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# Abstract

The family Hypericaceae in Sikkim is represented by the only genus *Hypericum* L. with 15 species and the genus constitutes nearly 50% representative of Indian members. Thus, the tiny state acts as an epitome of diversity of *Hypericum* species in the country. Presently, *H. patulum* has been considered as Indian member based on *H. hookerianum* Wight & Arn. var. *dentatum* S.N.Biswas which is now treated as synonym under the former. This article is highlighted with the exceptional diversity of the genus in Sikkim Himalaya along its phytogeographical affinity, endemism and economic perspectives. It also provides the horticultural importance and the medicinal uses of some species of *Hypericum*.

Keywords: Diversity, endemism, Himalaya, *Hypericum*, horticulture, phytogeographical affinity, medicinal uses, Sikkim.

#### INTRODUCTION

The phytodiversity of the Indian Himalayan state Sikkim is remarkable. It shares around 26% of Indian flowering plants (ca. 4600 species) despite of it shares only 0.2 % land mass of the country (Singh and Chauhan, 1998; Maity, 2021). Varied climatic conditions and the altitudes (from 285 m to 8586 m) provide the opportunity to flourish different groups of plants in this part of Himalaya. The state is situated in the 'Himalaya Hotspot' and rich in typical Eastern Himalayan floristic elements. The flora of the state has been highlighted by several workers since the time of Sir J.D. Hooker (1872-1897) to the recent (Singh *et al.*, 2019). The eminent workers are Hooker (1849), King and Pantling (1898), Hara (1966, 1971), Ohashi (1975), Hajra and Verma (1996), Lucksom (2007), Maity *et al.* (2018).

Both taxonomically and economically, the family Hypericaceae is one of the important groups of flowering plants (Li and Robson, 2007) and cosmopolitan in distribution, comprises about 560 species under 8 genera worldwide (Mabberley, 2017). In recent APG classification (APG IV, 2016) the family Hypericaceae are included under Clusiaceae. However, in this article we maintained conventional treatment in considering Hypericaceae as a distinct and independent family (Takhtajan, 1997; Cronquist, 1981) for easy approach to general readers. In India, the family Hypericaceae are credited with three genera, *viz. Cratoxylum* Blume, *Hypericum* L. and *Triadenum* Raf. *Cratoxylum* and *Triadenum* are represented by three species [*C. cochinchinense* (Lour.) Blume, *C. formosum* (Jack) Benth. & Hook.f. ex Dyer along with *C. formosum* 

subsp. *pruniflorum* (Kurz) Gogelein and *C. neriifolium* Kurz] and one species (*T. breviflorum* Wall. ex Dyer), respectively (Biswas, 1993).

The genus *Hypericum* counts about 28 species and 4 infraspecific taxa) in the country and majority of them are concentrated in the Himalaya and North Eastern states (Biswas, 1993; Singh *et al.*, 2019). Importantly, *H. japonicum* is found across the country whereas *H. patulum*, *H. humifusum*, *H. hookerianum* and *H. wightianum* are extended to Tamil Nadu, Karnataka and Kerala in addition to habitat in the Himalaya and NE India.

The tiny Himalayan state Sikkim shelters about 50% Indian members of *Hypericum*. Until now, 15 species and one infraspecific taxon are recorded from this state thus it appears as one of the rich centers of diversity of the genus in the country (Biswas, 1993; Singh *et al.*, 2019; Gogoi *et al.*, 2021). This diversity is mostly nested in the temperate forest though a few are also found in subtropical as well as alpine habitats.

The present article deals with the diversity of the genus in Sikkim and all species are enumerated with their detailed distributional records and phenological information. Additionally, the information on medicinal uses whenever available is also included. Moreover, the horticultural importances of few species are also mentioned here. The key to the taxa is also incorporated to facilitate easy recognition and correct identity of plants. Phytogeographical affinities of Sikkim Himalayan members, endemism and distribution of species along altitudinal gradient in Sikkim are provided.

# MATERIALS AND METHODS

This study is based on both vigorous field observation in last two decades and herbarium consultation. Most of the specimens are directly examined both in the field and in different repositories like CAL, BSHC, CUH, etc. In many cases old depositions are also included from few foreign herbaria like K, E, PE, G, GH, BM, etc. All relevant literatures are also scrutinized and important information are incorporated. In each case one specimen has been cited as an evidence of occurrence of the taxon in Sikkim.

