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Conservation threats to some important medicinal plants of the Sikkim Himalaya

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Abstract

There are records of about 400 plants of therapeutic value in the Sikkim Himalaya. Indiscriminate and non-systematic collection of medicinal plants has led to severe pressure on the availability of these plants, many of which are now rare, threatened or endangered. Six species, are taken as a case study, viz. *Aconitum heterophyllum* (Wall), *Podophyllum hexandrum* (Royle), *Nardostachys jatamansi* (DC), *Picrorhiza kurrooa* (Benth), *Swertia chirata* (Ham) and *Bergenia ciliata* (Har.) Stenb. The number of plants collected from the wild in Sikkim are very high (c. 800,000 *A. heterophyllum*; 7,700,000 *N. jatamansi*; 3,100,000 *P. kurrooa*, and 3,000,000 *S. chirata*). The six species studied are considered as test cases for successful conservation for the large number of species in Sikkim that are claimed to have therapeutic value and whose survival in the wild is threatened. © 2000 Elsevier Science Ltd. All rights reserved.

1. Introduction

In the Himalayan region the use of plants to cure/abate certain ailments and disease is an age-old practice starting from a situation when life-saving herbs from the wild provided the only refuge during emergency and trauma. The most ancient Indian system of Ayurvedic medicine goes back to 1000 BC. A great many of these traditional medicinal plants have found their way as raw materials into modern bio-pharmaceuticals and bio-cosmetic industries in recent times. The World Health Organization has estimated that about 4000 million people rely on herbal medicines and 25% of prescription drugs are based on plant-derived chemicals.

Careful exploitation of medicinal plants growing in mountain regions provide an opportunity for local development (Purohit, 1997). Earlier, such herbals were used only by local people in small quantities but commercialization of some species in recent years has increased their demands and consequent exploitation. Heavy extraction of these plants from the wild, loss of habitat by deforestation and excessive grazing pressure in high altitude pastures in the entire Himalayan region now threaten their survival.

Sikkim remained largely unexplored for a considerable period in history because of its geography, but from the middle of the 18th Century AD visits by naturalists and explorers exposed its biological wealth. It is now known as a biological 'Hot Spot' and about 5000 species of flowering plants are found in the 7096 km^2 area (Hajra and Verma, 1996). The first floristic study of the Sikkim Himalaya was by J.D. Hooker (1871–1897), and this was followed by a comprehensive work on medicinal plants of Darjeeling and Sikkim by Biswas (1956). Over 400 plants possessing therapeutic properties have been recorded from the region (Srivastava and Kapaki, 1990). Studies on the status, uses and potentials of 40 important medicinal plants of the Sikkim Himalaya were made by Rai and Sharma (1994). Many uses of Sikkim's medicinal plants in Ayurvedic and Tibetan medicines, their status and cultivation techniques have been carefully recorded (Nautiyal, 1995; Sharma, et al. 1995; Singh, 1995; Trogawa et al., 1995; Tsarong, 1995).

Six important species of medicinal plants have been selected for a study of conservation threats in Sikkim. This paper deals with the distribution, usage, harvest pressure and threats concerning *Aconitum heterophyllum* (Wall), *Nardostachys jatamansi* (DC), *Podophyllum hexandrum* (Royle), *Picrorhiza kurrooa* (Benth), *Swertia chirata* (Ham) and *Bergenia ciliata* (Har) Stenb. The first four species are endangered (Nayar and Sastry, 1990). These selected species are considered as test cases

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for successful conservation of the very large number of species in Sikkim that are claimed to have therapeutic value and whose survival in the wild is threatened.

2. Sikkim Himalaya

Sikkim Himalaya is defined by the great drainage region of the river Tista that constitutes the hills of Sikkim and Darjeeling district of West Bengal in the eastern Himalaya. The hills of Sikkim (7096 km^2) and Darjeeling (3149 km^2) range altitudinally from 100 m a.s.l. (foothills) through 4000 m (timberline) up to 8548 m (Mt. Khangchendzonga). The area thus covers several ecological zones viz., subtropical, temperate, sub-alpine and alpine. In such a small area sharp climatic differences in different ecological zones have promoted a rich flora.

