

***Corydalis anaginova* Lidén & Z.Y. Su, 1997 (Papaveraceae), a rare species from Tibet rediscovered in China**

Jin-Fei Xiao^{1,2}, Bu-Yun Zhang³, Hua Peng¹ & Chun-Lei Xiang^{1,*}

¹CAS Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China

²University of Chinese Academy of Sciences, Beijing 100049, China

³China Forest Exploration and Design Institute in Kunming, Kunming, 650200, Yunnan, China

*Corresponding author, e-mail: xiangchunlei@mail.kib.ac.cn

ABSTRACT

Corydalis anaginova Lidén & Z.Y. Su, 1997, is a poorly understood species that has been known from the type collection in 1943. In this study we report the rediscovery of one population of *C. anaginova*, almost 80 years since the first collection. This paper offers the recent finding, including a detailed species description and first available photographs, and discusses its taxonomy.

KEY WORDS

Corydalleae; Fumarioideae; taxonomy; Tibet.

Received 10.01.2022; accepted 25.03.2022; published online 18.05.2022

INTRODUCTION

Corydalis DC., 1805 is the largest genus within Papaveraceae with approximately 465 species mainly distributed in north temperate regions (Wu et al., 1999; Zhang et al., 2008). According to the updated English edition of the Flora of China (Zhang et al., 2008), 357 species of *Corydalis* have been reported in China, of which more than 260 species are endemic and geographically restricted. *Corydalis* has undergone marked diversification in the Hengduan Mountains and Qinghai-Tibet Plateau (QTP), and the region is considered to be the diversity center of the genus (Wu et al., 1996). Since the publication of the Flora of China (Zhang et al., 2008), there have been at least 10 new species described from China (Pathak et al., 2013; Wang D., 2017; Wang W.T., 2017; Wang et al., 2017a, b, 2021; Cheng et al., 2018; Mikhailova, 2019; Zhang et al., 2021), which further increased the species diversity of the genus.

Corydalis is one of the most taxonomically challenging groups in China (Wu et al., 1996). In par-

ticular, the highly variable morphological characters (especially floral and root morphology) and distribution of most species in inaccessible high-elevation regions has made species identification and infrageneric delimitation cumbersome. In addition, many species are known only from the type collection (e.g. *C. luquanensis* H. Chuang, 1990) or from very few collections (e.g. *C. rupifraga* C.Y. Wu & Z.Y. Su, 1993). At the same time, some medicinal plant species (e.g. *C. tomentella* Franch., 1894) are threatened from overexploitation.

Corydalis anaginova Lidén & Z.Y. Su, 1997, is a rare and poorly known species. It was described as a new species by Su & Lidén (1997) from a single specimen collected from Lhasa, Tibet in 1943 (Fig. 1). To our knowledge, *C. anaginova* had not been collected after its first collection and very scarce data are available about the biology and habitat of this species. During an expedition for the project “taxonomic study of *Corydalis*”, one population of *C. anaginova* was found near the type locality, which enabled us to provide an emended and extended description, as well as the first photographic

Figure 1. Holotype of *Corydalis anaginova* (BM [000574950!]).

documentation of the species. In addition, we provide data on phenology, habitat, and conservation status for this rare species.

MATERIAL AND METHODS

Field investigation was carried out in Banang Village, Dazi, Lhasa, Tibet, China. The specimens were checked and compared with identification keys and descriptions provided in the relevant literature (Su & Lidén, 1997; Wu et al., 1999; Zhang et al., 2008).

In order to evaluate the current status and determine the geographical distribution of *Corydalis anagिनova*, a comprehensive search for this species was undertaken from the following herbaria: BM, CDBI, IBSC, E, K, KUN, and PE (acronyms follow Theirs, 2016). For the evaluation of the conservation status of *C. anagिनova*, we followed criteria, categories and guidelines from IUCN (2019).

RESULTS AND DISCUSISON

Morphological observations

The previous morphological descriptions of *C. anagिनova* given by Su & Lidén (1997), Wu et al. (1999) and Zhang et al. (2008) were largely based on the single type specimen (Fig. 1). Those morphological descriptions are essentially correct. We extend these earlier descriptions by providing a detailed morphological description (see Taxonomy treatment) and first available photographs for this species (Figs. 2–9) based on our observations on living plants in the wild.

