in the mountains of Muli and Kulu, 4000 m, June–July 1929, *J. F. Rock 18012* (holotype: US; isotype: E).

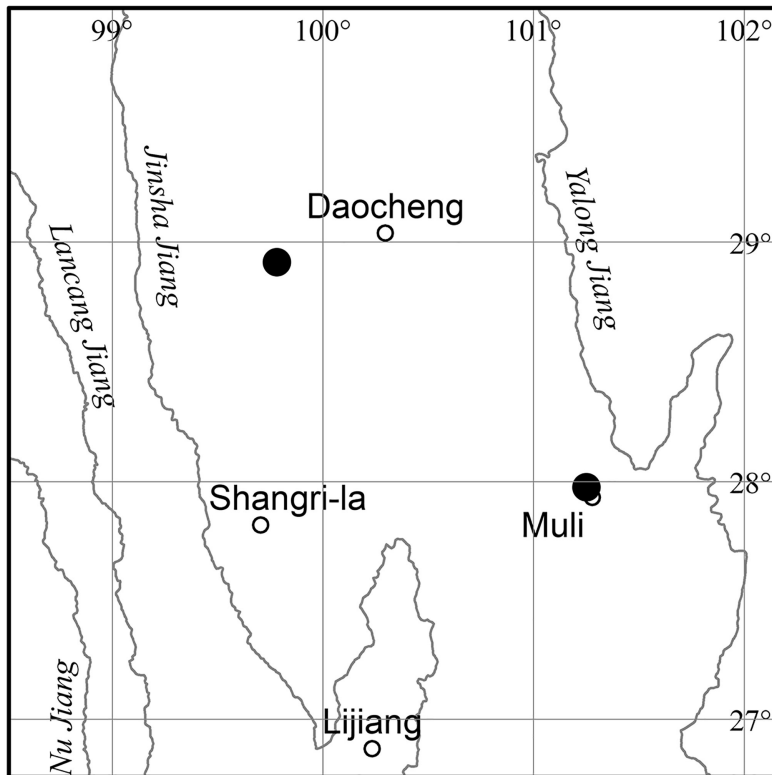
Herbs perennial, 10–20 cm tall. Stems numerous, erect or more or less diffuse, long-pubescent when young, glabrescent. Leaves basal

and cauline, alternate; petiole 2–4 cm long, long-pubescent; leaf blade oblong or linear-oblong, 2.5–5 cm long, 0.8–1.1 cm wide, pinnatisect; segments 8–11 pairs, widely spaced, ovate, becoming glabrous or sparsely pubescent, dentate. Proximal flowers axillary, distal ones dense, more or less sessile; bracts leaflike. Calyx 7–10 mm long, sparsely long-pubescent, deeply cleft anteriorly; lobes 3–5, unequal in size, posterior-lateral pair largest, pinnatifid. Corolla white; tube erect, slender, 65–75 cm long, 1–2 mm wide; galea strongly twisted, 9–10 mm long, glandular-pubescent; beak S-shaped; lower lip 7–10 mm long, 12–17 mm wide, finely ciliate, middle lobe truncate. Filaments anterior 2 sparsely pubescent apically.

Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows; 4000–4300 m.

Distribution: endemic; S Hengduan [Map 45(2)–160].



Map 45(2)–160: *Pedicularis leptosiphon* H. L. Li

Notes: *Pedicularis leptosiphon* H. L. Li is quite similar to *P. delavayi* Franch. ex Maxim. and *P. tenuituba* H. L. Li, and the main difference between *P. leptosiphon* H. L. Li and its relatives is flower color (white) and size of the middle lobe (broader than lateral ones). Only two collections of *P. leptosiphon* H. L. Li have been available.

S HENGDUAN: Muli, in the mountains of Muli and Kulu, 4000 m, June–July 1929, *J. F. Rock 18012* (HUH, IBSC, US). **Xiangcheng**, Rewu, 4300 m, 15 Aug. 1981, *Qinghai-Xizang Exped. 4089* (HITBC, KUN, PE).

161. *Pedicularis paxiana* H. Limpr., Repert. Spec. Nov. Regni Veg. Beih. 12: 483. 1922; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 371. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 207. 1998. Type: China, Sichuan, Daofu, “Ost-Tibet, Dawo, Lumpu-er Thal oberhalb des Thalschlusses Loritza”, 4300 m, 24 July 1914, *H. W. Limpricht 2008* [isotype: WU(WU0060219)].

Pedicularis decorissima Diels, Notizbl. Bot. Gart. Berlin-Dahlem 10: 891. 1930; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 367. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. **syn. nov.** China, Tibet, “Grasslands between Labrang and Yellow River, meadows between Hetso & Chiu ssu”, 2890–3050 m, 5 Aug. 1926, *J. F. Rock. 14546* [**lectotype designated here:** K(K000708723); lectotypes: E(E00438429), GH(00097214), PH(00019455)].

Herbs perennial, usually 8–15 cm tall, dark brown when dry. Stems usually several, densely tufted, outer stems usually procumbent to ascending, longer than central stem. Leaves basal and cauline; petiole 1–6 cm long, more or less long-pubescent; leaf blade linear to lanceolate-oblong, 2–7 cm long, 1.5–1.8 cm wide, glabrous except finely pubescent along midvein adaxially, usually pinnatipartite; segments 6–9 pairs, triangular to triangular-ovate, margin double-dentate; cauline leaves sometimes pseudo-opposite. Flowers axillary; pedicels short. Calyx more than 15–20 mm long, densely long-

pubescent, ca. 1/2 cleft anteriorly; lobes 2, shallowly pinnatifid. Corolla rose-pink, sometimes white; tube 70–120 mm long, sparsely pubescent; galea slightly twisted, densely pubescent at middle, prominently crested in front; beak curved below; lower lip 25–28 mm wide, long ciliate, rounded. Filaments densely pubescent. Figure 45(2)–75.

Phenology: flowering and fruiting from July to September.

Habitats: alpine meadows; 2900–3500 m.

Distribution: Tangut, N Hengduan [Map 45(2)–161]; also in other regions of Gansu, China.

Notes: Limpricht described *P. paxiana* H. Limpr. as new based on one collection (*H. W. Limpricht 2008*) from Dawu, Sichuan, China. The original description is very brief, and Li, Tsoong, and Yang, Holmgren & Mill did not see the type collection when they revised *Pedicularis* of China. We examined specimens in WU (noted as “isotype”) and find that it is almost the same as *P. decorissima* Diels. Both are distributed in Dawu, and the main difference is that the flower color is rose-pink (tube and base of galea white) in *P. decorissima* but white in *P. paxiana* H. Limpr. Hence, *P. decorissima* is here treated as a new synonym. This species resembles *P. armata* Maxim. but differs in its pink flowers (or white), prominent crest, and dense pubescence on galea. Our molecular phylogenetic results show that *P. paxiana* is a sister to *P. armata* Maxim.

Tangut: Zamtang, S of the city Zamtang, mostly well preserved *Picea* forest on slopes and along the river, also under *Abies* and *Juniperus*, 3720–4100 m, 7 Aug. 2007, *D. E. Boufford et al. 39253* (P04407356). **N HENGDUAN: Dawu**, 4300 m, 24 July 1914, *H. W. Limpricht 2008* (WU); Dawu, Songlinkou (Sunlingku), 3900 m, 13 Sept. 1934, *H. Smith 12132* (PE00118204).

162. *Pedicularis fastigiata* Franch., Bull. Soc. Bot. France 47: 25. 1900; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 370. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 206. 1998. Type: China, Yunnan, “Yunnan, au voisinage du Mékong, vens Tsiten (P. H. d’Orléans)”, 1896, *P. H. Orleans s.n.* [isotype: P(P00520823)].

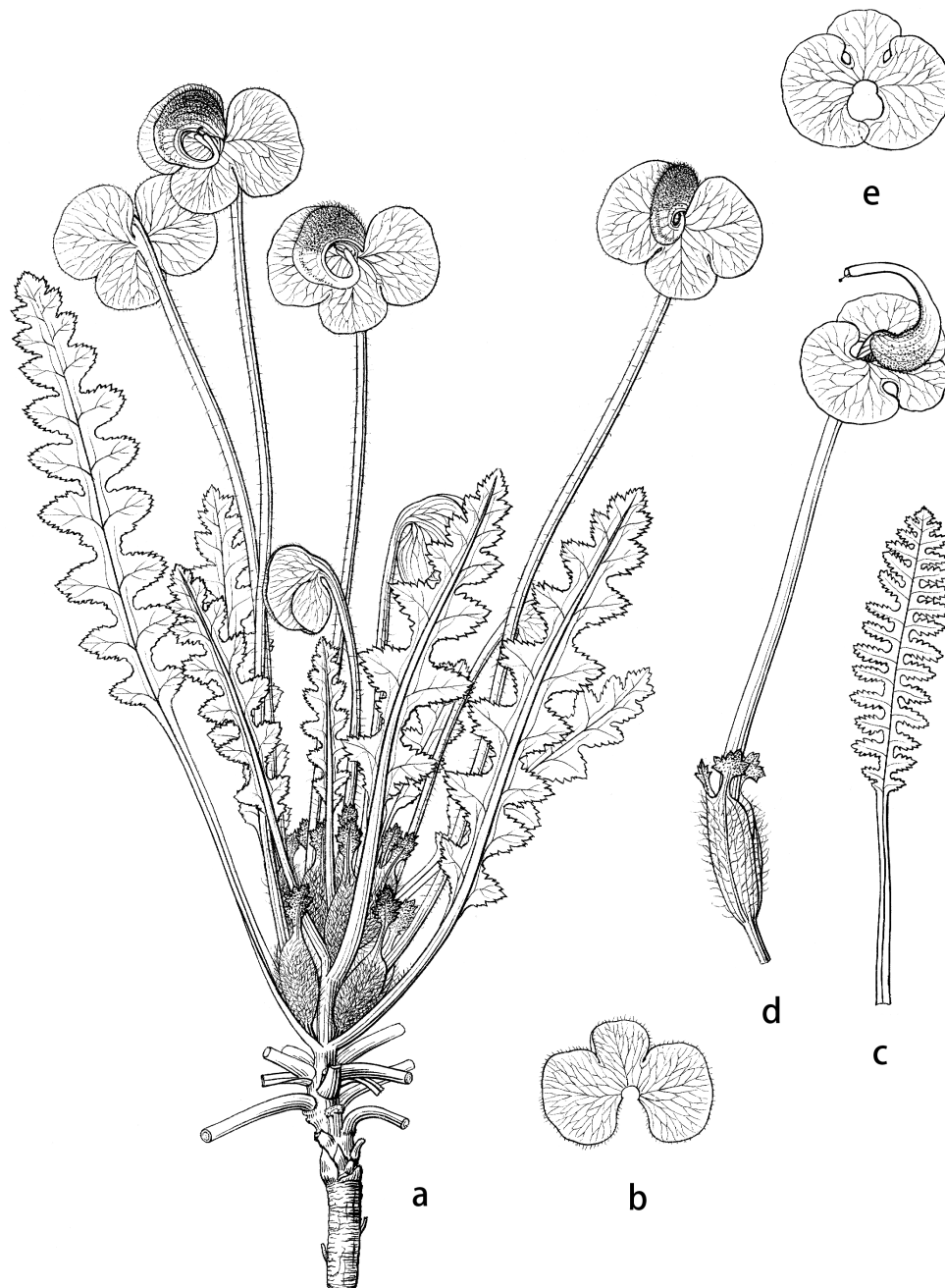
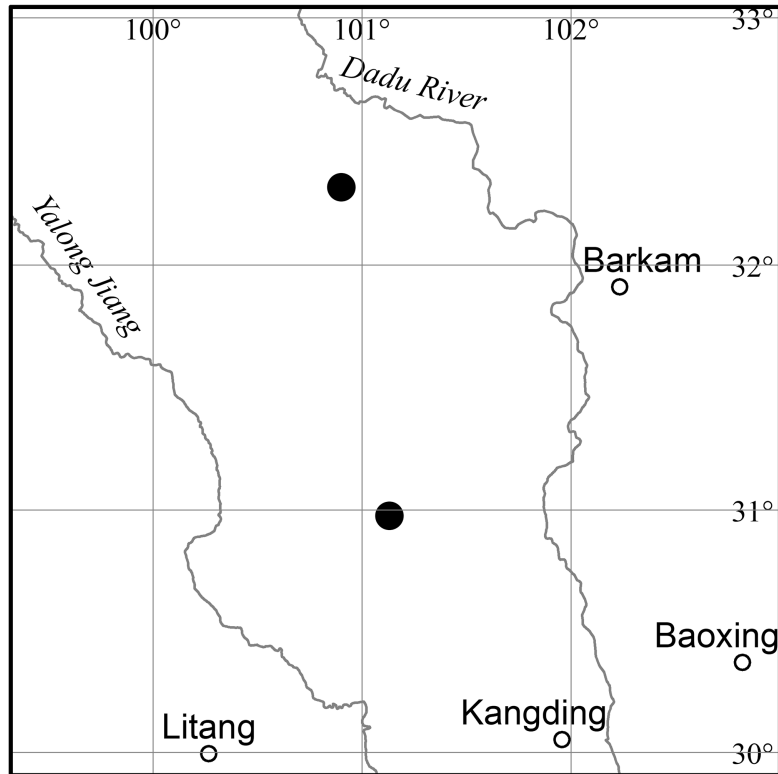


Figure 45(2)–75: **Pedicularis paxiana** H. Limpr. a-b: a, habit; b, corolla lip. Drawn by J.-Y. FENG & C.-R. LIU for *P. decorissima* Diels [*Fl. Reipubl. Popularis Sin.* 68: 367, figure 85: 1-2. 1963]. **Pedicularis fastigiata** Franch. c-e: c, leaf; d, flower; e, corolla lip. Drawn by J.-Y. FENG & C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 370, figure 85: 3-5. 1963].