Sikkim Himalaya is also a cornucopia of ethnicity having four major groups, Bhutias, Lepchas, Limbus and Nepalese, and a conglomerate of over 20 ethnic tribes and even more sub-tribes. The medicinal plants here are extracted by the local people for ethnic medicinal use, for use in Ayurvedic and Tibetan medicines and also for use in modern bio-pharmaceuticals and bio-cosmetics. The distribution of the selected six medicinal plants is presented in Fig. 1. *Swertia chirata* occurs at middle altitude while the other five species grow at high altitudes.

3. Distribution and usage

3.1. Aconitum heterophyllum *(Wall) (Ranunculaceae)*

An erect, rarely twining, herb distributed in the temperate Himalaya between Kashmir to Sikkim and further east to Myanmar. In the Sikkim Himalaya it is found around 3500 m. The dried root is used generally for fever and body pain. It is also used as alterative, diaphoretic, diuretic, expectorant, febrifuge and diapepsiac.

3.2. Podophyllum hexandrum *(Royle) (Berberidaceae)*

A succulent erect herb distributed in the Himalaya from Afghanistan and south-west China. In the Sikkim Himalaya it grows between 3600 and 4800 m a.s.l. The roots are used as emetic, cholagogue, vermifuge, purgative, alterative and blood purifier. The roots contain podophyllotoxin, which has been reported as anticancerous (Arnold, 1979).

3.3. Nardostachys jatamansi *(DC) (Valerianaceae)*

A herb growing up to 20 cm in height. It is found in the Himalaya between Kumaon and Sikkim. In the Sikkim Himalaya it is found at an elevation of 3600–4800 m. The roots are used generally as a stimulant and antispasmodic. Murty and Subramanyam (1989) cited many other uses such as diuretic and anticonvulsant, and used in epilepsy, hysteria, heart palpitation and cholera. Roots are reported to be rich in terpenoids (Wargner and Jurick, 1979).

3.4. Swertia chirata *(Ham) (Gentianaceae)*

A slender, upright herb occurring in the Himalaya from Kashmir to Bhutan and Khasi hills. In the Sikkim Himalaya it is found between 1600 and 2600 m a.s.l. The whole plant contains gentiamine alkaloids and the aerial part contains xanthones (Sharma, 1982). The water extract of the plant is generally used during fever. Other uses are in bronchial asthma, dyspepsia and debility. It is a favourite remedy in intermittent fevers, acidity and in bilious dyspepsia accompanied by fever.

3.5. Bergenia ciliata *(Har) Stenb. (Saxifragaceae)*

A creeping herb with rhizomes. It occurs commonly throughout temperate Himalaya between 1500 and 3000 m. The rhizome is used to cure diarrhea and vomiting. It is also used against fever, coughs and pulmonary infections, for boils and as an antiscorbic.

3.6. Picrorhiza kurrooa *(Benth) (Scrophulariaceae)*

A creeping herb found between Kashmir and Sikkim above 4000 m. Its roots are used as a tonic, cathartic, stomachic and purgative. It is also used in fever, dyspepsia and scorpion stings. Glycosides, especially picroside and kutkoside, are the chief bioactive phytochemicals of its roots (Aswal et al., 1984).

4. Conservation threats

So far all the medicinal plants that reach the common market are collected from the wild state. The majority of traders collect wild medicinal plants through untrained and unskilled labourers. This is generally in the form of extraction of the entire plants, roots, rhizomes, tubers and bulbs before seed set, making low regeneration of the species in the habitat. Over-exploitation of these species, as well as trampling at particular places during collection has changed the habitat conditions causing a gradual loss of other associated species.