# RESULTS

Enumeration of Hypericum L. in Sikkim (arranged in alphabetical sequence)

1. Hypericum benghalense S.N.Biswas in Bull. Bot. Surv. India 29: 53.1989. *Fl. & Fr*.: June-October.

*Distribution*: INDIA: Himalayas: West Bengal, Sikkim. [1000–2000 m amsl]. **Note:** This species included based on report by Sherpa *et al.* (2021).

**2. Hypericum choisianum** Wall. ex N. Robson in Nasir & Ali, Fl. W. Pakistan 32: 6. 1979.

Fl. & Fr.: June-September.

*Distribution:* INDIA: Himalayas: Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim; PAKISTAN; MYANMAR; NEPAL; BHUTAN; TIBET. [2100-4120 m amsl].

Specimen examined: Lachen, Chakraborty 2306 [BSHC].

3. Hypericum elodeoides Choisy in DC., Prodr. 1: 551. 1824. (Fig. 1A)

Fl. & Fr.: June-October.

*Distribution*: INDIA: Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh; Meghalaya; BHUTAN; NEPAL; CHINA; MYANMAR [1200–3300 m amsl]. Specimen examined: *Chakraborty* 2286 [BSHC].

**4. Hypericum gracilipes** Stapf ex C. Fischer in Bull. Misc. Inform. 1940: 32. 1940.

*Fl. & Fr.*: June–July. *Distribution*: INDIA: Himalaya: West Bengal (Darjeeling), Sikkim; Meghalaya; Nagaland [2100–2300 m amsl].

Specimen examined: Raju 4011 [BSHC].

5. Hypericum himalaicum N. Robson in J. Jap. Bot. 52: 287. 1977. *Fl. & Fr.*: July-August.

*Distribution*: INDIA: Himalayas: Jammu & Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim; PAKISTAN; NEPAL; BHUTAN; CHINA. [900-3900 m amsl].

Specimen examined: Raju & Singh 7815 [BSHC].

6. Hypericum hookerianum Wight & Arn. in Prodr. Fl. Ind. Orient. 99. 1834. (Fig. 1B)

Fl. & Fr.: April-November.

*Distribution:* INDIA: Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh; Meghalaya; Nagaland; Manipur; Punjab; Karnataka; Tamil Nadu; NEPAL; BHUTAN; BANGLADESH; TIBET; MYANMAR; THAILAND; VIETNAM. [1500-3300 m amsl].

Specimen examined: Maity & Maiti 21311[BSHC].

7. Hypericum japonicum Thunb. ex Murray in Syst. Veg. ed. 14. 702. 1784. *Fl. & Fr.*: February-August.

*Distribution:* Throughout INDIA; NEPAL; BHUTAN; CHINA; BANGLADESH; SRI LANKA; MYANMAR; MALAYSIA; THAILAND; VIETNUM; KOREA; TAIWAN; JAPAN; CAMBODIA; JAVA; INDONESIA; LAOS; BORNEO; NEW GUINEA; AUSTRALIA; NEW ZEALAND; HAWAII; MADAGASCAR; SULAWESI. [150-2600 m amsl]. Specimen examined: *Singh* 3455 [BSHC].

8. Hypericum monanthemum Hook.f. & Thomson ex Dyer in Hooker, J. D., Fl. Brit. India 1: 256. 1874. subsp. monanthemum

Fl. & Fr.: June-August.

*Distribution*: INDIA: Himalaya: West Bengal, Sikkim; Assam; NEPAL; BHUTAN; CHINA; MYANMAR. [1520-4400 m amsl]. **Specimen examined**: *Maity* 23074 [BSHC].

9. Hypericum monanthemum Hook.f. & Thomson ex Dyer subsp. filicaule (Dyer) N. Robson in Bull. Nat. Hist. Mus. (London), Bot. 31: 78. 2001.

Hypericum filicaule (Dyer) N. Robson in Bull. Brit. Mus. (Nat. Hist.), Bot. 5: 305. 1977.

*Fl. & Fr.*: July-November.

*Distribution*: INDIA: Himalaya: Sikkim; NEPAL; CHINA; MYANMAR [3500-4000 m amsl].

Specimen examined: Hooker s.n. [K, K000677221!]

**Note:** Biswas (1993) accepted *Hypericum filicaule* at species rank following Robson (1977b). Later, Robson (2001) in his recent treatment considered it a subspecies of *H. monanthemum* as *H. monanthemum* subsp. *filicaule* (Dyer) N.Robson. Following Robson (2001) we also consider the taxon at subspecies rank under *H. monanthemum*.

