

Short Communication

Report of carnivorous plants (Droseraceae, Lentibulariaceae and Nepenthaceae) from seasonally dry savannahs in Ratanakiri Province, Cambodia

Pierre-Olivier MAQUART^{1,*}, François Sockhom MEY², CHHUOY Kalyan¹, HENG Kimly¹, CHHUM Moeun¹, SUOR Kimhuor¹ & Sébastien BOYER¹

¹ Medical and Veterinary Entomology Unit, Institut Pasteur du Cambodge, No. 5, Monivong Boulevard, PO Box 983, Phnom Penh, 120210, Cambodia.

² 2b rue de l'abreuvoir, appartement 1105, 59320, Haubourdin, France.

* Corresponding author. Email pomaquart@pasteur-kh.org

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Cambodia is home to several species of carnivorous plants that attract, capture, kill and digest prey using modified leaves that act as traps (Mey *et al.*, 2010). This group of plants currently consists of about 860 known species belonging to 11 families and 18 genera (Cross *et al.*, 2020). In Cambodia, three genera from three families have been recorded: the sundews *Drosera* L. (Droseraceae), the pitcher plants *Nepenthes* L. (Nepenthaceae) and the bladderworts *Utricularia* L. (Lentibulariaceae) (McPherson, 2010). Until the beginning of the 21st century, carnivorous plants in the Indochinese Peninsula (Cambodia, Laos, Thailand and Vietnam, i.e. Indochina, as circumscribed in floristic treatments such as Lecompte (1965)) received little attention from scientists (McPherson, 2010).

Due to their spectacular appearance, species within the genus *Nepenthes* (commonly known as 'tropical pitcher plants', or 'ampuong sramoch' and 'ampuong kralôm' in Khmer) in the Indochinese Peninsula have been subjected to intense research since the late 2000's. This has resulted in the description of 13 new species, one emended species and one variety (Mey, 2009, 2010; Cheek & Jebb, 2009; Catalano, 2010, 2014, 2015, 2017, 2018; Mey *et al.*, 2011), two of which are endemic to Cambodia: *N. bokorensis* Mey and *N. holdenii* Mey (Mey *et al.*, 2011). At present, five pitcher plant species are known in

Cambodia and 18 from the four countries of the Indochinese Peninsula (Cross *et al.*, 2020). Most *Nepenthes* plants in Cambodia occur in association with other carnivorous plants such as *Drosera*, represented by four species in Cambodia (Lecompte, 1965; Mey, 2015), and *Utricularia*, represented by at least ten species in Cambodia (Taylor, 1989).

This article documents the first record of populations of *D. burmannii* Vahl (Droseraceae) (Fig. 1), *U. delphinoides* Thorel. ex. Pellegr. (Lentibulariaceae) (Fig. 2) and *N. smilesii* Hemsl. (Nepenthaceae) (Fig. 2) in Veun Sai—Siem Pang National Park, northeast Cambodia. These populations were located in a seasonally dry and sandy savannah (Fig. 3, referred to as 'veal' in Khmer) near Virachey National Park in Ratanakiri Province (exact location withheld for conservation purposes) at an elevation of 110 metres. Based on our observations and according to local rangers in January 2021, this may be the only location where these species occur in the park. The surface area covered by the plants was about 70 m² and a sample of each species was collected, dried and conserved in the herbarium collection of the Royal University of Phnom Penh under accession numbers 0001 (for *D. burmannii*), 0002 (*N. smilesii*) and 0003 (*U. delphinoides*).

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Fig. 1 *Drosera burmannii* Vahl (© Heng Kimly).



Fig. 2 Pitchers of *Nepenthes smilesii* Hemsl. and distinctive violet flower of *Utricularia delphinooides* Thorel. ex. Pellegr. (upper right) (© Pierre-Olivier Maquart).



Fig. 3 Seasonally dry savannah in Veun Sai—Siem Pang National Park.

Drosera burmannii is an acaulescent sundew which forms a rosette of characteristic suborbicular leaves covered with long peripheral tentacles. In Cambodia, it can only be vaguely confused with the juvenile rosettes of young *D. lunata* Buch.-Ham. ex DC before these enter their caulescent phase. The basal rosette of *D. lunata* produces petiolate, transversely elliptic or flabellate leaves which are very different from those of *D. burmannii* (Lowrie *et al.*, 2017a). *Drosera burmannii* is a widespread sundew species which can be locally abundant in Cambodia (Mey, unpublished data) and occurs in India, China, Japan, throughout Southeast Asia and

across the islands of the Malay Archipelago through to New Guinea and Australia (Lowrie *et al.*, 2017b).