The market stock of medicinal plants comes from private collectors and suppliers with legal permits for collection of herbs from specific collection sites. These sites are demarcated and collection permits issued by the Forest Department, Government of Sikkim. Major medicinal herbs are scattered throughout the region, but some sites are identified for profitable collection.

A collection cycle is maintained every year under rotation so that the same sites are not exploited repeatedly. Although this system has definite benefit to the conservation of these herbals it is not strictly followed. Absence of forest officials at remote sites allows collectors to enter sites other than the demarcated ones and there is a great deal of illegal collecting that cannot be measured from market investigations.

The collection season for the major species is shown in Fig. 2, and the major collection sites are cited in Table 1. After collection all the materials are brought to the respective road-heads and then transported to the markets at Gangtok, Siliguri, Kalimpong and other destinations such as Calcutta and New Delhi. The pricing and transaction of amount involved is kept strictly secret. Even the actual destination of the

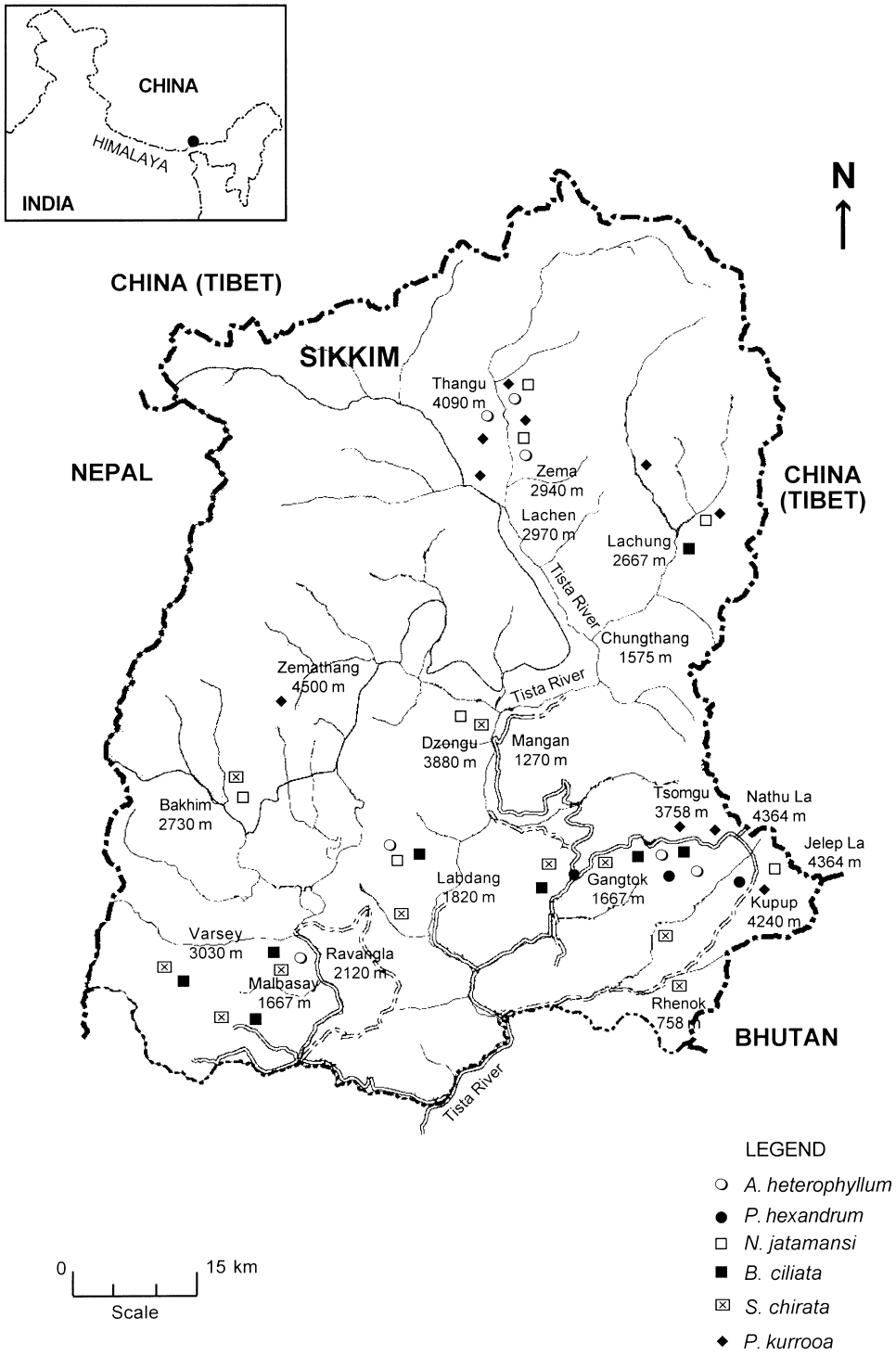

Fig. 1. Distribution of major medicinal plants in Sikkim.

shipment is not known as dealers maintain a guarded attitude towards relevant inquiries.

