

THREATENED PLANTS OF INDIA A State-of-the-Art Report

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BOTANICAL SURVEY OF INDIA, HOWRAH



**Botanical Survey of India and Man and Biosphere Committee
National Committee on Environmental Planning and Coordination
DEPARTMENT OF SCIENCE AND TECHNOLOGY, NEW DELHI**

THREATENED PLANTS OF INDIA

A State-of-the-Art Report



Botanical Survey of India

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FOREWORD

Extinction has been the destiny of a great number of plant species including several unique and irreplaceable varieties. Some of these have disappeared from the earth in nature's own process of evolutionary change. But for many others, extinction has been caused by man because of his inadvertence as well as ignorance about their economic potential and ecological functions. So far only a small fraction of the diverse populations of plants is known to us and a large majority still remains unidentified. Even in respect of familiar species, in many cases, little more is known than their appearance and location.

Through indiscriminate exploitation, destruction of habitats, spread of harmful chemicals and introduction of alien species, a number of plants have already disappeared while others await a similar fate, at times, even without our being aware of their existence. Thus human interference has been, more often than not, responsible for depletion of plant resources and consequent decline of genetic diversity. According to an estimate of the Threatened Plants Committee of the International Union for Conservation of Nature and Natural Resources (IUCN) about 10% (20,000 to 30,000) of the world's flowering plants are reported to be "dangerously rare", or "under threat". Norman Myers, a noted conservationist, concludes that at least one species is disappearing each day in the tropical forests alone and in a few more years there may well be a species lost each hour. The seriousness of the situation can be understood from the observation of Peter H. Raven that a "disappearing plant can take with it 10 to 30 dependent species, such as insects, higher animals and even other plants".

Realizing the ecological importance and economic utility of plant resources, there is growing concern throughout the world about the need for conservation. As pointed out by Otto Frankel, the well known Australian geneticist, it is now time for determined efforts "to keep the evolutionary options open so far as we can" and to desist from eroding the richness of genetic reserves. During the recent past such concern has found expression in the establishment of an International Board for Plant Genetic Resources, and the UNESCO launched the Man and the

Biosphere (MAB) programme. A modest beginning has also been made in our own country and a National Bureau of Plant Genetic Resources has been set up under the Indian Council of Agricultural Research. The National MAB Committee has undertaken the task of identifying areas for designation of Biosphere Reserves which may serve as "ecological protectorates". It is in this context that the Committee felt the need for a state-of-knowledge report on the distribution of rare and endemic plants in different parts of the country. The task of preparing this report was entrusted to the Botanical Survey of India. I am glad that its Director, Dr. S.K. Jain, with the assistance of the Ecologist of the Botanical Survey of India, Shri A.R.K. Sastry, has been able to complete this report.

The report provides an overview of the problem with an inventory of 135 threatened species including their classification, habitats, causal factors threatening their existence, and the necessary protective measures. I have no doubt that this report will be of great use to all concerned.

B.P. Pal

(B.P. PAL)

Chairman, National Committee
on Environmental Planning and Coordination.

New Delhi
8 August 1979

PREFACE

In the 11th meeting of the National Man and Biosphere Committee, held on 16th May, 1978, in Technology Bhavan, Department of Science & Technology, New Delhi, under the Chairmanship of Professor B.P. Pal, F.R.S., some important agenda items pertaining to Biosphere Reserves, Island Ecosystems were considered. Rare and Threatened species of Indian Flora, and Man's impact on Ecosystems in different parts of the country were discussed and it was decided that state-of-the-art reports be prepared on current important problems like the threatened plants and Ecosystems. Accordingly, the Committee entrusted the task of preparing a state-of-the-art report on rare and threatened species of Indian flora to the senior author (Dr. S.K. Jain), who is also a member of the National MAB Committee.

The draft of this report was seen by Prof. B.P. Pal, and by the members of the Scientific Programme Implementation & Evaluation Committee for the Botanical Survey of India. The report was also read out in the 5th meeting of the Flora Wing of the Indian Board of Wild Life, held on the 11th & 12th January, 1979, in the Committee Room of the Botanical Survey of India at Howrah, under the Chairmanship of Dr. S.K. Jain. The members were of the opinion that the report served its purpose well and stressed the need to get it printed early for wider circulation. Hence this booklet.