Map 45(2)-161: *Pedicularis paxiana* H. Limpr.

Stems erect, unbranched or branched, glabrescent, striate, leafy throughout. Proximal leaves alternate, distal ones more or less opposite; petiole long, glabrous; leaf blade linear, 1.5–5 cm long, 0.7–1 cm wide, abaxially sparsely white-scurfy, pinnatisect; segments lanceolate, serrulate. Flowers axillary, proximal ones widely spaced, distal ones dense and fastigiata; sessile or pedicels 3–6 mm long. Calyx ovate-oblong, 10–12 mm long, deeply cleft anteriorly; lobes 3, leaflike. Corolla rose, with a deep red galea; tube 30–40 mm long, slender, minutely pubescent; galea twisted, narrowly crested; beak semicircular, 6–9 mm long; lower lip 10–13 mm long, 12–15 mm wide, middle lobe ca. 1/2 as large as lateral lobes, rounded. Filaments glabrous. Figure 45(2)–75.

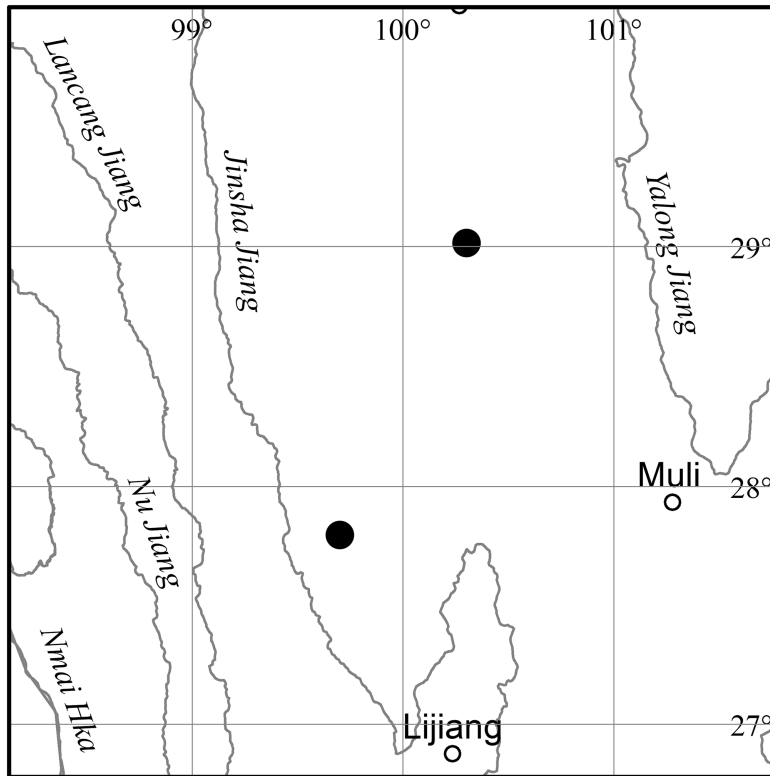
Phenology: flowering and fruiting from June to August.

Habitats: alpine meadows; ca. 3350 m.

Distribution: endemic; S Hengduan [Map 45(2)–162].

Notes: Franchet in the protologue of *P. fastigiata* Franch. stated that it is closely related to *P. garckeana* Prain, a Himalayan species of the series *Robustae*, but the long corolla tube (4 cm long) and arrangement of flowers are different from the latter. However, we find that *P. fastigiata* Franch. is quite similar to *P. delavayi* Franch. ex Maxim. and differs in racemose and smaller flowers. Only one sheet of type (noted as isotype) has been available. Two collections of *P. delavayi* Franch. ex Maxim. collected from Shangri-la (Zhongdian) were misidentified as *P. fastigiata* Franch.

S HENGDUAN: Daocheng, Riwagongshe, 4100 m, 8 Aug. 1982, *Q. Q. Wang 29123* (CDBI). **Shangri-la** (Zhongdian), Xiaozhongdian, 3350 m, 16 June 1981, *Hengduan Shan Group of Qinghai-Xizang Exped. 1154* (PE).



Map 45(2)-162: *Pedicularis fastigiata* Franch.

163. *Pedicularis tenuituba* Pennell & H. L. Li, Proc. Acad. Nat. Sci. Philad. 101: 195. 1949; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 372. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 207. 1998. Type: China, Sichuan, Muli, in the mountains of Muli and Kulu, 3080 m, Aug. 1929, *J. F. Rock 17403* (holotype: PH; isotype: E).

Herbs perennial, 10–30 cm tall. Stems numerous, erect or more or less diffuse, glabrous or sparsely long-pubescent. Leaves basal and cauline, alternate; petiole 2–4 cm long, narrow winged, long-pubescent; leaf blade oblong or linear-oblong, 4–7 cm long, 0.8–1.5 cm wide, pinnatisect; segments 8–15 pairs, widely spaced, ovate, glabrous or sparsely pubescent, dentate. Proximal flowers axillary, distal ones dense, more or less sessile; bracts leaflike. Calyx 8–11 mm long, sparsely long-pubescent, deeply cleft anteriorly; lobes 3 or 5, unequal in size,

posterior-lateral pair largest, pinnatifid. Corolla white or purple; tube erect, slender, 65–100 mm long; galea strongly twisted, 8–10 mm long, glandular-pubescent; beak S-shaped, 8–10 mm long; lower lip up to 9–11 mm long, 12–17 mm wide, finely ciliate, middle lobe truncate. Filaments anterior 2 sparsely pubescent apically. Capsule oblong, 14–17 mm long, 6 mm wide.

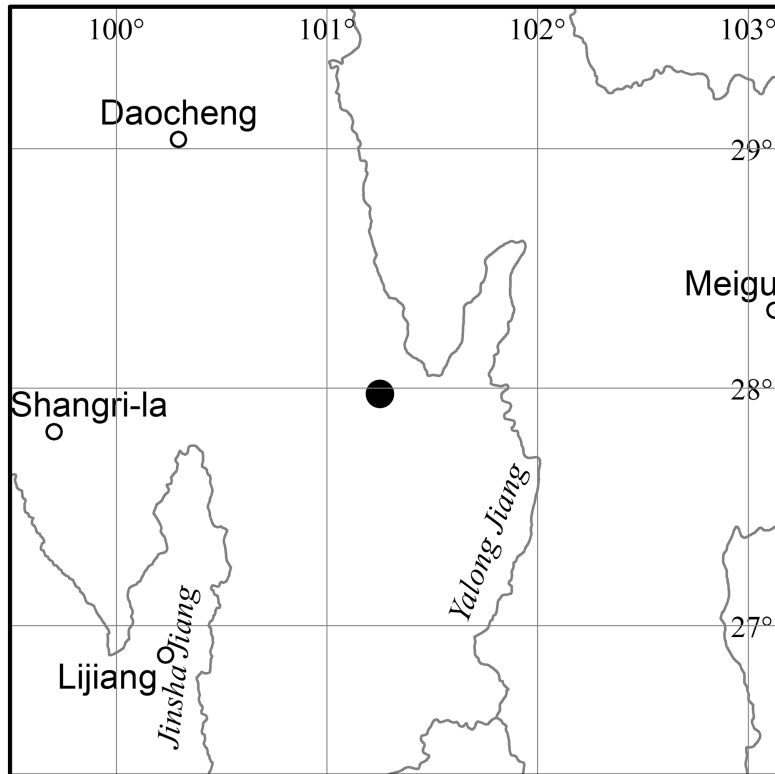
Phenology: flowering and fruiting from July to August.

Habitats: alpine meadows; 3000–3700 m.

Distribution: endemic; S Hengduan [Map 45(2)-163].

Notes: *Pedicularis tenuituba* Pennell & H. L. Li resembles *P. delavayi* Franch. ex Maxim. but differs mainly in obvious taller stems.

S HENGDUAN: Muli, mountains of Kulu, E of Muli Gomba, 3650–4425 m, June 1928, *J. F. Rock 16449* (PH, US); Muli, mountains of



Map 45(2)-163: *Pedicularis tenuituba* Pennell & H. L. Li

Kulu, *J. F. Rock 18087* (PH, US); Muli, 3080 m, Siga Shan, NE of Kulu, *J. F. Rock 18125* (PH, US); Muli, *J. F. Rock 17403* (PH, US); Muli, *J. F. Rock 17403* (PH, US); Muli, *J. F. Rock 17403* (PH, US); Muli, *J. F. Rock 17403* (PH, US).

Ser. 54. *Megalanthae*

Ser. *Megalanthae* (Prain) Bonati, *Mém. Soc. Bot. France* 18: 13. 1910, emend. R. R. Mill hoc loco (Sect. *Sacochilus* T. Yamaz.).

Herbs up to 80 cm tall. Stems erect, unbranched. Leaves alternate, ovate-lanceolate to linear-oblong. Inflorescences racemose and centrifugal. Calyx 5-lobed. Corolla tube very long; galea toothless; lower lip large, usually enveloping galea; beak curved, slender.

Five species; all in the Pan-Himalaya (4 endemics).

Notes: Mill (2011. *Edinb. J. Bot.* 68: 111–138) made a revision of the series *Megalanthae* Prain and treated *P. zhongdianensis* H. P. Yang as a member of the series *Megalanthae*. However, field investigation and specimen examination confirm that *P. zhongdianensis* is a new synonym of *P. tricolor* Hand.-Mazz. (see discussion in the series *Longiflorae*); therefore, it is removed from the series *Megalanthae* to the series *Longiflorae*. Mill [2001. *Edinb. J. Bot.* 58(1): 82] described *P. woodii* R. R. Mill as new based on one collection (*J. R. I. Wood 7316*) collected from Bhutan and he placed it in the series *Megalanthae*. Here, *P. woodii* R. R. Mill is treated as a new synonym of *P. garckeana* Prain ex Maxim. (See discussion in the series *Robustae* Prain).

- 1a. Corolla tube 20–40 mm long; corolla yellow, galea yellow, reddish, magenta, or purple.
- 2a. Herbs less than 20 cm tall; beak semicircular..... 164. *P. megalochila*
- 2b. Herbs usually 20–70 cm tall; galea twisted annular, S-shaped..... 165. *P. hoffmeisteri*
- 1b. Corolla tube 50–60 mm long; corolla wholly magenta.
- 3a. Petiole often 1–2 cm long; corolla tube 40–60 mm long.
- 4a. Filaments all pubescent; a horn on the dorsal side of galea..... 166. *P. cornigera*
- 4b. Filaments 2 pubescent, 2 glabrous; without a horn on galea..... 167. *P. megalantha*
- 3b. Petiole 3–8 cm long; corolla tube 50–80 mm long..... 168. *P. pauciflora*

164. *Pedicularis megalochila* H. L. Li, Taiwania 1: 91. 1948; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 375. 1963; Yang, Holmgren & Mill in Wu & Raven (eds.), Fl. China 18: 208. 1998. ≡ *Pedicularis megalochila* var. *typica* Prain, Ann. Bot. Gard. Calc. 3: 118. 1890. Type: Myanmar, Adung Valley, 1830–2135 m, 7 July 1931, *F. Kingdon-Ward* 9220 [holotype: F(F0072564)].

Pedicularis megalochila var. *ligulata* P. C. Tsoong, Acta Phytotax. Sin. 3: 279. 1955. **syn. nov.** Type: China, SE Tibet, Singo Samba, Lo La Chu near Molo, 28 June 1936, *F. Ludlow & G. Sherriff* 1874 [holotype: BM; isotype: E]

Herbs perennial, less than 20 cm tall, not black when dry. Roots fascicled, more or less fusiform. Stem single or cespitose, white strigose. Leaves mostly basal; petiole 2–4 cm long, leaf blade oblong-lanceolate, 4–6 cm long, 0.8–2 cm wide, adaxially pubescent along midvein, abaxially glabrescent, pinnatifid to pinnatipartite; segments 6–14 pairs, triangular-ovate to ovate-oblong, margin double-dentate; cauline leaves few, smaller than basal leaves; segments 5–6 pairs. Inflorescences centrifugal, usually more than 1/2 as long as stems; bracts leaflike, much shorter than flowers; pedicels 0.6–1 cm long, densely long-pubescent apically. Calyx usually with purplish dots, 2/3 cleft anteriorly; tube 8–17 mm long; lobes 5, unequal in size, posterior one smallest, 2 lateral larger and 2 lateral small, long white-ciliate. Corolla yellow, with brown-red or purple beak or corolla red throughout; tube 20–40 mm long, pubescent; galea falcate apically; beak semicircular, 7–10 mm long; lower lip 18–21 mm long, 20–25 mm wide, middle lobe obcordate, emar-

ginate or ligulate, not placed apically. Filaments all pubescent. Figure 45(2)–76.

Phenology: flowering and fruiting from June to October.

Habitats: on riverside moraines, on sunny grassy slopes, among *Rhododendron*, alpine meadows; 3800–4600 m.