Distribution and Habitat preference

Corydalis anagिनova is currently certainly known from Lhasa, Tibet, China. Besides type specimen, there are four records from Lhasa, Tingri and Lhunzhub of GBIF (https://www.org.occurrence/search?taxon_key=5531546), but we can not find herbarium specimens and their identification is still in doubt. Further exploration may result in the discovery of additional localities for this species. Based on the type specimen, little habitat information was provided for *C. anagिनova*. In our field investigation, we found that *C.*

anagिनova grows in riparian environments along alpine ephemeral streamlets (Fig. 2). More field work is needed to further elucidate its distribution area.

Morphologically similar species

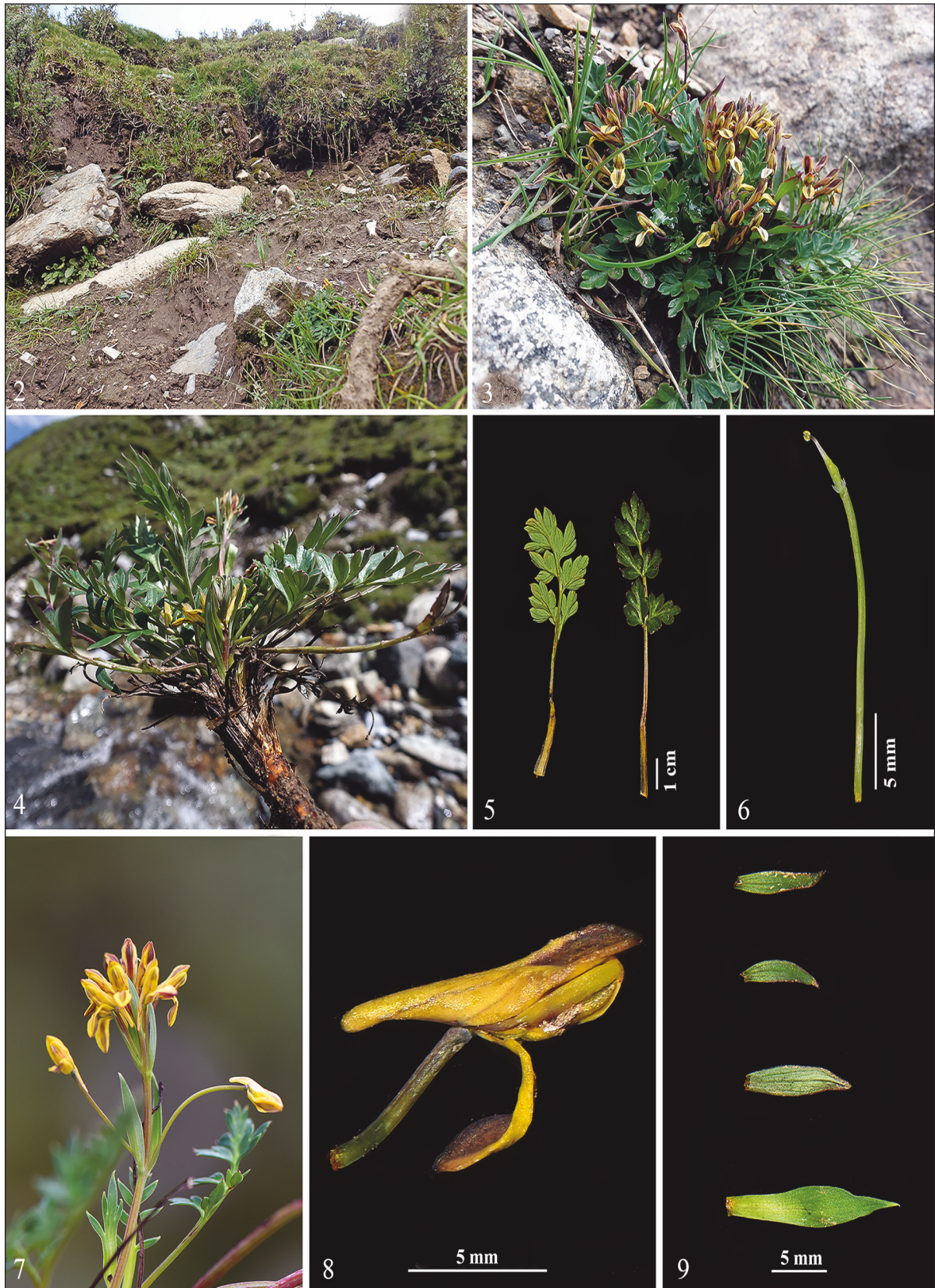
Corydalis is the largest genus within Papaveraceae (Zhang et al., 2018). However, relationships within the genus are poorly resolved and the monophyly of most sections was seldom tested (Wang, 2006). Su & Lidén (1997), Wu et al. (1999) and Zhang et al. (2008) classified *C. anagिनova* in *Corydalis* sect. *Chrysocapnos*, and all species in this section have cylindric and solid rhizomes, base of stems with petiolar remnants, yellow flowers, explosively dehiscent fruit capsules and recurved pedicels in fruiting (Zhang et al., 2008). However, because the monophyly of this section was not supported in the molecular phylogenetic study of Wang Y.W. (2006), we can only conclude that *C. anagिनova* is morphologically similar to *C. simplex* Lidén, 1989, which displays a general resemblance in morphology - i.e. sub-bipinnate or bipinnate leaves, entire and lanceolate bracts and dirty yellow flowers usually with a darker tip. *Corydalis anagिनova* can be distinguished from *C. simplex* by noticeably smaller flowers (upper petal ca. 11 mm vs. upper petal ca. 17 mm).