**10. Hypericum patulum** Thunb. in J.A. Murray, Syst. Veg. ed. 14: 700. 1784. *Hypericum hookerianum* Wight & Arn. var. *dentatum* S.N.Biswas in Bull. Bot. Surv. India 25:195.1985.

*Fl. & Fr.*: June-September.

*Distribution*: INDIA: Himalaya: Sikkim; Meghalaya; Tamil Nadu; SOUTH AFRICA; CHINA; JAPAN. [450-2400 m amsl]. **Specimen examined**: *Smith* 598 [CAL].

**11. Hypericum petiolulatum** Hook.f. & Thomson ex Dyer in Hooker, J. D., Fl. Brit. India 1: 255. 1874.

Fl. & Fr.: May-September.

*Distribution*: INDIA: Himalaya: West Bengal, Sikkim; NEPAL; BHUTAN; CHINA; MYANMAR; INDONESIA; VIETNAM. [1500–3000 m amsl]. **Specimen examined**: *Maity* 21647 [BSHC].

12. Hypericum reptans Hook.f. & Thomson ex Dyer in Hooker, J. D., Fl. Brit. India 1: 255. 1874.
Fl. & Fr.: July-October.
Distribution: INDIA: Himalaya: Sikkim; Assam; NEPAL; CHINA; MYANMAR. [2400-4000 m amsl].

Specimen examined: Maity 23313 [BSHC].

13. Hypericum tenuicaule Hook.f. & Thomson ex Dyer in Hooker, J. D., Fl. Brit. India 1(2): 254. 1874.

*Fl. & Fr.*: June-August.

Distribution: INDIA: Himalaya: Sikkim; Assam; Nagaland. [2100-3800 m amsl].

Specimen examined: *Dash* 16421 [BSHC]

14. Hypericum uralum Buch.-Ham. ex D. Don in Sims., Bot. Mag. 50: t. 2375. 1829.

Fl. & Fr.: July-December.

*Distribution:* INDIA: Himalayas: Jammu & Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh; Assam, Meghalaya, Manipur, Nagaland; PAKISTAN; NEPAL; BHUTAN; TIBET; CHINA; MYANMAR; THAILAND; INDONESIA [1200-3600 m amsl]. Specimen examined: *Sinha & Pradhan* 16650 [BSHC]. **15. Hypericum wightianum** Wall. ex Wight & Arn. in Prodr. 99.1834. *Fl. & Fr.*: April-August.

*Distribution*: INDIA: Himalayas: Jammu & Kashmir, Uttar Pradesh, West Bengal (Darjeeling), Sikkim, Arunachal Pradesh; Assam; Manipur; Nagaland; Meghalaya; Karnataka; Tamil Nadu; Kerala; PAKISTAN; SRI LANKA; NEPAL; BHUTAN; MYANMAR; THAILAND; CHINA. [1000-3000 m amsl].

Specimen examined: Long & Noltie 4 [E, E00047675!].

16. Hypericum williamsii N. Robson in J. Jap. Bot. 52: 279. 1977.
Fl. & Fr.: June-July.
Distribution: INDIA: Himalaya: Sikkim; NEPAL [1700-1800 m amsl].
Specimen examined: Meinertzhagen s.n. [BM, BM001204318!].

# **PHYTOGEOGRAPHICAL AFFINITIES**

Sikkim being part of 'Himalaya Hostspot' (Myers et al., 2000) is rich in biodiversity coupled with high degree of endemism. The flora is typically represented by the Eastern Himalayan members though the diversity is enriched by migration of different floristic elements from neighboring and far away countries. Among all the species of Hypericum found in Sikkim about six species, namely H. choisianum, H. elodeoides, H. himalaicum, H. hookerianum, H. uralum and H. wightianum are with common distribution with the Western Himalaya. There are at least eight species and one subspecies of the genus, viz. H. gracilipes, H. moanthemum, H. monanthemum subsp. filicaule, H. patulum, H. petiolulatum, H. reptans, H. tenuicaule, H. williamsii and *H. hookerianum*, which are also distributed in SE Asian countries like Myanmar and Thailand. Notably, the widest distributional pattern is noticed in case of *H. japonicum*. This species is found throughout the country and extends even to Australia and New Zealand. Similarly, H. patulum is also known to be distributed in South Africa, though the distributional range is comparatively narrower than that of *H. japonicum*.