Distribution: E Nepal, Bhutan, L Yarlung Zangbo [Map 45(2)–164]; also in other parts of Myanmar.

Notes: Tsoong described *P. megalochila* H. L. Li var. *ligulata* P. C. Tsoong and *P. megalochila* H. L. Li var. *megalochila* fo. *rhodantha* P. C. Tsoong as new. Both are here treated as synonyms of *P. megalochila* H. L. Li.

E NEPAL: **Mechi**, Taplejung, Jaljale Pokhari, 4000 m, 9 Aug. 1999, *M. Tateno, K. Fujikawa, R. H. Ree et al.* HUH-99-9 (HUH). **BHUTAN:** **Shingbe**, 4500 m, 23 Aug. 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 21088 (PE). **L YARLUNG ZANGBO:** **Mainling**, Xialonggou, 4600 m, 17 July 1972, *Tibet Chin. Medic. Herb. Exped. 3998* (HNWP); Mainling, Duoxiang Shan, 4200 m, 7 Aug. 1973, *Tibet Chin. Medic. Herb. Exped. 1813* (HNWP); Mainling, Pai Dis., 3900 m, 12 Aug. 1975, *Qinghai-Xizang Suppl. Exped. 751358* (HNWP, PE). **Nangxian**, Langong, 4110 m, 16 June 1938, *F. Ludlow & G. Taylor* 5574 (PE).

165. *Pedicularis hoffmeisteri* Klotzsch, in Klotzsch & Garcke, Bot. Ergeb. Reise Pr. Waldemar 108. 1862; Pennell, Monogr. Acad. Nat. Sci. Philad. 5: 147. 1943; Yamazaki in Hara *et al.*, Enum. Fl. Pl. Nepal 3: 123. 1982;

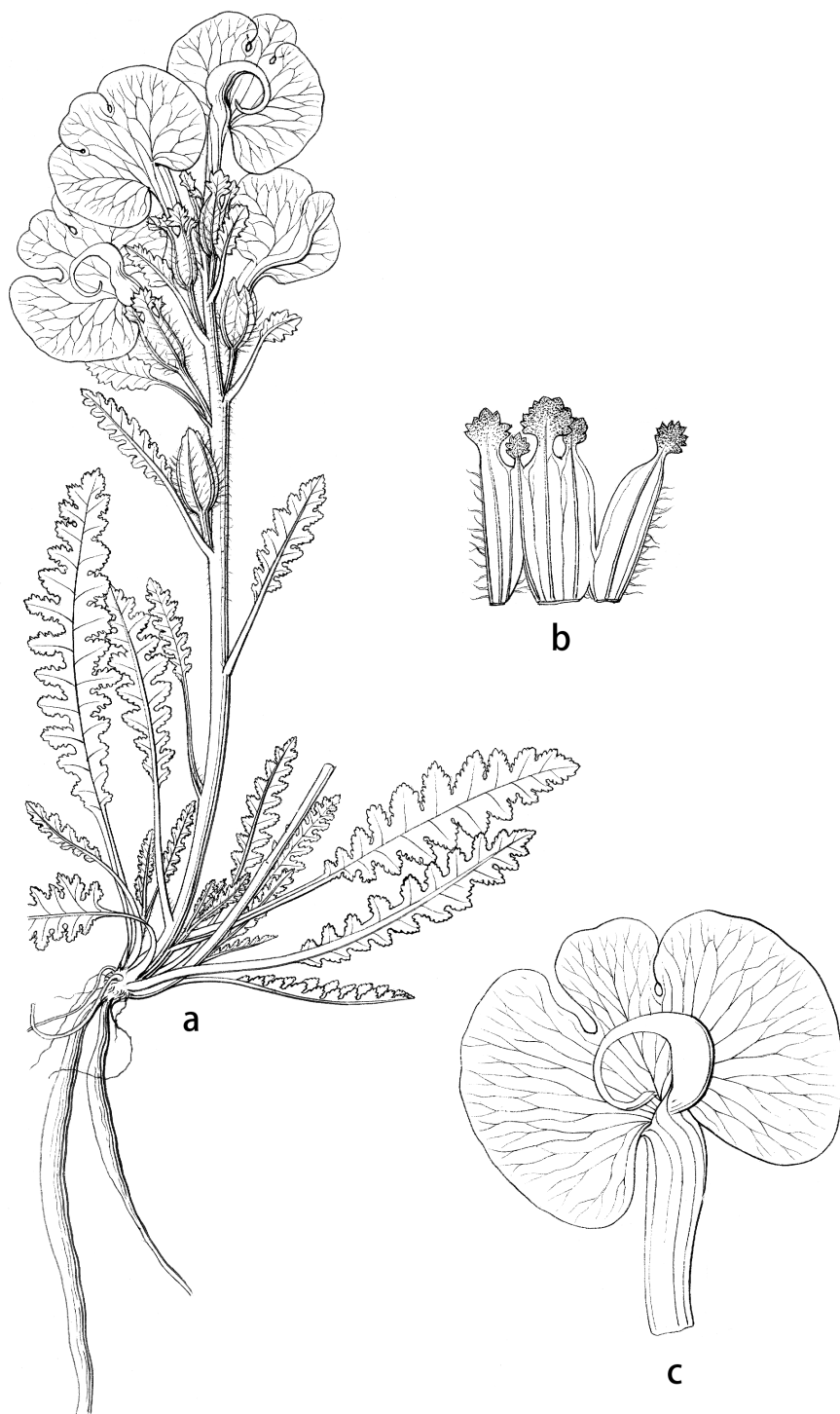
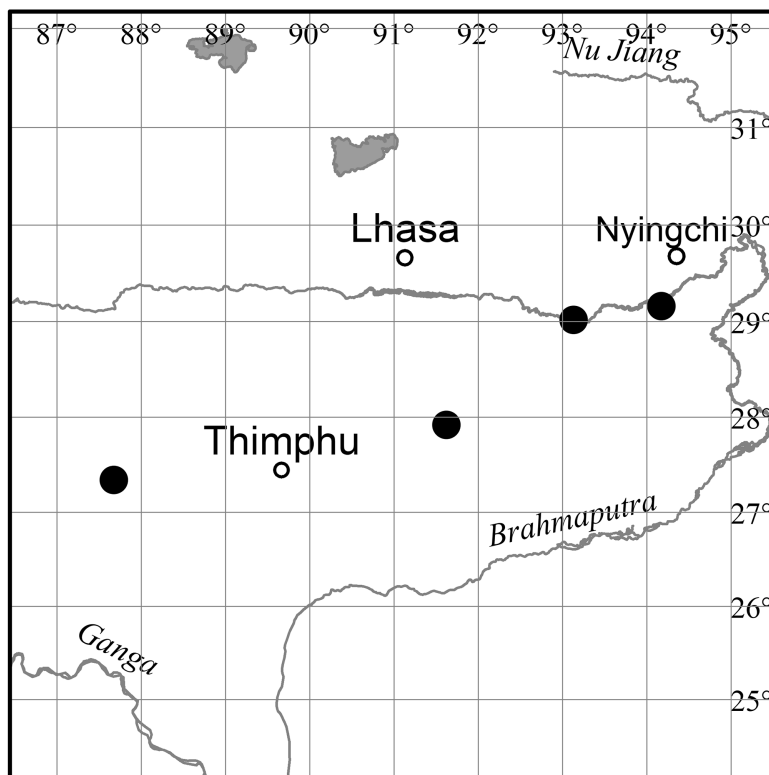


Figure 45(2)–76: *Pedicularis megalochila* H. L. Li. a, habit; b, calyx; c, corolla. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 375, figure 88: 1-3. 1963].



Map 45(2)-164: *Pedicularis megalochila* H. L. Li

Mill, Edinb. J. Bot. 68 (1): 131. 2011. ≡ *Pedicularis megalantha* var. *hoffmeisteri* Sealy, Bot. Mag. 162. 1939. Type: 'Dr Hoffmeister fand diese Art im Himalaya', no more information, the original material collected formerly at the herbarium B is lost. Type: Illustration [lectotype designated by Mill (2011: 132): Illustration, Klotzsch & Garcke, Bot. Ergeb. Reise Pr. Waldemar t. 60 (1862)].

Herbs 15–70 cm tall. Roots straight, simple, or sparsely branched. Stems single or sparsely branched at base, sparsely to subdensely pilose. Leaves alternate; petiole 2–7 cm long, white-pilose; leaf blades lanceolate or linear-lanceolate, 2–7(-11) cm long, 1–3 cm wide, subacute at apex, sparsely white-pilose, pinnatilobed or pinnatifid, segments oblong-ovate pinnatilobed, lobes acute-serrate. Flowers solitary-axillary or in terminal racemes; bracts leaf-like, petiole broad subdensely, white-lanate on margins; pedicels 2–8 mm long. Calyx membranous, urceolate-

tubular, 13–18 mm long, 5–6 mm wide, sparsely to densely white-lanate, 5-lobed, doubly incised-dentate. Corolla lemon-yellow with beak yellow or purplish, 30–40 mm long; tube straight slender, 25–35 mm long, 1 mm wide, 2–2.5 times as long as calyx, pilose; galea twisted annular, hood glandular-punctate under a microscope, gradually narrowing upward and produced into a slender 10–12 mm long beak, obliquely acute and emarginate at apex; lower lip large, enclosing galea, 15 mm long, 25 mm wide, pilose on margins, middle lobe ligular, 5–6 mm long, 3–4 mm wide. Filaments all villose. Capsule lanceolate, 20–25 mm long, 5–6 mm wide. Figure 45(2)-77.

Chromosomes: $2n = 16, 32$.

Phenology: flowering and fruiting from July to September.

Habitats: swampy places at forest margins, damp grassy slopes; 2300–4300 m.

Distribution: endemic; U Ganga & Indus, W Nepal, C Nepal [Map 45(2)-165].

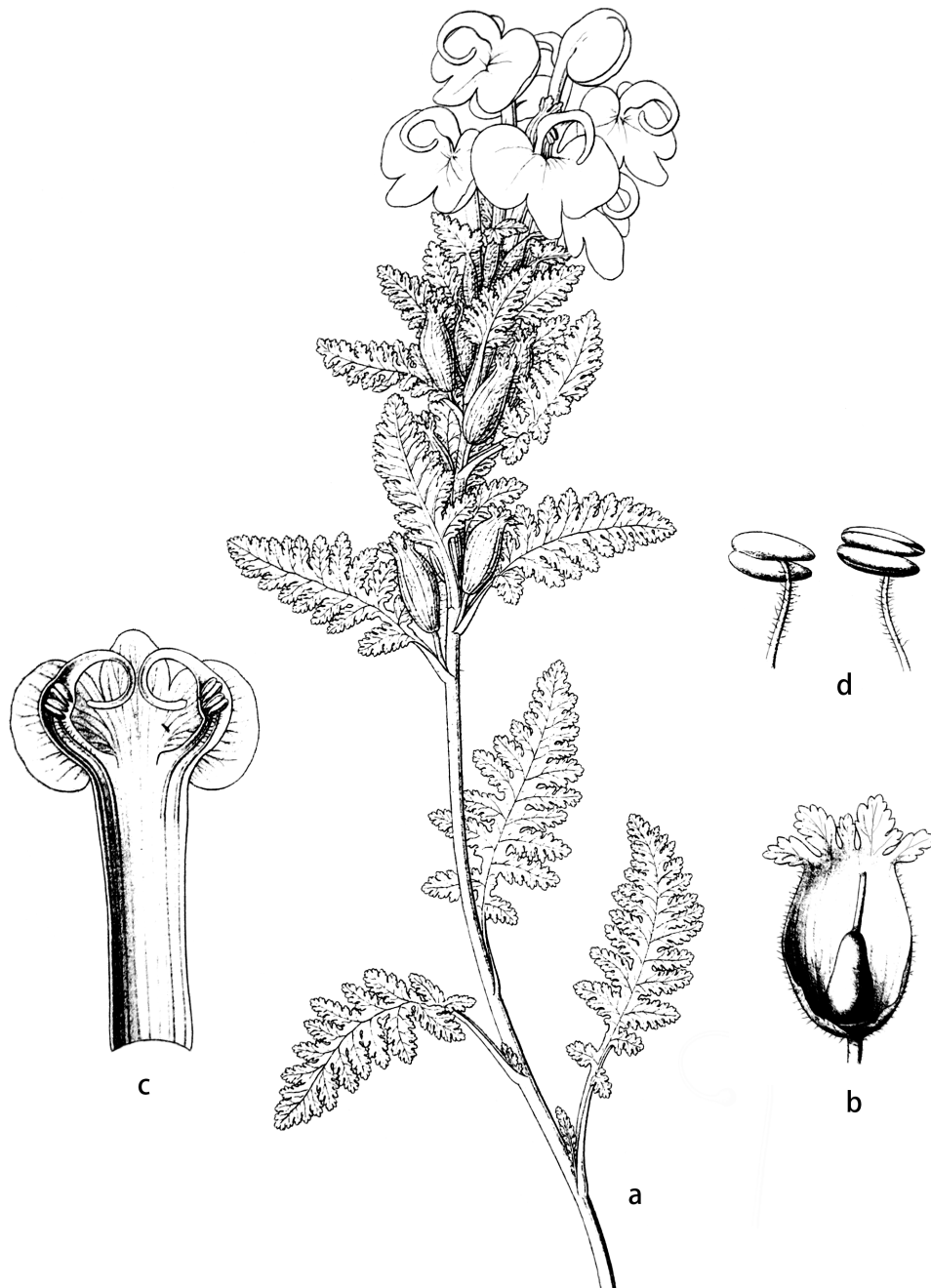
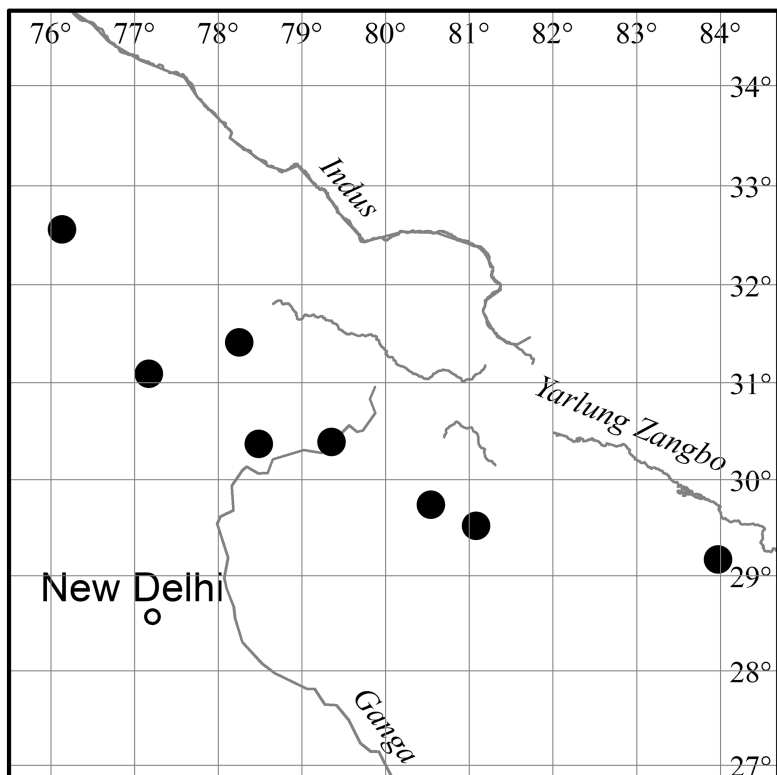