The authors wish to place on record their grateful thanks to Prof. B.P. Pal, Prof. H.Y. Mohan Ram, Prof. A.K. Sharma, Dr. T.N. Khoshoo, Shri K.C. Sahni, Shri Y.R. Chadha, Shri K. Kashyapa, Shri Brij Kishore and Dr. D.K. Biswas for their keen interest and useful suggestions. They also thank Sarvashri P.K. Hazra, R.L. Mitra, C.C. Mukherjee and L.D. Sangle for their help in the preparation of the manuscript and some of the illustrations.

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INTRODUCTION

This report aims at bringing out the general information on the rare and endangered species of Indian flora, together with the probable causes of rarity, habitats of the threatened species, action taken for their protection and suggestions for the future work.

GENERAL BACKGROUND TO THE PROBLEM OF THREAT TO PLANT SPECIES

The increase of human population in the last few decades demanding development in various spheres has resulted directly or indirectly in the sudden and often far-reaching disturbances in natural ecosystems. The growth of large urban areas, construction activities such as dams, buildings and roads, encroachment on vast areas of forest lands for extension of arable expanses and mining operations are examples of direct onslaughts on nature which have steadily depleted natural resources. Besides, the pollution resulting from urbanization, industrialization, excessive use of chemical fertilizers and pesticides and also of the several giant aircrafts have, in no small way, contributed to eco-imbances in soil, water and air. These imbalances have posed problems for the very survival of wild life. Besides these, in order to satisfy his ego and establish supremacy over other life by collecting, hunting, trapping and poaching, man has driven certain species on the verge of extinction.

Unfortunately, not until some species of animals became extinct, concern and thought on conservation and protection of wild life could be forthcoming. While the rapid disappearance of some beautiful animals boosted efforts in protection of fauna, the situation remained

unchanged for the flora. The word 'wild life' had till recently been considered synonymous to 'animal life' and consequently conservationists and naturalists gave their attention only to conservation of animal species.

It was only in the year 1968 at an International Conference (UNESCO 1968) that the problem of conservation of flora was appreciated and several recommendations were made urging the International Biological Programme (IBP), the International Union for Conservation of Nature and Natural Resources (IUCN) and various international and national organizations to initiate studies into these problems including the protection and preservation of wild fauna and flora in their natural habitats/ ecosystems by establishment of natural reserves.

Later at the 10th General Meeting of the IUCN, the Survival Commission reviewed the status of endangered species of plants and their habitats. The recent promulgation of the United States Endangered Species Act (1973), the U.K. Wild Creatures and Wild Plants Act (1975), development of international conventions on conservation (Wetlands Convention, World Heritage Convention, Endangered Species Convention and South Pacific Convention) and setting up of Biological Records Centre of the Nature Conservancy, U.K. and Threatened Plants Committee of the IUCN with regional and

specialist groups on palms, orchids, cycads, tree-ferns and succulents, etc. have brought about a world-wide awakening on the conservation, preservation and protection of floras of the world.

The year 1970 had been declared and observed as 'European Conservation Year' by the Council of Europe urging the member states to promote and encourage conservation programmes.

India also promulgated the Wild Life (Protection) Act in the year 1972. But it did not include any plants in the lists of scheduled protected species.

According to the volume 5 of the *Red Data Books* on angiosperms started by the Survival Commission of the IUCN in the year 1970 (Melville, 1970), it is estimated that out of the total of *ca* three lakhs (0.3 million) species of plants in the world, over 20,000 were in the category of either endangered or vulnerable and threatened with extinction by the year 2000 A.D. Besides the *Red Data Books*, there are now a number of lists and reports on the subject such as the Smithsonian Report on Endangered and Threatened Plant Species of the United States (Smithsonian Institution, Anon., 1975), Rare and Endangered Species of Hawaiian Vascular Plants (Fosberg and Herbst, 1975), List of Rare, Threatened and Endemic Plants for the Countries of Europe (Lucas and Walters,

1976) and reports from certain other countries: Italy, Switzerland, USSR, South Africa, Australia and New Zealand.

RARE SPECIES OF PLANTS, THEIR CATEGORIES AND DEFINITIONS

The following categories of rare plants have been recognized by the IUCN mainly basing on (i) the present and past distribution, (ii) decline in number of populations in course of time, (iii) abundance and quality of natural habitats, and (iv) biology and potential value of the species. These are defined as follows for purposes of conservation.

Endangered (E)

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Vulnerable (V)

Taxa believed likely to move into the endangered category in the near future if the causal factors continue operating.

Included are taxa of which most or all the populations are *decreasing* because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously *depleted* and whose ultimate security is not yet assured; and taxa with populations that are still abundant but are *under threat* from serious adverse factors throughout their range.