# DISTRIBUTION OF Hypericum SPECIES ALONG ALTITUDINAL GRADIENT IN SIKKIM

The distribution along altitudinal gradient is the most critical issues related to the survival of the species in this climate change scenario (Korner, 2000). Among 15 species of *Hypericum* and one infraspecific taxon, eight are growing in temperate forests though few of them are also extended to the subtropical habitat. *H. japonicum* is with most wide distributional range and is spread from 150 m to 2600 m amsl. *Hypericum tenuicaule*, an endemic species of India, is reported to climb up to 3800 m amsl in Sikkim. The highest altitudinal record is credited to *H. monanthemum* in this part of Himalaya. This species is found up to 4400 m amsl altitude where alpine environment is prevalent. Moreover, one of its members, *H. monanthemum* subsp. *filicaule* also grows in subalpine and alpine habitat (3500–4000 m amsl).

# **ENDEMIC SPECIES**

Being an Eastern Himalayan state, Sikkim shelters a good number of endemic plants. Maity (2021) reported about 44 flowering plant species (including several infraspecific taxa) which are strictly restricted to Sikkim. Apart from this, many Eastern Himalayan endemic taxa along with Indian endemic members are also well flourishing in this state (Singh and Chauhan, 1998; Maity *et al.*, 2018; Maity, 2021). India is credited with six endemic species of *Hypericum* (Table 1) (Biswas, 1993; Singh *et al.*, 2015), among them Sikkim shelters two species, *viz. H. gracilipes* and *H. tenuicaule*. Notably, *H. williamsii*, an Eastern Himalayan endemic species is also recorded here. This species shows most narrow distributional range and is only found in Nepal and Sikkim (India).

Tuble	Table 1. Species of Hyperical enderine to many Eastern Himalaya				
Sl.	Names of the species	Distribution			
no.					
Endemic to India					
1.	Hypericum assamicum	Assam, Arunachal Pradesh			
2.	Hypericum benghalense	West Bengal, Sikkim			
3.	Hypericum gaitii	Bihar, Orissa and Madhya Pradesh			
4.	Hypericum gracilipes	West Bengal, Sikkim, Meghalaya and			
		Nagaland			
5.	Hypericum lobbii	Meghalaya			
6.	Hypericum tenuicaule	Sikkim, Assam and Nagaland			
Endemic to Eastern Himalaya					
7.	Hypericum williamsii	India (Sikkim), Nepal			

Table-1: Species of Hypericum endemic to India/Eastern Himalaya

# Key to the species of Hypericum in Sikkim

1.	Plants herbaceous	2
-	Plants shrubby	8
2.	Stamens in 5 groups	H. japonicum
-	Stamens in 3 groups	3
3.	Leaves petiolate; petioles to 7 mm long	H. petiolulatum
-	Leaves sessile	- 4
4.	Bracts leafy	5
-	Bracts otherwise, never leafy	6
5.	Leaves glaucous beneath; flowers larger, 1.0-2.5 cm acro	SS
	<i>H. monanthemum</i> sub	sp. <i>monanthemum</i>
-	Leaves not glaucous, sparsely punctuate gland-dotted ber	neath;
	flowers smaller, 0.6–1.2 cm across	
	H. monanthemu	<i>n</i> subsp. <i>filicaule</i>
6.	Styles much longer, to 2.5 cm long	
		H. elodeoides
-	Styles shorter, up to 1.3 mm long	. 7
7.	Plants erect	
		H. himalaicum
-	Plants prostrate or decumbent	
		H. wightianum

8.	Flower solitary (often in pairs in <i>H. tenuicaule</i> )	9
-	Flowers few to many	10
9.	Plants prostrate or ascending, up to 30 cm	
		H. reptans
-	Plants erect, up to 1 m tall	_
		H. tenuicaule
10.	Styles distinctly longer than ovary	H. benghalense
-	Styles as long as or shorter than ovary	11
11.	Stamens about 30 per fascicle	H. gracilipes
-	Stamens usually 40 or more per fascicle	12
12.	Style as long as ovary	H. uralum
-	Style shorter than ovary (slightly shorter to equal	
	in <i>H. wiliamsii</i> , then branchlets terete)	13
13.	Branchlets always terete	14
-	Branchlets 2-4-angled	15
14.	Plants more than 2 m tall; flowers larger, more than 4.5-6.5	cm
	across; styles free	H. hookerianum
-	Plants up to 1.5 m tall; flowers smaller, 1.5-4 cm across; style	es
	connate at base	H. williamsii
15.	Leaves abaxially glaucous, ±densly glandular	H. patulum
-	Leaves abaxially not glaucous, eglandular	H. choisianum