Figure 45(2)–77: *Pedicularis hoffmeisteri* Klotzsch. a, habit; b, calyx, and ovary; c, corolla; d, stamen. A.-L. LI modified from Klotzsch & Garcke [*Bot. Ergeb. Reise Pr. Waldemar*: 108, figure 60. 1862].



Map 45(2)-165: *Pedicularis hoffmeisteri* Klotzsch

Notes: Hooker (1885. Fl. Brit. India 4: 313) reduced *P. hoffmeisteri* Klotzsch as a synonym of *P. siphonantha* D. Don, but Prain (1890. Ann. Bot. Gard. Calc. 3: 119) treated it as a synonym of *P. megalantha* D. Don. Hooker and Prain considered that the corolla color of *P. megalantha* D. Don is a phenotypic character and varies geographically. Pennell (1943. Monogr. Acad. Nat. Sci. Philad. 43: 147) recognized *P. hoffmeisteri* Klotzsch as a distinct species mainly on the basis of flower color, and Mill (2011. Edinb. J. Bot. 68: 111–138) agreed to Pennell that *P. hoffmeisteri* should be a good species. Our molecular phylogenetic results reveal that *P. hoffmeisteri* Klotzsch is close related to *P. megalantha* D. Don. Morphologically, *P. hoffmeisteri* differs from *P. megalantha* in 4 villose filaments and shorter corolla tube. Here we recognize the species status of *P. hoffmeisteri* Klotzsch.

U Ganga & Indus: Chamba, between Alwar and Sach Pass, 4000–5000 m, 29 Aug.

1896, *G. A. Gammie 18412* (DD). **Chamoli**, Badrinath, on way to Manna village, 12 Sept. 1968, *L. D. Kapoor & Party 70268/D* (LWG). **Sangla**, Bashahr, 2900 m, 22 Sept. 1964, *N. C. Nair 34151* (BSD); Sangla, 2600 m, 20 Sept. 1964, *N. C. Nair 33077* (BSD). **Shimla** (Simla), 2666 m, 1886, *Ram Buksh 5180* (BM). **Tehri Garhwal** (Tehri-Garhwal), Har-ki-Dun, Tons Forest division, 3660 m, 10 Sept. 1955, *N. C. Sahni 21999* (DD). **W Nepal: Seti**, Bajhang, Dhalaun-Rosia Pass, 2700 m, 1976, *H. Tabata et al. 1617* (TI). **Karnali**, Mugu, Tangkhaya-Teungoya, 3840 m, 1983, *H. Tabata et al. 17686* (KYO); Karnali, Mugu, Chittaikuna-Sirsnishonda, 2850 m, 1983, *H. Tabata et al. 17399* (KYO); Karnali, Mugu, Rara, Chuchemara Pass, 3800 m, 1983, *H. Tabata et al. 16644* (KYO). **C NEPAL: Dhawalagiri**, Muktinath, 3810 m, 1954, *J. D. A. Stainton et al. 1420* (BM).

166. Pedicularis cornigera T. Yamaz., J. Jap. Bot. 55: 293. 1980. Type: E Nepal, Lamni Nama,

4200–4900 m, 15 Aug. 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 772407 (holotype: TI).

Annual herbs, 5–20 cm tall. Root straight, simple, with several fibrous rootlets. Stems branched at base, sparsely white-pilose. Leaves alternate, sometimes sub-opposite upper; petiole 1–4 cm long, sparsely white-pilose; leaf blade lanceolate-oblong, 1–5 cm long, 0.5–2 cm wide, white-pilose on both surfaces, pinnatifid, segments 6–10-paired, ovate or oblong-ovate, obtuse at apex, crenate-serrate. Flowers solitary-axillary; pedicels 3–10 mm long, pubescent. Calyx membranous, 13–17 mm long, 4–5 mm wide, sparsely white-lanate, ventral part split 1/2 way down, mouth 5-lobed, posterior one obovate or oblanceolate-oblong, 1–2 mm long, crenate-dentate, lateral lobes ovate or ovate-flabellate, 2–4 mm long, 1–3 mm wide. Corolla cream-yellow, 40–60 mm long; tube slender, 30–50 mm long 1–2 mm wide, 3–4 times as long as calyx, sparsely pilose; galea twisted annular, glabrous, with a horn of 1 mm length on dorsal side; beak 12–15 mm long, obliquely acute and emarginate at apex; lower lip 16–19 mm long, 22–26 mm wide, densely pilose on margins, middle lobe ligular, lateral lobes reniform. Filaments all villose.

Phenology: flowering and fruiting from July to September.

Habitats: on riverside moraines, on sunny grassy slopes; 4000–4300 m.

Distribution: endemic; U Yarlung Zangbo, E Nepal [Map 45(2)–166].

Notes: Our molecular phylogenetic results reveal that *P. cornigera* T. Yamaz. is closely related to *P. megalantha* D. Don and *P. hoffmeisteri* Klotzsch. These three species form a well-supported clade in the phylogenetic tree.

U YARLUNG ZANGBO: Dinggyê, Riwu town, 4600–4800 m, 15 Aug. 1990, *B. S. Li et al.* 13058 (PE). **E NEPAL:** Mechi, Tapleijung, Thudam-Lamni Nama, 4000 m, 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 770364 (TI); Mechi, Tapleijung, Thudam-Lamni Nama, 4000 m, 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 773735 (TI).

167. *Pedicularis megalantha* D. Don, Prodr. Fl. Nepal. 94. 1825; Tsoong in Chien & Chun, Fl. Reipubl. Popularis Sin. 68: 377. ≡ *Pedicularis megalantha* var. *typica* Prain, Ann. Bot. Gard. Calc. 3: 118. 1890. Type: India, U Ganga & Indus, Kumaon, *N. Wallich 411/1* [lectotype designated by Mill (2001: 91): K].

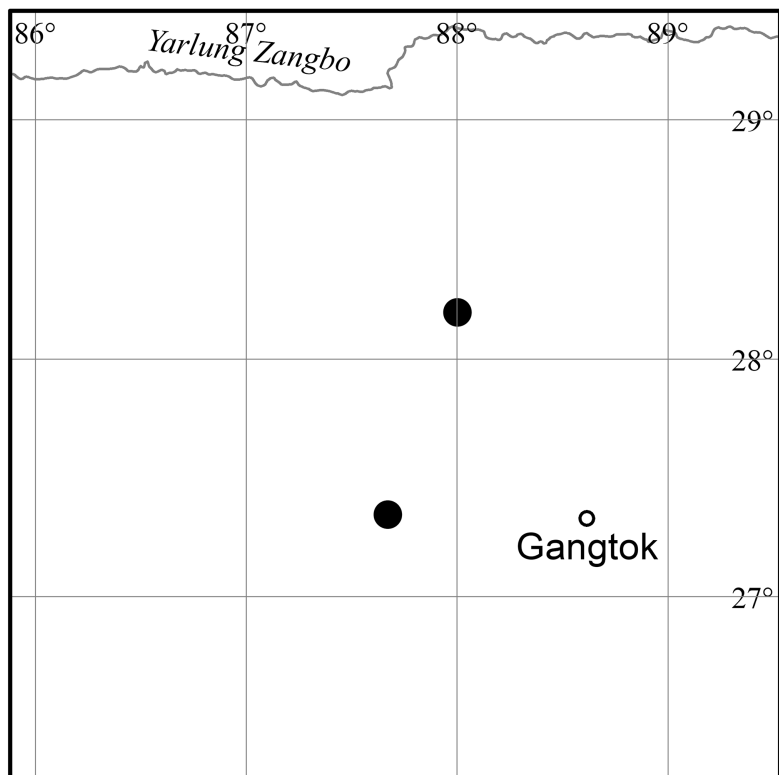
Herbs 10–80 cm tall. Roots straight, simple, or sparsely branched. Stems single or sparsely branched at base, erect or ascending, glabrous. Leaves alternate; petiole 2–8 cm long, glabrous; leaf blade linear-lanceolate, acute at apex, 4–12 cm long, 1–4 cm wide, sparsely pilose on both surfaces, pinnatifid to pinnatipartite; segments ovate or oblong-ovate, pinnatilobed, crenate-serrate. Flowers in terminal racemes; bracts leaf-like, as long as or longer than calyx, petiole short and broad, ciliate on margins; pedicels slender, 2–4 mm long, glabrous. Calyx membranous, urceolate-tubular, 15–20 mm long, 5–8 mm wide, glabrous or white-pilose, ventral part split about 1/3 way down, 5-lobed, lobes orbicular, doubly incised-dentate, posterior one smaller. Corolla pink or red-purple, 50–60 mm long; tube straight, slender, 40–60 mm long, sparsely pilose; galea twisted annular, arched part 2–3 mm wide; beak 8–11 mm long; lower lip enclosing galea, pilose on margins, middle lobe ligular, 6–7 mm long, 4–5 mm wide, lateral lobes 12–15 mm wide. Filaments anterior 2 pilose, posterior 2 glabrous. Capsule lanceolate, 20–30 mm long, 10 mm wide. Figure 45(2)–78. **Chromosomes:** n = 8.

Phenology: flowering and fruiting from July to September.

Habitats: swampy places at forest margins, damp grassy slopes; 2300–4300 m.

Distribution: endemic; U Ganga & Indus, U Yarlung Zangbo, C Nepal, E Nepal, Sikkim & Darjeeling, Bhutan, M Yarlung Zangbo, Yarlung Zangbo-Brahmaputra [Map 45(2)–167].

U GANGA & INDUS: Shimla, 2438 m, Aug. 1896, *B. Rau 5180* (K). **U YARLUNG ZANGBO:** Gyirong, Tuodang, 3400 m, 22 June 1972, *Tibet Chin. Medic. Herb. Exped.* 489 (HNWP); Gyirong, Tuoba, 3700 m, 22 June 1972, *Tibet Chin. Medic. Herb. Exped.* 489 (HNWP);



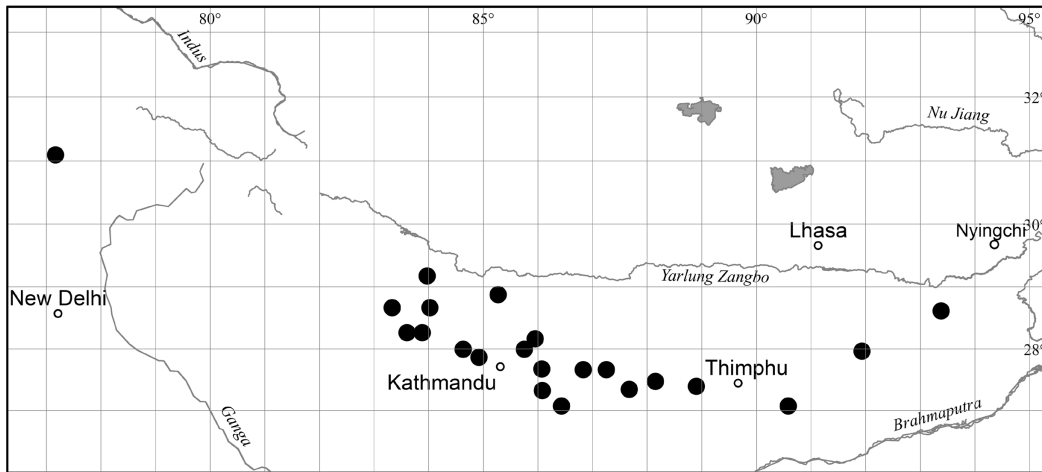
Map 45(2)-166: *Pedicularis cornigera* T. Yamaz.