Rare (R)

Taxa with small world populations that are not at present endangered or vulnerable, but are at risk.

These taxa are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Threatened (T)

Threatened is used in the conservation context for species which are in one of the three categories: Endangered, Vulnerable and Rare. Some species are marked as Threatened where it is *known* that they are Endangered, Vulnerable or Rare, but there is not enough information to say which of the three categories is appropriate.

Out of danger (O)

Taxa formerly included in one of the above categories.

but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival has been removed.

Indeterminate (I)

Taxa that are suspected of belonging to one of the first three categories, but for which insufficient information is currently available.

MAIN CAUSES OF THREAT TO SPECIES

Many factors, both natural and man-made have been responsible for limiting the distribution of certain species and causing them to become rare or even extinct. Normally for a species the processes involved in its evolution, spread and finally becoming extinct are very slow in time and space. It is well known now that several plant species have become extinct due to certain natural phenomena, such as land upheavals, volcanic eruptions, glaciation, protracted periods of rain or drought spreading of desert lands, forest fires, and eutrophication in the geological past. While such natural processes in the past had no doubt led to the extinction of floras, the resulting new environmental conditions had also resulted in the evolution and speciation of new floras and migration of floral elements.

But, in recent times, man with his anthropogenic associates and other factors or practices such as fire or 'slash and burn' for shifting cultivation (also called as 'jhum' or 'podu' cultivation in India), grazing by cattle and by several other mechanical means, has suddenly accelerated disastrous conditions in natural ecosystems.

Besides, commercial exploitation of entire plants, roots, rhizomes, tubers, bulbs, seeds and fruits have been the prime cause of depletion of more important wild economic plants throughout the world for lucrative financial gains in the trade which flourishes both by legal and illegal means. *Rauvolfia serpentina*, *Coptis teeta*, *Dioscorea* spp, and *Podophyllum hexandrum* serve as good examples. In certain other cases species are said to have become very old or senescent and suffered genetic depletion, thus becoming disabled to adapt to the new environment, eventually leading to their extremely confined distribution (e.g. *Ginkgo biloba* and *Metasequoia glyptostroboides*). Apart from these the vigorous competition with alien weeds and effects of plant pests and diseases have also been sources of threat to several native floras. Species of *Mikania*, *Eupatorium*, *Parthenium* and *Eichhornia* are some familiar examples on alien plants adversely affecting indigenous flora in India.

AREAS VULNERABLE TO RARITY AND EXTINCTION OF SPECIES IN INDIA

In India, the real threat to plant species lies especially in areas which are subjected to considerable developmental activities, e.g. forests which lie in close proximity to villages and agricultural lands. Such areas lie in the entire length and breadth of the Himalayas, the Western and Eastern Ghats of peninsular India, the Vindhya and Satpura Hill ranges, and the densely forested hilly regions in Assam, Nagaland, Meghalaya, Manipur and Mizoram in Eastern India. These regions incidentally abound in many tourist spots and pilgrimage centres, which attract large number of people who cause damage to the flora.

Besides, endemics which are confined to narrow, restricted areas or specialized ecological niches, also in some respects fall in the category of threatened plants. Some phytogeographers believe that endemic species or genera are the survivors of the one-time widely distributed groups, which are now in the course of gradual extinction. Others maintain that they are newly evolved and recent forms still in the process of extending in their geographical range of distribution. In either case, due to their rarity they are to be considered as threatened plants, because any disturbance or imbalance in their narrowly confined ecosystems/habitats could mean

extermination of the species.

Isolation, as in the case of island floras, and natural barriers such as mountain ranges, are considered main factors resulting in endemism.

India has a very rich element of endemics in its flora. According to Chatterjee (1940) Indian subcontinent has about 61.5 per cent of endemic flora with about 7,000 endemic species and 134 endemic genera. Of these, the Himalayas and the Khasi Hills account for about 3,000 endemic species, and the Deccan peninsula for about 2,000 endemic species. These figures eloquently speak of the great need for protecting the endemics. This can be done effectively by carefully analyzing the floristic composition of the various phytogeographical units of Indian flora and by selecting suitable natural forests in these units and preserving them as 'Biosphere Reserves'

Sapria himalayana, *Uvaria lurida*, *Alcimandra cathcartii*, *Magnolia gustavii*, *M. pealiana*, *Pachylarnax pleiocarpa*, *Nepenthes khasiana*, *Dicentra roylei*, several species of *Primula* and *Rhododendron* and the Lady's Slipper orchids, *Paphiopedilum insigne*, *P. hirsutissimum*, *P. fairieanum*, *P. spicerianum* and *P. venustum*, are some of the noteworthy endemics of the Himalayas and Khasi Hills, *Antiaris toxicaria*, *Campanula cytinooides*, *Pedicularis perrotteti*, and some species of the Podostemaceae are

endemic to the Western Ghats or the Nilgiri Hills in South India.