Taxonomy treatment

Corydalis anagिनova Lidén & Z.Y. Su, 1997 (Fig. 2–9)

TYPE. China. Xizang Province (Tibet Autonomous Region), Lhasa, 29°04'N, 91°05'E, on steep hillsides, alt. 4500 m, 25 June 1943, Ludlow & Sherriiff 9698 (holotype: BM!).

DESCRIPTION. Perennial herbs, 10–20 cm tall, glabrous. Rootstock elongate, sometime branched, near stem base densely clothed with long, narrow, straw-colored, shiny, residual petiolar bases. Stems 1 to few from radical leaf axils, sometimes branched, near base with 1 or 2 opposite leaves (sometimes very small). Radical leaves many; petioles 2–13 cm, vaginate at base; blade oblong, 2.5–6.7 × 1–5 cm, sub-bipinnate with 3 or 4 pairs of pinnae; pinnae ovate, deeply pinnatifid; lobes lanceolate, 4–16 × 2–5 mm, acute. Racemes long and lax, 6–16-flowered; bracts lanceolate, 5–32 × 1–3(5) mm, en-



Figures 2–9. *Corydalis anaginova*. Fig. 2: habitat; Figs. 3–4: plants; Fig. 5: leaves; Fig. 6: style; Fig. 7: inflorescence; Fig. 8: flower in the lateral view; Fig. 9: bracts (Fig. 7 photo by Y.P. Chen, Figs. 2-6, 8 and 9 photos by B.Y. Zhang).

tire, lowermost one rarely divided. Pedicel 3–30 mm, slender, at fruiting recurved. Sepals minute. Corolla dirty yellow, with distinct veins; outer petals usually tipped with reddish brown; outer petals acute, without or with crest; upper petal 9.5–13 mm; spur short, ca. 4 mm, narrow, attenuate toward slightly downcurved apex; nectary ca. 1/2 as long as spur, slender; inner petals 5.5–6 mm. Ovary elliptic; style 2–2.5 mm; stigma rectangle, apically emarginate, with diffuse confluent apical papillae, base with prominent lobes tipped with papillae.

PHENOLOGY. Flowering occurs from June to September.

CONSERVATION STATUS. *Corydalis anaginova* is currently known from Lhasa certainly. Although other two localities from Tingri and Lhunzhub were recorded on GIBF, no specimen can be traced and currently only the type specimen is accessible. At the location newly recorded, ca. 200 individuals were discovered in alpine riparian areas at an altitude between 4,500 m and 5,000 m. It has an area of occupancy estimated at less than 100 km². The habitat is vulnerable to destruction from livestock grazing and potential agricultural expansion (Fig. 2). Due to the insufficient data, the species is categorized as “Data Deficient (DD)” following the IUCN guidelines (IUCN, 2019).

ADDITIONAL SPECIMENS EXAMINED. *Corydalis anaginova* Lidén & Z.Y. Su, 1997. China. Xizang Province (Tibet Autonomous Region), Lhasa, Dazi, Banang Village, near the streams, alt. 4679 m, 5 September 2019, Y.P. Chen et al., *EMI030* (KUN).

Corydalis simplex Lidén, 1989. Nepal. Jangla Bhangjyang, alpine meadow, sandy place, alt. 4300 m, 12 July 1973, S. Einarsson, L. Skärby & B. Wetterhall 1970 (BM); moist places near streams, usually in grass, alt. ca. 4300 m, 30 June 1952, O. Polunin, W.R. Sykes & L.H.J. Williams 2343 (E).