Gyirong, Gyirong Dis., Anba, 3400–3700 m, *Qinghai-Xizang Exped.* 6384 (PE). **Nyalam**, Quxiang, 3400 m, 16 July 1975, *Qinghai-Xizang Exped.* 6384 (HNWP); Nyalam, Zhangmu, 2800 m, 18 Aug., *Tibet Chin. Medic. Herb. Exped.* 1302 (HNWP). **C NEPAL: Bagmati**, Dhading, Kaste Khola, 4000 m, 12 Aug. 1970, *J. F. Dobremez* 591 (BM); Bagmati, Rasuwa, Kyanjin Gompa, 3640 m, 17 July 1967, *S. B. Malla* 9181 (BM); Bagmati, Rasuwa, Langtang, 3480 m, 22 July 1949, *O. V. Polunin* 527 (BM); Bagmati, Rasuwa, 3750 m, 15 Aug. 1994, *F. Miyamoto, K. R. Rajbhandari, S. Akiyama et al.* SHB9440169 (BM); Bagmati, Rasuwa, Cholang Pati, 2880 m, 9 Sept. 1935, *F. M. Bailey s.n.* (BM); Bagmati, Rasuwa, Gosainkund, 4850 m, 28 Oct. 1935, *F. M. Bailey* 63 (BM); Bagmati, Rasuwa, Khola Kharka, 4090 m, 17–19 July 1949, *O. V. Polunin* 1073 (BM); Bagmati, Rasuwa, Lauribinayak Pass,

3000–3640 m, 25 July 1994, *F. Miyamoto, K. R. Rajbhandari, S. Akiyama et al.* SHB9440022 (E); Bagmati, Rasuwa, Tatopani Khola, 2730 m, 18 June 1962, *J. D. A. Stainton* 3860 (E); Bagmati, Rasuwa, Timure, 3180 m, 2 July 1949, *O. V. Polunin* 758 (BM); Bagmati, Sindhupalchok (Sindupalchok), 3480 m, 11 Oct. 1960, *S. B. Malla & S. B. Rajbhandary* 52-4 (KATH); Bagmati, Sindhupalchok, Bhuanjeng Garka, 3400 m, 10 August 1974, *J. H. de Haas* 2165 (BM). **Dhawalagiri**, Baglung, Phagune Dhuri, 3790 m, 7 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3426 (BM); Dhawalagiri, Baglung, Dhorpaton, 3330 m, 14 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3498 (BM); Dhawalagiri, Mustang, Larjung, 3030 m, 22 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 1993 (BM); Dhawalagiri, Mustang, Tukucho, 3790 m, 21 July 1954, *J. D. A. Stainton, W. R.*



Figure 45(2)-78: **Pedicularis megalantha** D. Don. a, habit; b, flower. Drawn by C.-R. LIU [*Fl. Reipubl. Popularis Sin.* 68: 377, figure 88: 5-6. 1963].



Map 45(2)-167: *Pedicularis megalantha* D. Don

Sykes & L. H. J. Williams 1895 (BM); Dhawalagiri, Myagdi, 3840 m, 20 Sept. 1996, M. Mikage, R. Hirano, A. Takahashi et al. SHB9682906 (E). **Gandaki**, Gorkha, Ganesh Himal, 3640 m, 19 July 1962, J. D. A. Stainton 4017 (BM); Gandaki, Kaski, 3000 m, 28 Aug. 1976, R. G. Troth 986 (BM); Gandaki, Manang, Bimtang, 3790 m, 25 Aug. 1950, D. G. Lowndes 1449 (E). **Janakpur**, Dolakha, Khare Khola, 4100–4300 m, 10 Sept. 1983, H. Ohba, M. Wakabayashi, M. Suzuki et al. SHB8351404 (E); Janakpur, Ramechhap, Neju, 3651 m, 1 Aug. 1985, H. Ohba, T. Kikuchi, M. Wakabayashi et al. 8571013 (E). **E NEPAL: Kosi**, Sankhuwasabha, 3510–4180 m, 7 Aug. 1991, H. Ohba et al. SHB9110352 (E). **Mechi**, Taplejung, Khang La, 3790 m, 17 June 1974, L. H. J. Williams 696 (BM). **Sagarmatha**, Solukhumbu, Bhote Koshi Valley, Thame, 4200 m, 30 Aug. 1966, H. J. Lange 17 (K); Sagarmatha, Solukhumbu, Namche Bazar, 3640 m, 28 July 1966, M. L. Banerji & P. R. Shakya 5632 (KATH); Sagarmatha, Solukhumbu, Tak Tor, 3330–3640 m, 1930, L. Dhwoj 30 (BM). **SIKKIM & DARJEELING: Sikkim**, Jongri (Dzongri), Dzongri-Thangshing, 4038 m, 18 Sept. 1983, B. N. Starling, P. Cunningham, J. Main et al. 576 (K). **BHUTAN: Gaylephug**, E slopes of Pele La, W of Tongsa, 3300 m, 27°32'N, 90°12'E, 11 July 1979 (K). **M YARLUNG ZANGBO: Yadong**, Chunpi, 3900 m, 14 Sept. 1974, *Qinghai-Xizang*

Exped. 74-2475 (PE). **YARLUNG ZANGBO-BRAHMAPUTRA: Cona**, S slopes of Bo Shan, 3600 m, *Qinghai-Xizang Suppl. Exped.* 751889 (HNWP). **Tsari** (Migyutin), 5000 m, 23 Aug. 1936, F. Ludlow & G. Sherriff 2476 (PE).

168. *Pedicularis pauciflora* (Prain) Pennell, *Monogr. Acad. Nat. Sci. Philad.* 5: 149. 1943; Yamazaki, *J. Jap. Bot.* 61: 301. 1986. ≡ *Pedicularis megalantha* var. *pauciflora* Prain ex Maxim., *Bull. Acad. Sci. Saint-Petersb.* 32: 532. 1888. Type: India, Sikkim, Bhoktan near Jongri, July 1887, *King's collector s.n.* [lectotype designated by Mill (2011: 134): CAL].

Pedicularis megalochila subsp. *longituba* T. Yamaz., *J. Jap. Bot.* 55: 294. 1980. **syn. nov.** Type: Nepal, Thudam-Lamni Nama, 3500–4000 m, 14 Aug. 1977, H. Ohashi, H. Kanai, H. Ohba et al. 772460 (holotype: TI).

Annual herbs, 7–20 cm tall. Roots straight, simple. Stems short, 2–5 cm long, glabrous, or sparsely pilose. Leaves membranous, alternate; petiole 1–2 cm long, pubescent; leaf blade linear-lanceolate, 1–2.5 cm long, 3–10 mm wide, white-scurfy on both surfaces, pinnatifid, segments 6–8-paired, oblong-ovate, obtuse at apex, doubly crenate-serrate. Flowers solitary-axillary, 3–8 on short stems; pedicels 2–3 mm long, puberule. Calyx tubular, 13–15 mm long, 3 mm wide, sparsely white-pilose, ventral part

split about 1/3 5-lobed, posterior lobe oblanceolate, crenate-serrate, lateral lobes ovate, 2 mm long, 1.5 mm. Corolla purple; tube straight slender, 50–80 mm long, 2–3 mm wide, 4.5–6 times as long as calyx, sparsely pilose; galea twisted annular, 3–4 mm wide, gradually narrowed upward and produced into a slender 15 mm beak; lower lip enclosing galea, 13–16 mm long, 20–25 mm wide. Filaments all villose. **Chromosomes:** $2n = 16, 32$.

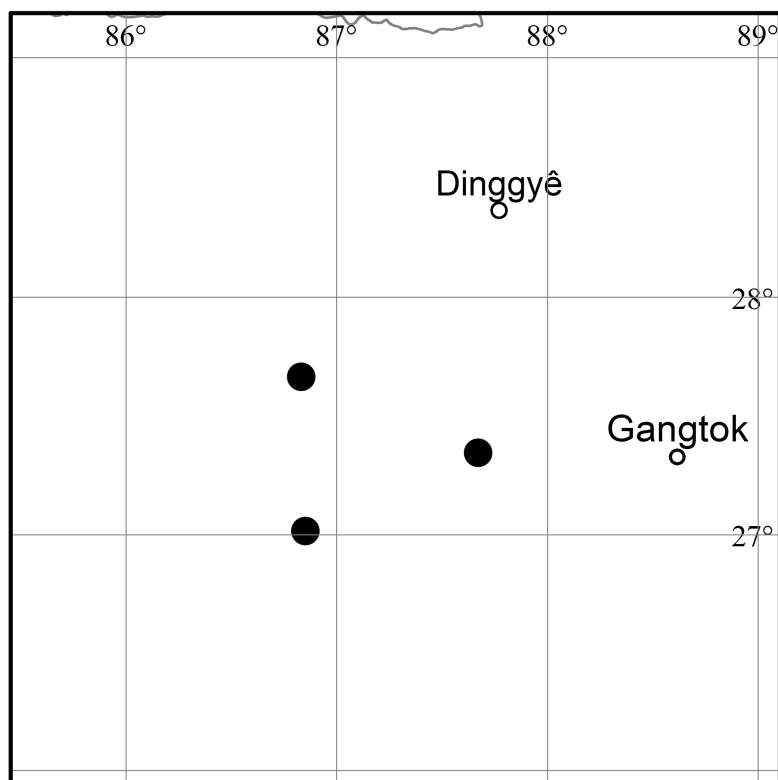
Phenology: flowering and fruiting from June to August.

Habitats: grassy slopes; 2300–4300 m.

Distribution: endemic; E Nepal [Map 45(2)–168].

Notes: Corolla tube of *P. pauciflora* (Prain) Pennell is obviously shorter than that of *P. megalantha* D. Don. Pennell stated that the former is a distinct species; however, Husain *et al.* [2010. Genus *Pedicularis* L. (Scrophulariaceae) in India: 160] treated it as a variety of *P. megalantha* D. Don. Here we recognize the species status of *P. pauciflora* (Prain) Pennell.

E NEPAL: Mechi, Taplejung, Jaljale Pokhari, 4080 m, 1 Aug. 1999, *Tateno et al. RHR-99-9* (HUH). Sagarmatha, Thosa Kharka-Beni Kharka, 3600–4600 m, Aug. 1985, *H. Ohashi, H. Kanai, H. Ohba et al. 8581110* (TI); Beni Kharka-Dudh Kund, 4000–4600 m, Aug. 1985, *H. Ohashi, H. Kanai, H. Ohba et al. 8572048* (TI).



Map 45(2)–168: *Pedicularis pauciflora* (Prain) Pennell

Ser. 55. *Curvipes*

Ser. *Curvipes* (Prain) Hurus., J. Jap. Bot. 22: 180. 1948.

Leaves alternate or pseudo-opposite. Flowers axillary or lax raceme, centripetal inflorescence. Calyx teeth 2 or 4 (-5), posterior tooth absent or very reduced. Corolla pink or purple; tube straight, glabrous; galea arcuate, with a declinate or horizontal beak.

Three species; two in the Pan-Himalaya (two endemics).

Notes: Husain *et al.* (2006. Edinb. J. Bot. 63: 49–65) made an extensive revision of this poorly known series based on ten collections from six herbaria, and they recognized three species (two species are represented by a single collection). However, they neglected *P. terrenoflora* T. Yamaz., a species described based on a collection from East Nepal. When Yamazaki (1975. Univ. Mus. Univ. Tokyo. Bull. 8: 102) described *P. terrenoflora* T. Yamaz. as new he stated that it resembles *P. amplicollis* T. Yamaz. (Ser. *Curvipes*) but differs in stems with densely pubescence and obvious pilose on the margin of lower lip, and he placed it in the series *Curvipes*. Interestingly, Yamazaki (1988. The Himalayan Plants 1: 91–161) then placed *P. terrenoflora* T. Yamaz. in the series *Muscicolae* Maxim. without any special explanation. This may be a reason why Husain *et al.* (2006. Edinb. J. Bot. 63: 49–65) neglected *P. terrenoflora* T. Yamaz. when they revised the series *Curvipes*. After examinations of type collection, original description, and sketches of *P. terrenoflora* T. Yamaz. and *P. amplicollis* T. Yamaz., we believe that these two species, as noted by Yamazaki, are quite similar and should be placed under the series *Curvipes* (Prain) Hurus.

- 1a. Calyx glabrous or minutely glandular but not woolly, with only 2 or 3 apical foliaceous lobes; margin of lower lip glabrous; stem glabrous, or only bifariously hairy 169. *P. curvipes*
- 1b. Calyx woolly, with 4–5 apical foliaceous lobes; margin of lower lip pilose or ciliate; stem woolly-pubescent all round.
 - 2a. Stems erect, or at least main stems erect; calyx often 4-lobed..... 170. *P. amplicollis*
 - 2b. Stems slender, creeping, long, dense pubescence; calyx often 5-lobed.....
..... 171. *P. terrenoflora*

169. *Pedicularis curvipes* Hook. f., Fl. Brit. India 4: 316. 1884; Prain, Ann. Roy. Bot. Gard. Calc. 3: 151; Tsoong, Acta Phytotax. Sin. 5: 60. 1956; Husain *et al.*, Edinb. J. Bot. 63: 49–65. 2006. Type: India, Sikkim, Tumbok, 3050 m, 9 Oct. 1870, C. B. Clarke 12764A [holotype noted in Husain *et al.* (2006: 58; 2010: 135); lectotype designated by Agnihotri *et al.* (2018: 265): K(K000708926)].