INVENTORY OF RARE AND ENDANGERED SPECIES OF INDIAN FLORA

Consequent to the global awareness on the problem of rare and endangered species of plants, some studies were undertaken by the Botanical Survey of India and the Forest Research Institute about a decade ago. A tentative list of rare and endangered plants had been prepared primarily based on a cursory perusal of the several floras and floristic accounts of the country. This list dealt with the names of about 120 plants. However, since its preparation, further studies in the subject indicated need for some additions or deletions.

This list is provisional. Intensive botanical explorations and studies on taxonomy and phytogeography necessitate its constant modification. It also does not include all the endemic species.

HIMALAYA AND EASTERN INDIA

1. *Abies delavayi* Franchet (Pinaceae)
Tree. A Chinese Fir recorded from Arunachal Pradesh; rare occurrence.
2. *Acanthephippium sylhetense* Lindl. (Orchidaceae)
Herb. A terrestrial orchid distributed in Garampani sanctuary (Assam), Khasi, Orissa, Abor Hills and Sylhet (Bangladesh); rare occurrence.
3. *Aconitum deinorrhizum* Stapf (Ranunculaceae)
Herb. One of the important Indian Aconites of medicinal value originally discovered from Bashahr Himalaya and recently reported from Bhadrwah, J & K. State; rare occurrence; medicinal; exploited for trade.
4. *Adinandra griffithii* Dyer (Theaceae)
Tree. Distributed in Khasi Hills, Meghalaya; rare occurrence.
5. *Aglaia perviridis* Hiern. (Meliaceae)
Tree. Distributed in Khasi Hills, Meghalaya; rare occurrence.
6. *Amblyanthus multiflorus* Mez (Myrsinaceae)
Shrub. Rarely reported from Assam.



7. *Anacolosia ilicoides* Mast. (Olacaceae)
Tree. Distributed in Khasi Hills, Meghalaya; rare occurrence.
8. *Anoectochilus sikkimensis* King & Pantl. (Orchidaceae)
Terrestrial herb, the 'Jewel Orchid' Distributed in Sikkim Himalaya, recently reported from Garampani sanctuary, Assam; rare occurrence.

***Acanthophippium sylhetense* Lindl.**

9. *Angiopteris evecta* Hoffm. (Angiopteridaceae)
Terrestrial fern. Widely distributed in India, Sri Lanka and S.E. Asia; sporadic in occurrence.
10. *Aphyllorchis montana* Reichb. f. (Orchidaceae)
Herb. A terrestrial orchid, petals straw-coloured, purple at back and tips. Distributed in Sikkim and Khasi Hills; rare occurrence.
11. *Arachnanthe cathcartii* (Lindl.) Benth. [*Esmeralda cathcartii* (Lindl.) Reichb.] (Orchidaceae).
Epiphytic. Attractive with large brownish-red flowers. Distributed in East Nepal, Sikkim, Bhutan and Arunachal Pradesh; rare occurrence.
12. *Arachnanthe clarkei* (Reichb.f.) Rolfe (*Esmeralda clarkei* Reichb. f.) (Orchidaceae)
Epiphytic. Robust orchid with large, attractive, yellowish-brown flowers. Occurs only in Sikkim and Bhutan; rare occurrence.
13. *Artemisia amygdalina* Decne. (Asteraceae)
Herb. A botanically interesting species with leaves like those of a willow (J.D. Hooker), known only from Pir Panjal, J. & K. State; extremely rare in occurrence.



Angiopteris evecta Hoffm.



Arachnanthe clarkei
(Reichb. f.) Rolfe.

14. *Arundina graminifolia* (D. Don) Hochr (Orchidaceae)
 Terrestrial, perennial plant. The 'bamboo orchid' with highly ornamental flowers. Distributed in Sikkim, Khasi Hills and Arunachal Pradesh; rare occurrence; horticultural value; exploited in trade.
15. *Astragalus strobiliferus* Royle (Papilionaceae)
 Herb. The only member of the Tragacanth group of Himalayan Astragali occurring in W. Himalaya; rare occurrence.
16. *Atropa acuminata* Royle ex Lindl. (Solanaceae)
 Herb. The 'Indian Belladonna', distributed in Himachal Pradesh and Kashmir; rare occurrence; exploited as a medicinal plant.
17. *Balanophora dioica* R. Br. (Balanophoraceae)
 Herb, clump-forming, fleshy, club-shaped parasite on tree roots in dense forests in the entire Himalayan region; of extreme rare occurrence; botanical interest (Also other species of *Balanophora*).