A general herbal inventory from a typical *jadi-buti* salesman is presented in Table 2. The final product may be sold as raw, unprocessed or under-processed (in the form of twigs, leaves, barks, roots and rhizomes) or in the form of processed powder, crude tablets or syrups.

In general, the plant parts suitable for the marketing purpose increase with maturity; one can get better economic returns with the fully matured plants and this is dictated by a regular market demand. However, most of these species take 7–8 years to attain full maturity and to become economically viable (Nautiyal, 1995), which can severely test the patience of herbal farmers. The resultant option, thus remains, direct collection of the herbs from the wild state. The amount collected for a calendar year from the different collection centres in Sikkim is given in Table 1. Comparison of collections and harvesting pressures in Sikkim and Nepal clearly shows that the situation is even worse in Nepal, especially for *P. kurrooa* and *S. chirata* (Table 3). The extraction pressure, in terms of number of plants, for a single calendar year is very high for almost all the species. Average yields are given in Table 4. This shows the approximate number of plants which are required (shoot or root dry mass) to produce 1 kg of medicinal part. *A. heterophyllum*, for example requires a total of 75 plants uprooted from the nature to realize 1 kg. Likewise, plant numbers required for every kilogram are highest in *P. kurrooa* followed by *N. jatamansi*, *S. chirata*, *B. ciliata* and lowest in *P. hexandrum*. Except for *S. chirata* only the underground parts are marketable.