Stems 30 cm or more long, unbranched or branched, erect to prostrate. Leaves pseudo-opposite or alternate, petiole 6–10 mm long, puberulous or nearly glabrous; leaf blade 10–35 mm long, 8–25 mm wide, pinnatisect with 3–5 pairs of lateral segments; segments 3–10 mm long, incised-dentate. Inflorescences a lax terminal

raceme of 7–20 flowers; pedicels 1–2 cm long. Calyx ovoid, 6–8 mm long, tube split to 1/3 on the anterior side, membranous, with 2 small obovate-oblong, crenate posterior lobes, glabrous except for cilia along margins of anterior fissure. Corolla pale-rose with a whitish throat and dark-pink galea; tube whitish, 6–9 mm long, glabrous, straight; galea puberulous and glandular, with vertical part 4–6 mm long; beak 5–6 mm long with emarginate apex; lower lip 6–7 mm long, 10–12 mm wide, middle lobe emarginate. Filaments anterior 2 glabrous, posterior 2 sparsely pilose. Capsule 8–10 long and 3–4 mm wide. Seeds pinkish-purple, narrowly cylindrical with basal elaiosome, 2–4 mm long, 0.7–1 mm wide. Figure 45(2)–79.

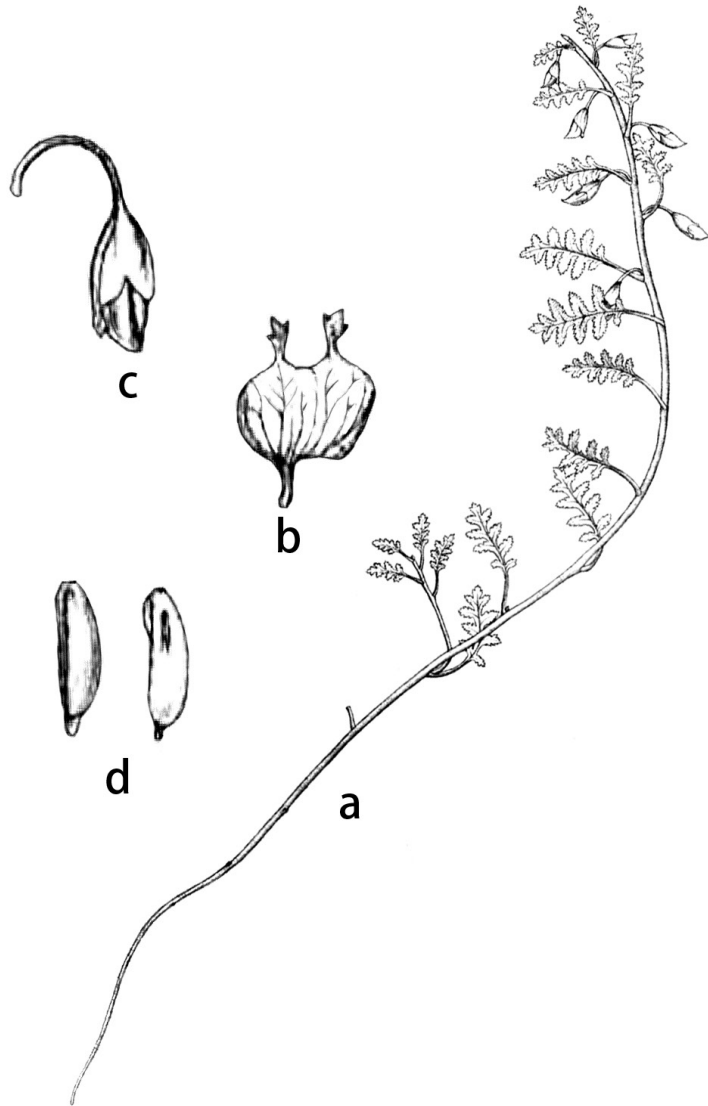


Figure 45(2)–79: *Pedicularis curvipes* Hook. f. a, habit; b, calyx; c, ovary; d, seed. Modified from D. PRAIN [Ann. Roy. Bot. Gard. Calc. 3: 151, plate 35: 1-4. 1890].

Phenology: flowering period in the wild unknown, flowered in May in cultivation.

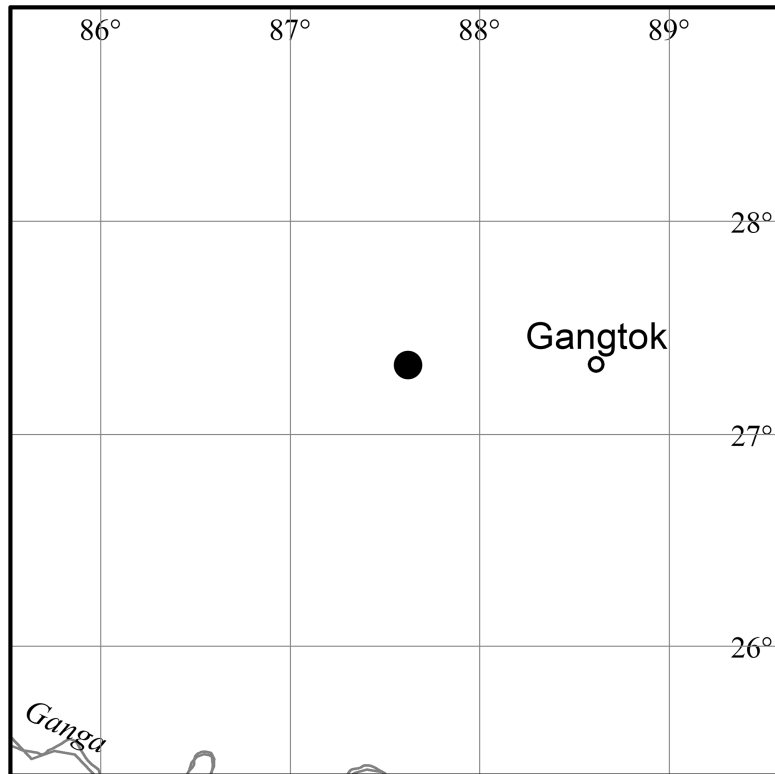
Habitats: unknown; ca. 3050 m.

Distribution: Sikkim & Darjeeling [Map 45(2)–169]; may also be in Nagaland of India.

SIKKIM & DARJEELING: Sikkim, Tum-bok, 3050 m, 9 Oct. 1870, *C. B. Clarke 12764A* (K000708927).

170. *Pedicularis amplicollis* T. Yamaz., Acta Phytotax. Geobot. 19: 111. 1963; Naithani, Fl. Pls. India, Nepal & Bhutan 317. 1990. Type: Bhutan, Thimphu, Kyapcha Dzong, 2800 m, 4 July 1958, *S. Nakao 523* [holotype: KYO].

Stems 10–20 cm long, pubescent, branched, erect to prostrate. Leaves petiolate, pseudo-opposite to alternate; petiole hairy; leaf blade



Map 45(2)-169: *Pedicularis curvipes* Hook. f.

1–2.5 cm long, hairy, pinnatipartite, with 3–5 segments on each side of blade; segments oblong, 3–7 mm long, 1.5–4 mm wide, each divided into coarsely and sharply toothed lobes. Flowers alternate in axils of upper leaves, pedicels 3–13 mm long, hairy. Calyx tubular-campanulate, 10–12 mm long, 3–4 mm wide, densely hairy, incised-dentate. Corolla purple, 20 mm long; tube straight, longer than calyx; arched part 4–5 mm long and 3 mm broad; beak 5–7 mm long, slender, incurved; lower lip 12–13 mm long, 18–19 mm wide, margins slightly undulate and very minute-pilose, lateral lobes large, weakly undulate, middle lobe 3 mm long, 8 mm wide and emarginate or 2-lobed at apex. Filaments pubescent. Immature capsule obliquely oblong, 7–9 mm long, acuminate at apex.

Phenology: flowering and fruiting from June to August.

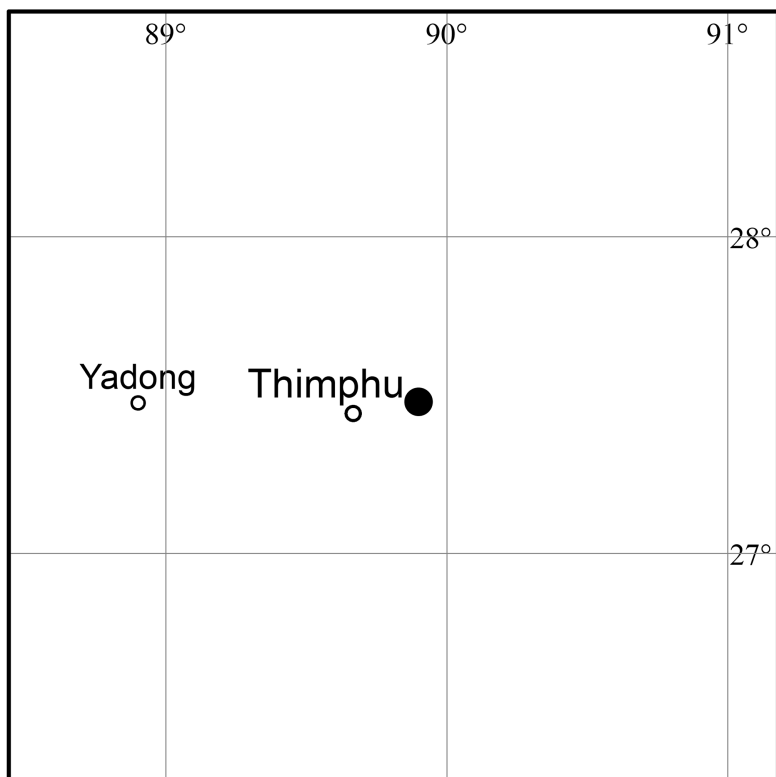
Habitats: unknown; ca. 2800 m.

Distribution: endemic; Bhutan [Map 45(2)-170].

BHUTAN: Thimphu, Kyapcha Dzong, 2800 m, 4 July 1958, *S. Nakao 523* (KYO).

171. *Pedicularis terrenoflora* T. Yamaz., Univ. Mus. Univ. Tokyo Bull. 8: 1975. Type: Nepal, E Nepal, Shewaden-Mewa Khola, 2200 m, on a rock with mosses, 29 June 1972, *H. Kanai, H. Ohashi, K. Iwatsuki et al. 1855* (holotype: TI).

Perennial herbs, 10–30 cm long. Roots fibrous. Stems branched at base, simple, slender, prostrate, densely brownish-villose. Leaves alternate; petiole 0.8–4 cm long; leaf blade ovate or oblong-ovate, obtuse, 1–3 cm long, 0.8–2 cm wide, glabrous above, sparsely lanate on nerves beneath, pinnatisect; pinnae 3–6-paired, oblong-ovate, acute, pinnatipartite, lobes oblong,



Map 45(2)-170: *Pedicularis amplicollis* T. Yamaz.

acute-serrate. Flowers solitary-axillary; pedicels 3–8 mm long, with patent long brownish villosae hairs. Calyx campanulate, 8–10 mm long, 3–4 mm wide, densely brownish-villose, 5-lobed, posterior lobe more or less small oblong, lateral lobes ovate or orbicular-ovate. Corolla pink, 15–21 mm long; tube straight, 13–17 mm long, glabrous, 2–3 times as long as calyx; galea strongly decurved, glabrous, erect part 3–4 mm long, 1.5 mm wide, short-bidentate at ventral margins, arched part 6–8 mm long, 2–3 mm wide; beak straight 5–6 mm long; lower lip 8–11 mm long, and 11–13 mm wide, pilose on margins, middle lobe broadly orbicular, lateral lobes reniform.

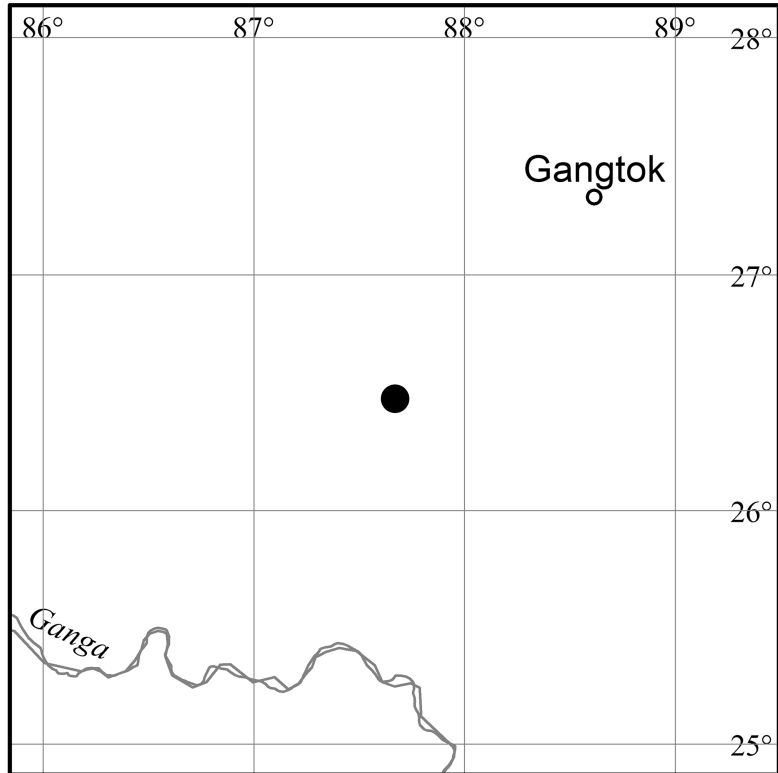
Filaments 2 pilose, 2 glabrous. Capsule lanceolate, acuminate, 7–10 mm long, 2–3 mm wide.