Arundina graminifolia
(D. Don) Hochr.



Balanophora dioica R. Br.

18. *Botrychium virginianum* Sw. (Ophioglossaceae)
Perennial. A pretty fern of botanical interest. Distributed in the Himalaya (Kumaon to Arunachal Pradesh), Khasi Hills, Peninsular India and Sri Lanka; rare occurrence.
19. *Brainea insignis* (Hook.) J. Sm (Blechnaceae)
Terrestrial fern. Distributed only in Khasi Hills in India; very rare; also occurs in Malay Peninsula.
20. *Camellia caduca* C. B. Cl. ex Brandis (Theaceae)
Shrub. Distributed in Sikkim, Bhutan, Arunachal Pradesh and Khasi Hills, rare occurrence; botanical interest.
21. *Catamixis baccharoides* T. Thoms. (Asteraceae)
Herb. An endemic species restricted to rock cliffs in U.P. Siwaliks; rare occurrence; botanical interest.
22. *Colchicum luteum* Baker (Liliaceae)
Herb. Endemic to N.W. Himalaya; rare occurrence; exploited in trade for its valuable alkaloid Colchicine.



23. *Coptis teeta* Wall. (Ranunculaceae)
Herb. Distributed in Mishmee Hills, Arunachal Pradesh; rare occurrence; heavily exploited in trade for its medicinal rhizomes—'Mishme Tee-ta', now under cultivation.
24. *Cyathea gigantea* (Wall. ex Hook.) Holtt. (Cyatheaceae)
The giant tree fern of botanical interest. Widely distributed in hilly regions of eastern and peninsular India, but nowhere abundant; exploited for starch by the local people; trunk used for growing epiphytic orchids.
25. *Cymbidium macrorhizon* Lindl. (Orchidaceae).
The only terrestrial leafless Indian Cymbidium. Distributed in N.W. Himalaya, Sikkim, Khasi and Naga Hills; rare occurrence; horticultural importance.
26. *Cypripedium cordigerum* D. Don (Orchidaceae)
Terrestrial herb. Highly ornamental "Lady's Slipper Orchid," once reported abundant at Gulmarg (Coventry's Wild Flowers of Kashmir, 1923), but has been sighted only once in the course of five visits (K.C. Sahn). Also scarce in Western Himalaya and Tehri-Garhwal region; extremely rare; threatened due to trade.
27. *Cypripedium elegans* Reichb.f. (Orchidaceae)
Terrestrial herb; flowers brownish, attractive. One of the ornamental "Lady's Slipper Orchids." Distributed in Lachen Valley, Sikkim and Eastern Tibet; rare occurrence; threatened due to trade.
28. *Cypripedium himalaicum* Rolfe (Orchidaceae)
Terrestrial herb; flowers showy, reddish or purplish-red. Distributed in Western Himalaya, Sikkim and Bhutan, rare occurrence, threatened due to trade.

Brainea insignis (Hook.) J. Sm.



29. *Cypripedium macranthon* Sw. (Orchidaceae)
Terrestrial herb with attractive large brownish-purple flowers. Distributed from Garhwal to Sikkim; rare occurrence; threatened due to trade.
30. *Dendrobium densiflorum* Wall. ex Lindl. (Orchidaceae)
Epiphyte. A highly ornamental orchid distributed in the tropical and subtropical forests of Nepal, Sikkim, Arunachal Pradesh and Khasi Hills but nowhere common; exploited in trade.
31. *Dianthus cachemiricus* Edgew. (Caryophyllaceae)
Herb. Apparently endemic in Kashmir; rare occurrence. (*D. chinensis* L. is cultivated in India for its perfume-yielding flowers).
32. *Didickea cunninghamii* King et Prain (Orchidaceae)
Terrestrial herb. An interesting monotypic orchid originally found in Sikkim and recently collected in Garhwal Himalaya after a lapse of seven decades; rare occurrence; botanical interest.
33. *Dioscorea deltoidea* Wall. ex Kunth (Dioscoreaceae)
Herbaceous climber. Western Himalaya; becoming scarce; threatened due to over-exploitation from the wild for its medicinally important tubers
34. *Dipteris wallichii* (R. Br.) Moore (Dipteridaceae)
Perennial herb. A fern of botanical interest. Distributed in Khasi and Jaintia Hills; recently discovered in Subansiri, Arunachal Pradesh; rare occurrence.
35. *Dischidia benghalensis* Colebr (Asclepiadaceae)
An interesting climber with fleshy leaves. Eastern Nepal, Sikkim, Assam; rare occurrence; botanical interest

Dendrobium densiflorum Wall. ex Lindl.