Our identification of the bladderwort *U. delphinooides* was similarly straightforward as the species produces a dense inflorescence of very distinctive dark violet flowers (Taylor, 1989) which are the largest for the genus in Cambodia and cannot be confused with any other *Utricularia* species in the Indochinese Peninsula. Populations of the species with pink flowers have been recorded in neighbouring Thailand (Catalano, 2010) but have yet to be observed in Cambodia. *Utricularia delphinooides* also occurs in Laos and Vietnam, where it grows in swamps, near paddy fields, in open wet places in grasslands and in open pine forests in acid soils (Taylor, 1989). Its distribution in Cambodia appears to be much patchier than that of *D. burmannii*, although this may be due to the fact that it is virtually undetectable outside of flowering periods.

Besides *N. mirabilis*, *N. smilesii* is the most widespread pitcher plant species in the Indochinese Peninsula (Mey, 2010). The low elevation at which it is found in Ratanakiri is unusual since the species mainly occurs between 500 and 1,000 m above sea level in the rest of the peninsula (Mey, 2010). *Nepenthes smilesii* is a member of an informal group referred to as the '*Nepenthes thorelii* aggregate' (Mey, 2010) or the '*Nepenthes smilesii* group' (Cheek & Jebb, 2013). Both species groups include very closely related species (including *N. kampfotiana*, *N. bokorensis*

and *N. holdenii* in Cambodia) that occur across the Indochinese Peninsula and are now included in the *Nepenthes* section Pyrophytae (Cheek & Jebb, 2016). Species in this section are pyrophytes that almost exclusively occur in nutrient-poor soil types in open to semi-open habitats which are seasonally wet. *Nepenthes* plants survive severe droughts and dry season fires in these habitats due to their fleshy underground tuberous rootstocks. In the Indochinese Peninsula, *Nepenthes* spp. usually grow in acidic sandy soils and frequently occur in sympatry with sundews such as *D. indica* L., *D. burmannii* L. (more rarely *D. serpens* Planch. and *D. lunata* Buch.-Ham. ex DC) and various bladderworts such as *U. bifida* L., *U. odorata* Pellegr., *U. minutissima* Vahl, *U. geoffrayi* Pellegr., *U. subuluta* L. and *U. caerulea* L. (Mey, unpublished data).

Due to its close relationship with other taxa in the 'Nepenthes thorelii aggregate' in Cambodia, Laos, Vietnam and Thailand, identification of *N. smilesii* is more complicated than *D. burmannii* and *U. delphinioides*. However, *N. smilesii* can be confidently distinguished by the following characters: the taxon generally develops lower pitchers that are cylindrical with a bulbous base and produced at the end of relatively short tendrils, whereas the leaves are conspicuously covered with short hairs. Because *N. holdenii* and *N. bokorensis* are restricted to the Cardamom Mountains and Phnom Bokor in Cambodia respectively, *N. smilesii* can only be confused with *N. kampoiana* as both taxa share the same habitat and develop similar cylindrical to narrowly infundibular yellow upper pitchers. However, *N. kampoiana* generally produces pyriform to subglobose lower pitchers at the end of long tendrils and its vegetative parts are glabrous.

We observed the contents of *N. smilesii* pitchers and found several digested arthropods including scorpions (Arachnida: Scorpiones: *Lychas* spp.), ants (Hymenoptera: Formicidae: *Oecophylla* spp.), assassin bugs (Hemiptera: Reduviidae), but also some live larvae of *Toxorhynchites* spp. (Diptera: Culicidae). While some Culicidae larvae, like the Bornean endemics *Culex rajah* Tsukamoto, 1989, *Tx. rajah* Tsukamoto, 1989 and *Topomyia nepenthicola* Miyagi & Toma, 2007 are well-known nepenthebionts (Tsukamoto, 1989; Miyagi & Toma, 2007), there are only a few studies of the prey spectrum of the Indochinese *Nepenthes* (Hosoishi *et al.*, 2012). Scorpions have been observed in the pitchers of the natural hybrid *N. mirabilis* × *thorelii* in southern Vietnam (Mey, 2010), but what attracts these predators to *Nepenthes* pitchers remains to be studied and understood.

The last 15 years of research indicate that the natural habitats of carnivorous plants in Cambodia have been severely reduced in private lands, for agricultural expansion, and in protected areas such as the Preah Monivong

Bokor National Park, for the tourism industry (Mey, 2010). Carnivorous plants are threatened in the country and two endemic taxa (*N. bokorensis* and *N. holdenii*) can be regarded as Critically Endangered according to IUCN Red List criteria (Cross *et al.*, 2020). As the apparently small populations of the three species in Veun Sai–Siem Pang National Park demonstrate, carnivorous plants are sometimes restricted to very small areas. We recommend strict protection of these taxa and their habitats in the national park. Monitoring is also required to develop understanding of the diversity and distribution of carnivorous plants in Cambodia, so that they can be protected in future. This particularly applies to the relatively inconspicuous species in the carnivorous plant genera *Drosera* and *Utricularia*, and to a lesser extent, *Nepenthes*.

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