Phenology: flowering and fruiting from June to August.

Habitats: on a rock with mosses; 2000–2800 m.

Distribution: endemic; E Nepal [Map 45(2)-171].

E NEPAL: Meichi, Taplejung, Shewaden-Mewa Khola, 2200 m, on a rock with mosses, 29 June 1972, *H. Kanai, H. Ohashi, K. Iwatsuki et al.* 720925 (TI); Meichi, Taplejung, Shewaden, 2666 m, 22 Aug. 1977, *H. Ohashi, H. Kanai, H. Ohba et al.* 773961 (TI).



Map 45(2)-171: *Pedicularis terrenoflora* T. Yamaz.

Ser. 56. Regelianae

Ser. Regelianae T. Yamaz., H. Ohba & S. B. Malla, *The Himalayan Plants* 1: 132. 1988.

Stems branched at base, erect or ascending above. Leaves alternate, clustered near base; petiole long; leaf blade pinnatisect. Flowers axillary, pedicels slender. Corolla tube 2–3 times as long as the calyx.

Two species; both endemic to the Himalaya.

- 1a. Petiole 1–7 cm long; middle lobe of lower lip 5 mm long, 6 mm wide.....172. *P. regeliana*
- 1b. Petiole 5–7 mm long; middle lobe of lower lip 2 mm long, 3 mm wide.....173. *P. microloba*

172. *Pedicularis regeliana* Prain, *J. Asiat. Soc. Bengal* 58: 273. 1889; Limpricht in Fedde, *Rep. Sp. Nov. Veget.* 20: 198. 1924; Tsoong, *Bull. Brit. Mus. (Nat. Hist.) Bot.* 2: 33. 1955; Yamazaki in Hara *et al.*, *Enum. Fl. Pl Nepal* 3: 125. 1982. Type: India, Sikkim, Jongri, 3657 m, Sept. 1887, *King's collector s.n.* [type collection listed by Husain *et al.*

(2010: 124): CAL, BM; **lectotype designated here:** BM(BM000629896); isolectotype: BM(BM000629897)].

Perennial herbs, 3–12 cm tall. Roots several, flagelliform, subfleshy. Stems branched at base, erect or ascending above, 3–20(-50) cm long, glabrous or sparsely pilose. Leaves

clustered near base; petiole 1–7 cm long, with long pilose hairs on upper surfaces; leaf blade 1.5–6 cm long, 5–10 mm wide, glabrous on both surfaces, distantly pinnatisect; pinnae oblong to ovate, 4–6-paired, deeply acute-serrate. Flowers solitary-axillary, pedicels 1–4 cm long, sparsely pilose. Calyx tubular-campanulate, 6–10 mm long, sparsely pilose, 5-lobed, posterior lobe lanceolate-oblong, acutely incised-serrate. Corolla rose, 20–35 mm long; tube straight, 10–25 mm long, 2–3 mm wide, 2–3 times as long as calyx, glabrous; galea decurved, erect part ca. 3 mm long, arched part 5–6 mm long; beaked truncate apex; lower lip 10–11 mm long, 14–16 mm wide, longer than galea, pilose on margins, middle lobe broadly orbicular, lateral lobes reniform.

Filaments anterior 2 pilose, posterior 2 glabrous. Capsule oblong, acuminate at apex, 10–18 mm long, 4–5 mm wide. Figure 45(2)–80.

Phenology: flowering from July to September.

Habitats: on mossy rocks in the forest; 3400–4450 m.

Distribution: endemic; C Nepal, E Nepal [Map 45(2)–172].

C NEPAL: **Bagmati**, Rasuwa, Lauribinayak Pass, 4000 m, 25 July 1974, *Y. Bernard 24* (BM); Bagmati, Rasuwa, Gosainkund, 4100 m, 11 Aug. 1974, *J. H. de Haas 2198* (BM). **Gandaki**, Lamjung, Rambrong Pass, 3640 m, 30 June 1954, *J. D. A. Stainton, W. R. Sykes &*

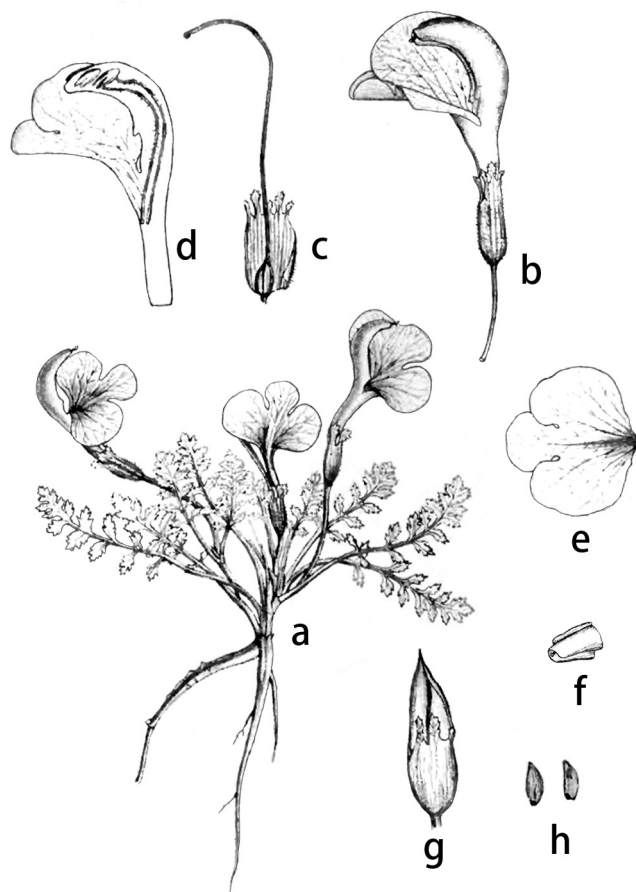
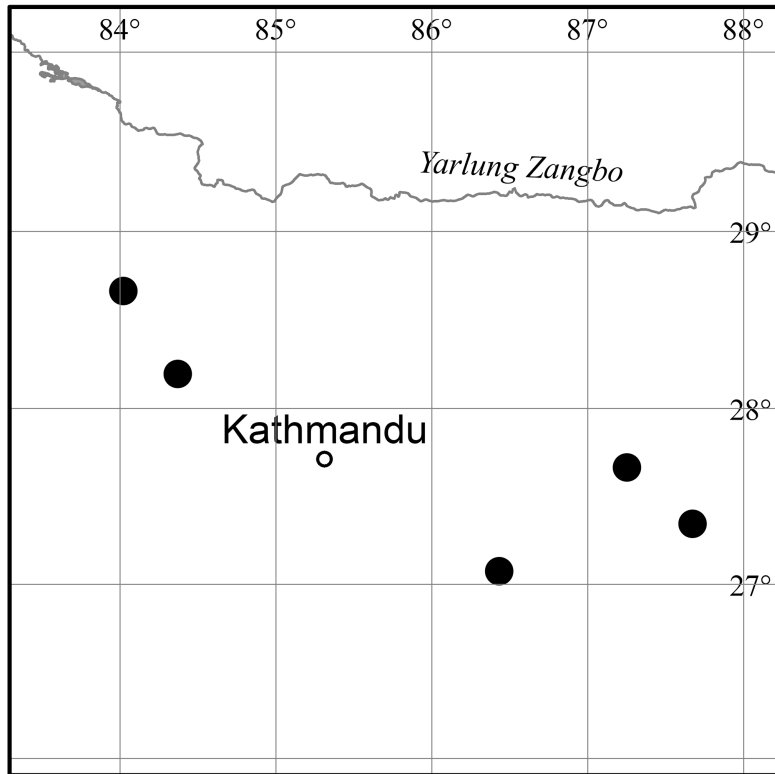


Figure 45(2)–80: **Pedicularis regeliana** Prain. a, habit; b, flower; c, calyx; d, corolla; e, corolla lip; f, beak; g, capsule; h, seed. A.-L. LI modified from D. Prain [*Ann. Roy. Bot. Gard. Calc.* 3: 169, plate 10: 11-17. 1890].



Map 45(2)-172: *Pedicularis regeliana* Prain

L. H. J. Williams 6053 (BM); Gandaki, Manang, Bimtang, 3790 m, 25 Aug. 1950, *D. G. Lowndes* 1436 (BM). **E NEPAL:** Kosi, Sankhuwasabha, Jaljale Himal, 4150 m, 25 July–3 Aug. 1991, *H. Ohba, S. Akiyama, H. Ikeda et al.* 9120186 (E). **Mechi,** Taplejung, Jaljale Pokhari, 4000 m, 22 Aug. 1972, *J. F. Dobremez* 1662 (BM).

173. *Pedicularis microloba* R. R. Mill, *Edinb. J. Bot.* 58: 74. 2001. Type: Bhutan, Thimphu, Phajudin, 3960 m, 5 Aug. 1914, *R. E. Cooper* 2744 [holotype: BM(000885889): isotype: E(E00273602)].

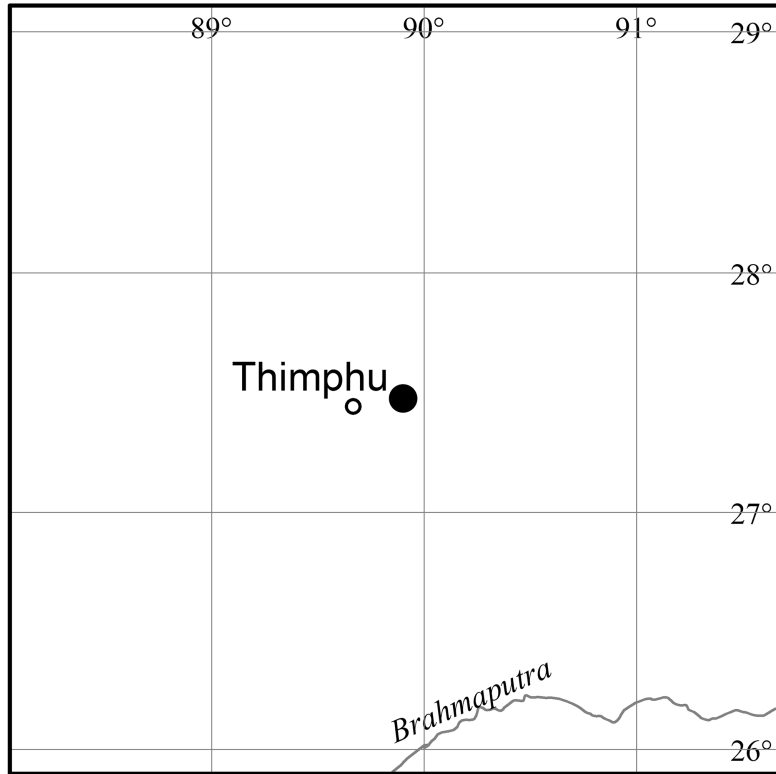
Almost acaulescent, low perennial. Roots slender, fibrous, and slightly fleshy. Leaves all basal, numerous, forming a loose tuft; petiole 5–7 mm, glabrous; leaf blade ovate or oblong-ovate, 4–10 mm long, 2–5 mm wide, pinnatisect with 3–5 pairs, ovate to suborbicular, incised-lobate mucronate segments. Flowers few; pedicels 8–14 mm long, glabrous. Calyx cylindrical-

campanulate, 6–8 mm long; tube 5–6 mm long, sparsely pilose on veins in basal half, upper glabrous; lobes 5, posterior narrowly triangular with a lateral tooth, laterals broadly obovate from stipitate base, with 2 lateral teeth and broad, acute apex, anterior like laterals but smaller. Corolla pink, 25–28 mm long; tube 9–11 mm long, 1–2 mm wide, sparsely long-pilose; erect part of galea 3–4 mm long, anther-bearing part slightly inflated, rather abruptly tapered into a short-conical beak, ca. 3 mm long, obliquely truncate, bluntly crenulate apex; lower lip 7–8 long, 9–10 mm wide, lateral lobes reniform, middle one small and indistinct, ovate-suborbicular, margins more or less entire, glabrous. Filaments 2 sparsely villous, 2 glabrous.

Phenology: flowering from July to Autumn.

Habitats: on mossy rocks; 3900–4000 m.

Distribution: endemic; Bhutan [Map 45(2)-173].



Map 45(2)-173: *Pedicularis microloba* R. R. Mill

Notes: *Pedicularis microloba* R. R. Mill was described as new by Mill in 2001 based on one collection of R. E. Cooper from Bhutan, on which recorded “sp. aff. *cooperi*”. Mill stated that it resembles *P. cooperi* P. C. Tsoong but differs in corolla with a small middle lobe, villous anterior filaments, and smaller corolla, and designated “*R. E. Cooper 2744* (holo. BM, iso. E)” as types.