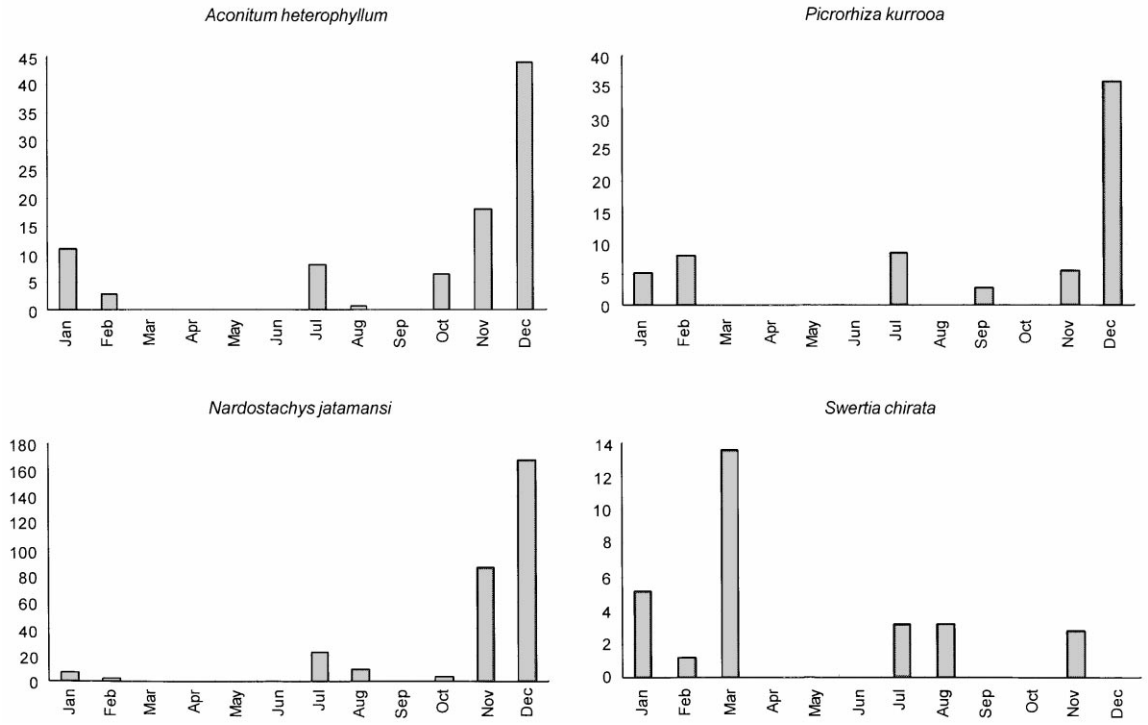

Fig. 2. Seasonal extraction (×100 kg) of medicinal plants from Sikkim.

Table 1
Quantity (kg) of medicinal herbs harvested (1990–1991) at different collection sites in Sikkim[a]

Collection sites	*Aconitum heterophyllum*	*Nardostachys jatamansi*	*Swertia chirata*	*Picrorhiza kurrooa*
Gangtok	–	–	720	–
Gnathang	–	1400	–	520
Gyalzing	1120	–	640	–
Lachen	7880	26160	80	4840
Lachung	–	200	–	800
Parkha[b]	–	–	320	–
Ravangla	–	–	320	–
Rongli	–	–	1360	–
Thangu	1740	3240	–	40

[a] Values for *Bergenia cilita* and *Podophyllum hexandrum* not available.
[b] Includes Parkha, Rigu and Barapathing collection area.

In any case the volume of biomass taken out every year from the wild state in the form of medicinal herbs has been quite remarkable. Total plant numbers harvested annually from Sikkim is given in Table 4. These numbers are very high and suggest heavy harvesting pressure on their natural habitats indicating a high and steady biomass loss every year.

5. Conservation initiatives

In the Sikkim Himalaya, research and development on conservation of medicinal plants are being carried out by the G.B. Pant Institute of Himalayan Environment and Development, the Forest Department and other agencies (Table 5). Propagation techniques for *Aconitum*, *Picrorhiza* and *Podophyllum* have been developed using seeds or cuttings of stems, stolons, tubers and rhizomes (Nautiyal, 1995). The Forest and Horticulture Departments have established a nursery for growing high altitude medicinal plants, but sustained cropping has not yet been successfully achieved.

So far, no local agencies have taken measures for systematic cultivation and marketing of these herbs. However, works on protection, conservation and management, along with an awareness drive among medicinal plant collectors, have been initiated by the Forest Department. A policy of rotational harvesting from demarcated areas through permits allows recuperation and a sustainable harvest. Most of the medicinal plants occur in restricted areas of the state and collection permits are only issued to local inhabitants. This has restrained collectors from outside the area who are normally very numerous in the central Himalaya. The Forest Department has also been planting some of these medicinal plants back into natural habitats to see whether sustainable harvesting in demarcated areas can meet the requirements for traditional use. The remaining areas in the wild should be set aside for *in situ* conservation by banning exploitation there. Another

Table 2
Herbal medicines claimed by herbal practitioners (*Jadibuti* man) with usage and price in a weekly market in Sikkim