36. *Dischidia rafflesiana* Wall. (Asclepiadaceae)
A climber with pitcher-like leaves. Assam; rare occurrence; a botanical curio
37. *Drosera burmanni* Vahl (Droseraceae)
Herb. The well-known insectivorous 'Sundew' plant. Also the other species, *D. peltata* Sm. Both distributed from Himalaya to the east and south, scarcely distributed; botanical interest.
38. *Drosera indica* Linn. (Droseraceae)
Herb. In marshy habitats. Distributed in Deccan Peninsula, up to Chota Nagpur, recently reported from Birbhum (W. Bengal); sporadic; botanical interest
39. *Elaeocarpus prunifolius* (C. Muell.) Mast. (Elaeocarpaceae)
Tree. Distributed in Khasi Hills and Manipur; rare occurrence; botanical interest.
40. *Eremostachys superba* Royle ex Benth. (Lamiaceae)
An attractive large herb on the slopes of Dehra Dun Siwaliks. Threatened due to erosion of habitat.

***Dischidia rafflesiana* Wall.**

41. *Eria crassicaulis* Hook.f. (Orchidaceae)
Epiphyte. An attractive orchid with long racemes and pale purple-banded flowers. Distributed only in Khasi Hills; rare; horticultural value.
42. *Galeola lindleyana* Reichb.f. (Orchidaceae)
Tall, attractive, saprophytic orchid with tomentose yellow flowers. Sikkim, Khasi and Naga Hills. Also another species, *G. falconeri* Hk.f. with deep yellow flowers is found only in parts of Arunachal Pradesh; rare occurrence; botanical interest.
43. *Gastrodia exilis* Hook.f. (Orchidaceae)
Terrestrial herb, flowers white. A very singular orchid species (J.D. Hooker). Khasi Hills; rare occurrence; horticultural value.
44. *Gentiana kurroo* Royle (Gentianaceae)
A herb with beautiful, large, purple-blue flowers Western Himalaya, rare occurrence, medicinally important; exploited in trade.
45. *Hedysarum cachemirianum* Benth. ex Baker (Papilionaceae)
Herb. An attractive plant. Endemic in Kashmir; rare occurrence; botanical interest.
46. *Helminthostachys zeylanica* (Linn.) Hook. (Helminthostachyaceae)
Terrestrial, perennial fern. Distributed in submontane parts of north, north-east and peninsular India and deltaic Bengal, recently collected in Pilibmt district, U.P. sporadic in distribution, botanical interest.
47. *Helwingia himalaica* Hook.f. & Thoms. ex C.B.Cl. (Helwingiaceae)
Shrub. An attractive plant with epiphyllous flowers. Eastern Himalaya and Khasi Hills; rare occurrence; of great botanical interest.
48. *Ilex embelioides* Hook.f. (Aquifoliaceae)
Small tree. Distributed in Khasi Hills; rare.
49. *Iodes hookeriana* Baill. (Icacinaceae)
Woody climber with attractive panicles of yellow-red drupes. Khasi Hills (and Chittagong Hills, Bangladesh); rare occurrence; botanical interest; horticultural value.
50. *Lavatera kashmiriana* Camb. (Malvaceae)
Herb. 'The Kashmir Hollyhock' with pink flowers. Endemic in Kashmir; scarce.

51. *Lespedeza elegans* Camb. (Papilionaceae)
Endemic in Kashmir; sporadic in occurrence.
52. *Loropetalum chinense* Oliv. (Hamamelidaceae)
Small tree. Distributed in Assam and Arunachal Pradesh; scarce.
53. *Magnolia griffithii* Hook.f. & Thoms. (Magnoliaceae)
Tree. Endemic in Upper Assam; rare occurrence.
54. *Magnolia gustavi* King (Magnoliaceae)
Large tree. Endemic in Upper Assam, rare occurrence.
55. *Magnolia pterocarpa* Roxb. (Magnoliaceae)
Tall tree. Scarcely found in Assam and Arunachal Pradesh. Hutchinson (Evolution and Phylogeny of flowering plants, 1969) considers this plant to be perhaps the most ancient species of living flowering plants. Of considerable botanical interest.
56. *Meconopsis betonicifolia* Franchet (Papaveraceae)
Perennial herb. Blue poppy of the Eastern Himalaya, also found in S.E. Tibet, Northern Burma and Yunnan; very rare in the wild, exploited for trade; introduced into cultivation in Kew Botanic Gardens in 1924 and now grown in Europe.