After examinations of herbarium specimens, we find that one sheet of BM (BM000885889) was labelled as isotype and a sheet of E(E00273602) was labelled as holotype. Here we determined the types referring to the record of *Edinb. J. Bot.* (2001. 58: 74).

BHUTAN: Thimphu, Phajudin, 3960 m, 5 Aug. 1914, *R. E. Cooper 2744* (BM).

List of nomenclatural novelties published in the present volume

- Pedicularis angustilabris* H. L. Li, **syn. nov.** = **Pedicularis recurva** Maxim.
- Pedicularis anomala* P. C. Tsoong & H. P. Yang, **syn. nov.** = **Pedicularis strobilacea** Franch. ex F. B. Forbes & Hemsl.
- Pedicularis anserantha* var. *elevatogaleata* (T. Yamaz.) T. Yamaz., **syn. nov.** = **Pedicularis anserantha** T. Yamaz.
- Pedicularis armata* Maxim. var. *trimaculata* X. F. Lu, **syn. nov.** = **Pedicularis armata** Maxim.
- Pedicularis bella* Hook. f. subsp. *holophylla* (C. Marquand & Airy Shaw) P. C. Tsoong, **syn. nov.** = **Pedicularis bella** Hook. f.
- Pedicularis bhutanomuscoides* T. Yamaz., **syn. nov.** = **Pedicularis flammea** subsp. *oederi* (Vahl) F. S. Yang
- Pedicularis brevirostris* Pennell, **syn. nov.** = **Pedicularis dolichorrhiza** Schrenk
- Pedicularis breviscaposa* T. Yamaz., **syn. nov.** = **Pedicularis cryptantha** C. Marquand & Airy Shaw
- Pedicularis cacuminidenta* T. Yamaz., **syn. nov.** = **Pedicularis takpoensis** P. C. Tsoong
- Pedicularis chengxianensis* Z. G. Ma & Z. Z. Ma, **syn. nov.** = **Pedicularis macrosiphon** Franch.
- Pedicularis cinerascens* Franch., **syn. nov.** = **Pedicularis craspedotricha** Maxim.
- Pedicularis crenata* Maxim. subsp. *crenatifomis* (Bonati) P. C. Tsoong, **syn. nov.** = **Pedicularis crenata** Maxim.
- Pedicularis cryptantha* C. Marquand & Airy Shaw subsp. *erecta* P. C. Tsoong, **syn. nov.** = **Pedicularis cryptantha** C. Marquand & Airy Shaw
- Pedicularis daltonii* Prain, **syn. nov.** = **Pedicularis robusta** Hook. f.
- Pedicularis decora* Franch., **syn. nov.** = **Pedicularis rudis** Maxim.
- Pedicularis decorissima* Diels, **syn. nov.** = **Pedicularis paxiana** H. Limpr.
- Pedicularis dianmianensis** F. S. Yang, **nom. nov.**
- Pedicularis dichrocephala* Hand.-Mazz., **syn. nov.** = **Pedicularis strobilacea** Franch. ex F. B. Forbes & Hemsl.
- Pedicularis elephantiflora* T. Yamaz., **syn. nov.** = **Pedicularis rhinanthoides** Schrenk ex Fischer & C. A. Mey. subsp. *labellata* (Jacq.) Pennell
- Pedicularis elwesii* Hook. f. subsp. *major* H. L. Li, **syn. nov.** = **Pedicularis elwesii** Hook. f.
- Pedicularis elwesii* Hook. f. subsp. *minor* (H. L. Li) P. C. Tsoong, **syn. nov.** = **Pedicularis elwesii** Hook. f.
- Pedicularis fengii* H. L. Li, **syn. nov.** = **Pedicularis dissectifolia** H. L. Li
- Pedicularis filiculiformis* var. *dolichorhyncha* P. C. Tsoong, **syn. nov.** = **Pedicularis filiculiformis** P. C. Tsoong
- Pedicularis fischeri* P. C. Tsoong, **syn. nov.** = **Pedicularis dianmianensis** F. S. Yang.
- Pedicularis flammea** L. subsp. *oederi* (Vahl) F. S. Yang, **comb. et stat. nov.**
- Pedicularis fletcheri* P. C. Tsoong, **syn. nov.** = **Pedicularis aschistorrhyncha** C. Marquand & Airy Shaw
- Pedicularis flexosoides* T. Yamaz., **syn. nov.** = **Pedicularis microcalyx** Hook. f.

- Pedicularis gracilicaulis* H. L. Li, **syn. nov.** = **Pedicularis strobilacea** subsp. **pseudocephalantha** (Botani) F. S. Yang
- Pedicularis gracilituba*. subsp. *setosa* (H. L. Li) P. C. Tsoong, **syn. nov.** = **Pedicularis gracilituba** H. L. Li
- Pedicularis gruina* Franch. ex Maxim. subsp. *pilosa* (Bonati) P. C. Tsoong, **syn. nov.** = **Pedicularis gruina** Franch. ex Maxim.
- Pedicularis gruina* subsp. *polyphylla* (Franch. ex Maxim.) P. C. Tsoong, **syn. nov.** = **Pedicularis gruina** Franch. ex Maxim.
- Pedicularis gyirongensis* H. P. Yang, **syn. nov.** = **Pedicularis bifida** (Buch.-Ham. ex D. Don) Pennell
- Pedicularis habachanensis* Bonati subsp. *multipinnata* P. C. Tsoong, **syn. nov.** = **Pedicularis flammea** L. subsp. **oederi** (Vahl) F. S. Yang
- Pedicularis heteroglossa* (Prain) Pusalkar & D. K. Singh, **syn. nov.** = **Pedicularis flammea** L. subsp. **oederi** (Vahl) F. S. Yang
- Pedicularis hookeriana* Wall. ex Benth, **syn. nov.** = **Pedicularis siphonantha** D. Don
- Pedicularis hypophylla* T. Yamaz., **syn. nov.** = **Pedicularis flammea** L. subsp. **oederi** (Vahl) F. S. Yang
- Pedicularis imbricata* P. C. Tsoong, **syn. nov.** = **Pedicularis clarkei** Hook. f.
- Pedicularis kaghanensis* T. Yamaz., **syn. nov.** = **Pedicularis punctata** Decne
- Pedicularis kangtingensis* P. C. Tsoong, **syn. nov.** = **Pedicularis recurva** Maxim.
- Pedicularis karakorumiensis* T. Yamaz., **syn. nov.** = **Pedicularis uliginosa** Bunge
- Pedicularis kongboensis* var. *obtusata* P. C. Tsoong, **syn. nov.** = **Pedicularis kongboensis** P. C. Tsoong
- Pedicularis laktangensis* Bonati, **syn. nov.** = **Pedicularis monbeigiana** Bonati
- Pedicularis lanceifolia* P. C. Tsoong, **syn. nov.** = **Pedicularis monbeigiana** Bonati
- Pedicularis lanpingensis* H. P. Yang, **syn. nov.** = **Pedicularis strobilacea** Franch. ex F. B. Forbes & Hemsl.
- Pedicularis lasiophrys* var. *sinica* Maxim. **syn. nov.** = **Pedicularis lasiophrys** Maxim.
- Pedicularis lobatostrata* T. Yamaz., **syn. nov.** = **Pedicularis przewalskii** Maxim.
- Pedicularis longiflora* Rudolph var. *hongyuanensis* Y. Tang, **syn. nov.** = **Pedicularis armata** Maxim.
- Pedicularis longiflora* Rudolph var. *tubiformis* (Klotzsch) Pennell, **syn. nov.** = **Pedicularis longiflora** Rudolph
- Pedicularis longiflora* Rudolph var. *yinshanensis* Z. Y. Chu & Y. Z. Zhao, **syn. nov.** = **Pedicularis longiflora** Rudolph
- Pedicularis longipetiolata* Franch. ex Maxim., **syn. nov.** = **Pedicularis cephalantha** Franch. ex Maxim.
- Pedicularis lophotricha* H. L. Li, **syn. nov.** = **Pedicularis steingeri** Botani
- Pedicularis megalochila* H. L. Li subsp. *longituba* T. Yamaz., **syn. nov.** = **Pedicularis pauciflora** (Prain) Pennell
- Pedicularis megalochila* H. L. Li var. *ligulata* P. C. Tsoong, **syn. nov.** = **Pedicularis megalochila** H. L. Li
- Pedicularis melalimne* R. R. Mill, **syn. nov.** = **Pedicularis clarkei** Hook. f.
- Pedicularis merrilliana** H. L. Li subsp. **yarilaica** (R. R. Mill) F. S. Yang, **comb. et stat. nov.**
- Pedicularis monbeigiana* var. *birmanica* Bonati, **syn. nov.** = **Pedicularis monbeigiana** Bonati
- Pedicularis mucronulata* P. C. Tsoong, **syn. nov.** = **Pedicularis clarkei** Hook. f.
- Pedicularis muscoides* H. L. Li subsp. *himalayca* T. Yamaz., **syn. nov.** = **Pedicularis muscoides** H. L. Li

- Pedicularis mustanghatana* T. Yamaz., **syn. nov.** = **Pedicularis uliginosa** Bunge
- Pedicularis nepalensis* Prain, **syn. nov.** = **Pedicularis robusta** Hook. f.
- Pedicularis nyingchiensis* H. P. Yang & Tateishi, **syn. nov.** = **Pedicularis cryptantha** C. Marquand & Airy Shaw
- Pedicularis obliquigaleata* W. B. Yu & H. Wang, **syn. nov.** = **Pedicularis mussotii** Franch.
- Pedicularis oederi* Vahl, **syn. nov.** = **Pedicularis flammea** L. subsp. **oederi** (Vahl) F. S. Yang
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- Pedicularis pantlingii* Prain subsp. *chimiliensis* (Bonati) P. C. Tsoong, **syn. nov.** = **Pedicularis pantlingii** Prain
- Pedicularis peduncularis* M. Pop., **syn. nov.** = **Pedicularis rhinanthoides** Schrenk ex Fischer & C. A. Mey.
- Pedicularis perpusilla* P. C. Tsoong, **syn. nov.** = **Pedicularis tayloriana** P. C. Tsoong
- Pedicularis platychila* P. C. Tsoong, **syn. nov.** = **Pedicularis clarkei** Hook. f.
- Pedicularis przewalskii* Maxim. subsp. *australis* (H. L. Li) P. C. Tsoong, **syn. nov.** = **Pedicularis przewalskii** Maxim.
- Pedicularis przewalskii* Maxim. subsp. *hirsuta* (H. L. Li) P. C. Tsoong, **syn. nov.** = **Pedicularis przewalskii** Maxim.
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- Pedicularis pseudogracilituba* P. C. Tsoong, **syn. nov.** = **Pedicularis geosiphon** Harry Sm. & P. C. Tsoong
- Pedicularis pseudoheydei* P. C. Tsoong, **syn. nov.** = **Pedicularis praeceptorum** Bonati
- Pedicularis pseudohookeriana* T. Yamaz., **syn. nov.** = **Pedicularis siphonantha** D. Don
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- Pedicularis pseudosteingeri* Bonati, **syn. nov.** = **Pedicularis steingeri** Bonati
- Pedicularis pushpangadanii* T. Husain & Arti Garg, **syn. nov.** = **Pedicularis rhinanthoides** Schrenk ex Fischer & C. A. Mey.
- Pedicularis qinghaiensis* T. Yamaz., **syn. nov.** = **Pedicularis flammea** L. subsp. **oederi** (Vahl) F. S. Yang
- Pedicularis quxiangensis* H. P. Yang, **syn. nov.** = **Pedicularis siphonantha** D. Don
- Pedicularis rhinanthoides* Schrenk ex Fischer & C. A. Mey. subsp. *angulata* Vved., **syn. nov.** = **Pedicularis rhinanthoides** subsp. **rhinanthoides** Schrenk ex Fischer & C. A. Mey.

- Pedicularis rhinanthoides* Schrenk ex Fischer & C. A. Mey. subsp. *revoluta* Pennell, **syn. nov.** = **Pedicularis rhinanthoides** Schrenk ex Fischer & C. A. Mey.
- Pedicularis rhinanthoides* Schrenk ex Fischer & C. A. Mey. subsp. *speciosa* Pennell, **syn. nov.** = **Pedicularis rhinanthoides** Franch. ex F. B. Forbes & Hemsl. subsp. **labellata** (Jacq.) Pennell
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- Pedicularis roseialba* T. Yamaz., **syn. nov.** = **Pedicularis yui** H. L. Li
- Pedicularis ruoergaiensis* H. P. Yang, **syn. nov.** = **Pedicularis muscicola** Maxim.
- Pedicularis sanguilimbata* R. R. Mill, **syn. nov.** = **Pedicularis clarkei** Hook. f.
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- Pedicularis stylosa* H. P. Yang, **syn. nov.** = **Pedicularis flammea** L. subsp. **oederi** (Vahl) F. S. Yang
- Pedicularis tapaoensis* P. C. Tsoong, **syn. nov.** = **Pedicularis tayloriana** subsp. **tapaoensis** (P. C. Tsoong) F. S. Yang
- Pedicularis tayloriana** subsp. **tapaoensis** (P. C. Tsoong) F. S. Yang, **comb. et stat. nov.**
- Pedicularis tenacifolia* P. C. Tsoong, **syn. nov.** = **Pedicularis yui** H. L. Li
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