Species	Local name	Usage	Price[b] ($/kg)
Aconitum heterophyllum[a]	Bikhma	Rheumatism, fever and body pain	32.0
Bergenia ciliata[a]	Pakhanbhed	Oral inflammation, infection, diarrhea	0.3
Nardostachys jatamansi[a]	Jatamashi	Anticonvulsant, cholera, palpitation	1.3
Podophyllum hexandrum[a]	Papari	Vermifuge, emetic, blood purifier	1.5
Picrorhiza kurrooa[a]	Kutki	Dyspepsia and malarial fever	4.6
Swertia chirata[a]	Chirowto	Fever and acidity	0.2
Aesculus indica	Pangra (kernel)	Mumps	4.0
Alstonia scholaris	Chhatiwan (bark)	Diabetes	0.4
Citrus sp.	Bimbira (root)	Worms in children	4.0
Curcuma zedoaria	Phachyeng	Jaundice	1.0
Diplazium polypodioides	Kaliningro (root)	Dysentery	1.5
Mesua ferrea	Nagesori	Inflammation and septic conditions	6.0
Orchis latifolia	Panchunlay	Body-ache, cuts and bruises	1.8
Rheum nobile	Padamehal	Blood clot/swellings	1.4
Terminalia belerica	Barra	Cough	2.0
Terminalia chebula	Harra	Cough	2.0
Viscum album	Harchar	Bone fracture	2.0

[a] Species covered in this study.
[b] US $ 1 = Rs. 42.

Table 3
A calendar year collection (kg) of some medicinal plants showing harvesting pressure (kg/km^2) during 1990–1992 in the Sikkim and Nepal Himalaya

Species	Sikkim[a]		Nepal[b]	
	Quantity (kg)	Pressure (kg/km^2)	Quantity (kg)	Pressure (kg/km^2)
Aconitum heterophyllum	10720	1.51	10000	2.0
Nardostachys jatamansi	31000	4.37	30000	6.1
Picrorhiza kurrooa	6200	0.87	24000	4.85
Swertia chirata	3440	0.48	154000	31.1

[a] Source: Department of Forest, Government of Sikkim.
[b] Edwards and Bowen (1993).

Table 4
Plant numbers required for unit weight and numbers harvested annually from Sikkim

Species	Number of plants required to reach a kilogram		Plant numbers harvested for	
	As shoot parts	As root parts	Shoot parts	Root parts
Aconitum heterophyllum	72	75	771840	804000
Bergenia ciliata	125	95	–[b]	–
Nardostachys jatamansi	970	420	1190240	7678080
Picrorhiza kurrooa	286	500	1773200	3100000
Podophyllum hexandrum	335	50	–[b]	–
Swertia chirata[a]	346	–	3007000	–

[a] Only shoot part is medicinal.
[b] –Indicates data not generated as market from Sikkim was not known.

Table 5
Indian institutions involved in research and development works on medicinal plants dealt in this article

Institution	Location	Activities
High Altitude Plant Physiology Research Centre	H.N.B. Garhwal University, Srinagar, UP hills	The field research station at Tungnath (3600 m) conducts studies on phenology, seed germination, seedling development, vegetative propagation, tissue culture, population study, genetic diversity assessment and trials for higher yields
Jadi Buti Sansthan	Gopeshwar, Garhwal, UP hills	Transfer of technology to farmers for cultivation of medicinal plants. Awareness drive for sustainable harvest
G.B. Pant Institute of Himalayan Environment and Development	Kosi–Katarmal Almora, Kumaon, UP hills	Conservation and propagation of rare and threatened species. Biotechnological assessments and development of tissue culture protocols
G.B. Pant Institute of Himalayan Environment and Development	Tadong, Gangtok, Sikkim Himalaya	Survey on status, usage, harvest and potentials. *Ex situ* and *in situ* conservation efforts
Central Institute of Medicinal and Aromatic Plants	CSIR Laboratory, Lucknow, UP	Biochemistry and pharmacological assessments of active principles

possible approach is through community involvement in sustainable use. An enterprise at Humla in Nepal provides a success story for conserving *N. jatamansi* and its habitat. Local people harvest the roots of this species from nearby alpine meadows using minimum disturbance and taking only the largest plants, process them on-site and export the oil through the Humla Conservation and Development Association (Biodiversity Conservation Network, 1997).

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