ACKNOWLEDGMENTS

We would like to thank Ms. Yue Zhao and Dr. Ya-Ping Chen of the Kunming Institute of Botany (KIB), Chinese Academy of Sciences for their assistance with field collections. We are grateful to Dr. Bryan T. Drew (University of Nebraska at Kearney, USA) for reviewing the manuscript. We would

like to thank Mr. Tiantian Xue of Institute of Botany, Chinese Academy of Sciences for helping to search specimens. Thanks are also extended to the staff of following herbaria for their help in research facilities: BM, CDBI, IBSC, E, K, KUN, and PE. This study was funded by the the “Ten Thousand Talents Program of Yunnan” (Top-notch Young Talents Project, No. YNWR-QNBJ-2018-279), the “Excellent Youth Program” (No. 2019FI009), and the CAS “Light of West China” Program to CLX.

REFERENCES

- Cheng M.E., Peng H.S., Wang D.Q. & Huang L.Q., 2018. *Corydalis huangshanensis* (Fumariaceae), a new species from Anhui, China. *Nordic Journal of Botany*, 36: e01960. <https://doi.org/10.1111/njb.01960>
- IUCN Standards and Petitions Subcommittee., 2019. Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. IUCN Standards and Petitions Subcommittee.
- Mikhailova M.A., 2019. A new species of *Corydalis* (Fumariaceae) from Gansu (China). *Novitates Systematicae Plantarum Vascularium*, 50: 115–119. <https://doi.org/10.31111/novitates/2019.50.115>
- Pathak M. K., Chowlu K., Saikia B. & Liden M., 2013. Fumariaceae in North East India: New species and records in *Corydalis* and *Dactylicapnos*. *Nelumbo-The Bulletin of the Botanical Survey of India*, 55: 31–50.
- Su Z.Y. & Lidén M., 1997. *Corydalis* in China I: some new species. *Edinburgh Journal of Botany*, 54: 55–84.
- Thiers B., 2016. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden’s Virtual Herbarium. Available from: <http://sweetgum.nybg.org/ih/> (accessed 18 Dec 2021)
- Wang D., 2017. *Corydalis pseudohemsleyana* sp. nov. (Papaveraceae) from Hubei, China. *Nordic Journal of Botany*, 35: 593–597. <https://doi.org/10.1111/njb.01553>
- Wang D., 2017. *Corydalis pseudohemsleyana* sp. nov. (Papaveraceae) from Hubei, China. *Nordic Journal of Botany*, 35: 593–597.
- Wang D., Huang X., Xu X.D. & Wang L., 2021. *Corydalis austroshaanxiensis* sp. nov. (Papaveraceae), a neglected species from Shaanxi, China, and a revised circumscription for *C. pseudoincisa*. *Nordic Journal of Botany*, 39: e03272. <https://doi.org/10.1111/njb.03272>
- Wang D., Xu X.D. & Gan Q.L., 2017a. *Corydalis pseudoamplisepala* (Papaveraceae), a new species from

- NW Hubei, China. *Annales Botanici Fennici*, 54: 223–227.
- Wang D., Xu X.D. & Liu P. 2017b. *Corydalis hualongshanensis*, a new species of *Corydalis* sect. *Fumarioides* (Papaveraceae) from Shaanxi, China. *Phytotaxa*, 307: 153–158.
- Wang W.T., 2017. Two new species of Fumariaceae. *Guihaia*, 37: 1083–1087.
- Wang Y.W., 2006. Systematics of *Corydalis*. Ph.D. dissertation, University of Chinese Academy of Sciences, Beijing, 118 pp.
- Wu C.Y., Zhuang X. & Su Z.Y., 1996. The systematic evolution of *Corydalis* in relation to florogenesis and floristic regionalization in the world. *Acta Botanica Yunnanica*, 18: 241–268.
- Wu C.Y., Chuang H. & Su Z.Y., 1999. *Corydalis* DC. In: Wu C.Y. (Ed.), *Flora Reipublicae Popularis Sinicae*, vol. 32. Science Press, Beijing, 96–481.
- Zhang B.Y., Xiao J.F. & Yi S.R., 2021. *Corydalis nanchuanensis* (Papaveraceae), a new species from Chongqing, China. *Phytotaxa*, 382: 163–170. <https://doi.org/10.11646/phytotaxa.510.2.5>
- Zhang M.L., Su Z.Y. & Lidén M., 2008. *Corydalis* DC. In: Wu C.Y., Raven P. H. & Hong D.Y. (Eds.), *Flora of China*, vol. 7. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, 295–428.