# DISCUSSION AND CONCLUSION

The family Hypericaceae is an important and diversified group of plants in India (Biswas, 1993). It is represented by 28 species and five infraspecific taxa out of which six species (about 20%) are strictly endemic to the country (Biswas, 1993; Singh et al. 2015; Singh et al., 2019). Hypercium lobbii N. Robson was described by Robson (in J. Roy. Hort. Soc. 95: 491, 496.1970) from Meghalaya, Khasia hills which is endemic to this region. Biswas (1993) reduced its status to infraspectic level and treated a variety under H. hookerianum as H. hookerianum var. lobbii (N. Robson) S. N. Biswas. However, Robson (2012) in his Monographic work on Hypericum retained it as good species, H. lobbii N. Robson. Biswas (in Bull. Bot. Surv. India 25:195.1985) described H. hookerianum var. dentatum Biswas and until now it is considered as endemic to India (Biswas, 1993; Singh et al., 2015; Singh et al., 2019). Notably, H. hookerianum var. dentatum is treated as synonym of H. patulum Thunb. by Robson (2012). H. patulum is well distributed in China, Japan and South Africa (Li and Robson, 2007). In this account we included H. patulum under Indian species count following Robson's treatment (2012). Robson (1977a) described Hypericum wightianum subsp. axillare N. Robson, and it has been retained by Biswas (1993). But later Robson (2001) revised its taxonomy and synonymised under H. kingdonii N. Robson. In this account we included H. kingdonii under Indian species count based on Robson (2001). Recently, Singh et al. (2019) also included this species under the enumeration of Indian Himalayan taxa. Notably, two species, H. mysurense and H. gaitii are not yet recorded in Himalayan region (Biswas, 1993). With about 50% species and three endemics Sikkim appears one of the most important habitats of the genus in Indian subcontinent. H. benghalense is included here based on report of

Sherpa *et al.* (2021). Majority of the species flower during the monsoon (June-July), however *H. petiolulatum* (April-November) and *H. wightianum* (April-August) flower in the pre-monsoon season. *H. japonicum* completes its phenological cycle between February and August.

# ECONOMIC USES (MEDICINAL, FODDER AND HORTICULTURAL)

Traditionally, the different species of Hypericum were used for the treatment of diverse ailments like wounds, cuts, boils, inflammation, fever, asthma, dysentery, eye diseases, neuralgia, sciatica, mental problems, nerve tonic, dog bites and bee stings, etc. (Barnes et al., 2001; Butola et al., 2007). Bhatt (2013) reported the use of H. choisianum leaf powder in treatment of fever. It has antiviral property, used to treat anxiety and inflammation (Butola et al., 2007). Whole plant of *H. monanthemum* is used in the treatment of eye diseases (Butola et al., 2007). H. japonicum is widely used to treat asthma, dysentery, acute hepatitis, pain in the liver region, appendicitis and as styptic. It is also traditionally used to get remedy from scrofula, contusions, abscesses, wounds, skin diseases due to fungal infection and leech bites in China (Butola et al., 2007). Traditionally, the decoction of leaves of *H. oblongifolium* is given to facilitate delivery (Butola et al., 2007). Hypericum perforatum is long being used in Homeopathy medicine system in the treatment of wounds, abrasions, burns, sunburns and inflammatory skin disorders (Barnes, 2001). The paste of leaves is used to check bleeding in cuts and it has astringent, expectorant and diuretic properties and used in pulmonary and urinal problems, diarrhoea and in depression too (Butola et al., 2007). John's Wort Oil is prepared from the fresh flowers of *H. perforatum* with olive oil and used externally to cure urns, wounds, sores, ulcers, swellings and sometimes against rheumatism, lumbago and intestinal worms (Butola et al., 2007). Many species of this genus like H. choisianum, H. hookerianum, etc. are also used as fodder (Butola et al., 2007). H. perforatum act as a source of dye (Butola et al., 2007). The roots of H. oblongifolium yield yellow dye (Butola et al., 2007).

The large bright yellow flowers of its members have great horticulture potential. Many species are well known garden plant in Sikkim and other states of India. Biswas (1993) reported seven such species of *Hypericum* having gorgeous yellow flowers. With the ongoing modern urbanization habitat destruction of the species is obvious everywhere and Sikkim is also not exceptional from this. To protect the unique diversity as well as the endemic species of *Hypericum* in the state, some initiatives should be taken by the competent authority.



Fig. 1: Hypericum A. H. elodeoides, B. H. hookerianum

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