57. *Nardostachys grandiflora* DC. (Valerianaceae).
Perennial herb. The Himalayan spikenard with aromatic rhizomes (Jatamansi). Alpine Himalaya; rare occurrence; exploited in trade.
58. *Nepenthes khasiana* Hook.f. (Nepenthaceae)
Climbing under-shrub. The Indian insectivorous pitcher plant. Endemic in Khasi and Garo Hills; rare; botanical curio. The populations have dwindled due to excessive collections by traders and students of botany.
59. *Olax nana* Wall. (Olacaceae)
Shrub. Scarcely found on the crest of Saharanpur Siwaliks (W. Himalaya), W. Bengal, Assam and Meghalaya; rare occurrence.
60. *Ormosia glauca* Wall. (Papilionaceae)
Tree. Distributed in Nepal, Darjeeling, recently reported from Assam; rare and sporadic in occurrence.
61. *Osmunda regalis* Linn. (Osmundaceae)
Perennial shrub. The Royal Fern. Scattered in Kumaon, Eastern Himalaya, Khasi Hills, Pachmari Hills, and peninsular India, but nowhere abundant; botanical interest.

***Nepenthes khasiana* Hook. f.**



62. *Paphiopedilum druryi* (Bedd.) Pfitz. (Orchidaceae)
Terrestrial herb, flowers yellowish-green with reddish-purple blotches and streaks. Endemic in Travancore Hills, W. Ghats; rare occurrence.

63. *Paphiopedilum fairieanum* (Lindl.) Pfitz. (Orchidaceae)
Terrestrial herb. The "Asian Lady's Slipper Orchid" with large attractive greenish or creamy, reddish and purple-veined flowers. Endemic in Kameng (Arunachal Pradesh) and Bhutan; very rare occurrence; threatened due to habitat destruction and indiscriminate collections for trade.

64. *Paphiopedilum hirsutissimum* (Lindl.) Pfitz. (Orchidaceae)
Terrestrial herb with large violet-purple flowers of ornamental value. Endemic in Khasi Hills; becoming extremely rare due to indiscriminate collections from the wild.

***Paphiopedilum fairieanum* (Lindl.) Pfitz.**



Paphiopedilum hirsutissimum
(Lindl.) Pfitz.



65. *Paphiopedilum insigne* (Wall.) Pfitz. (Orchidaceae)
Terrestrial herb, with attractive greenish, purple-spotted flowers. Sparsely distributed in E. Himalaya, Khasi Hills and Nepal; becoming very scarce due to habitat destruction and over exploitation in trade.
66. *Paphiopedilum spicerianum* (Reichb. f.) Pfitz. (Orchidaceae).
Terrestrial scapigerous herb; flowers with purplish sepals and yellow or olive green, red spotted petals and brownish-crimson tinged lip. Endemic in Cachar Hills, Assam; rare occurrence.
67. *Paphiopedilum venustum* (Lindl.) Pfitz. (Orchidaceae)
Terrestrial herb with blotched leaves; flowers showy and ornamental with white dark striped sepals and greenish-purple warty petals. Distributed in tropical Sikkim Himalaya and Meghalaya, becoming rare due to clearing of forests and over-exploitation from the wild.

***Paphiopedilum insigne* (Wall.) Pfitz.**

- 68 *Paphiopedilum villosum* (Lindl.) Pfitz.
(Orchidaceae)

Terrestrial herb, flowers large, ornamental, purplish-brown. Distributed in Mizoram (Lushai Hills) and Moulmein, Tenasserim (Burma), extremely rare and threatened due to indiscriminate collections from the wild.

- 69 *Phyllostachys bambusoides* Sieb. & Zucc.
(Poaceae)

Shrub. A Sino-Japanese bamboo. Distributed in Arunachal Pradesh, rare occurrence.



***Paphiopedilum villosum* (Lindl.) Pfitz.**



70. *Picea brachytyla* Pritz. (Pinaceae)
Tree. A Chinese spruce with restricted distribution in Arunachal Pradesh; also occurs in N. Burma, Western Hupeh, and W. Yunnan (China).
71. *Platycterium wallichii* Hook. (Polypodiaceae)
Epiphytic fern. Recently collected from Manipur; very rare; earlier known from Malay Peninsula, Tenasserim.
72. *Pleione humilis* D. Don (Orchidaceae)
Epiphytic herb. A pretty orchid. Distributed in Khasi Hills and Arunachal Pradesh; recently reported from Kumaon, W. Himalaya; rare occurrence; exploited in trade.

← *Platycterium wallichii* Hook.

Pleione humilis D. Don. →





73 *Podophyllum hexandrum* Royle (Podophyllaceae)
Herb. The Himalayan may-apple. Widely distributed, but nowhere abundant. Heavily exploited for its medicinal value.

74. *Populus gamblei* Dode (Salicaceae)
Tree. 'Poplar'. Distributed in Eastern Himalaya; rare.

***Podophyllum hexandrum* Royle**

75. *Potameia paradoxa* (Hook.) Koster. (Lauraceae)
Tree. A curious plant with 1-celled anthers; only once collected from Bhutan; rare occurrence; botanical interest.
76. *Psilotum nudum* (Linn.) Beauv. (Psilotaceae)
Perennial herb. A fern-ally of botanical interest. Widely distributed in India, but nowhere common; botanical interest.
77. *Rauvolfia serpentina* (Linn.) Benth. ex Kurz (Apocynaceae)
Shrub. A very important medicinal plant of widespread distribution. Now scarce in the wild due to over-exploitation; cultivated.
78. *Renanthera imschootiana* Rolfe (Orchidaceae)
Epiphytic herb. A climbing orchid with showy yellow, red-spotted petals and red-flushed lateral sepals. Distributed in Assam region, (Also in Indo-China); rare occurrence; of ornamental value.
79. *Rheum nobile* Hook.f. & Thoms. (Polygonaceae)
Perennial herb. The rhubarb of eastern Himalaya (400–4500 m); rare; exploited for its leaves used as substitute for tobacco.
80. *Rhododendron arizelum* Balf. & Forr. (Ericaceae)
Tree with highly ornamental rose-pink flower bunches. Discovered as new to India from Subansiri district, Arunachal Pradesh; rare occurrence; not reported from other parts of the eastern Himalaya.
81. *Rhododendron dalhousiae* Hook.f. (Ericaceae)
A shrubby rhododendron with attractive large flowers; occurs in Eastern Himalaya; rare occurrence; exploited for horticultural purpose.
82. *Rhododendron edgeworthii* Hook.f. (Ericaceae)
An epiphytic ornamental shrub, reported from Arunachal Pradesh; rarely collected; exploited for horticultural value.
83. *Rhododendron nivale* Hook.f. (Ericaceae)
Epiphytic herb. The smallest of rhododendrons, only 5 cm high, distributed in eastern Himalaya at an altitude of 5000 m; rarely collected; botanical interest.
84. *Rhododendron nuttallii* Booth (Ericaceae)
Tree or epiphytic shrub; flowers large white with creamy base, sweet scented. Distributed in Bhutan and Daphla Hills, Arunachal Pradesh; rarely collected.



85. *Rhododendron santapau* Sastry *et al.* (Ericaceae)
Pretty epiphytic shrub with white starry flowers.
Collected so far only from Subansiri district,
Arunachal Pradesh; very rare; endangered due to
clearing of forests.

Rhododendron santapau Sastry *et al.*

86. *Rhododendron stenaulum* Balf. & W.W. Sm. (Ericaceae)
Tree. Flowers white, fragrant. Discovered as new to India from Apathani Valley, Subansiri district, Arunachal Pradesh. Only one tree was seen; rare occurrence; threatened due to clearing of forests in the Valley.
87. *Rhus hookeri* Sahnii & Bahadur (Anacardiaceae)
Small tree. Endemic in Eastern India; rare occurrence.
88. *Sapria himalayana* Griff. (Rafflesiaceae)
A root parasite of botanical interest. flowers ca 15 cm across. First collected in 1836 from Mishmee Hills, then collected after a century from Aka Hills, recently collected from Lohit district; distributed only in Arunachal Pradesh; very rare; of considerable botanical interest.
89. *Saussurea bracteata* Decne. (Asteraceae)
Herb. A delicately fragrant species of western Himalaya; rare occurrence.
90. *Saussurea gnaphalodes* (Royle) Sch.-Bip. (Asteraceae)
A curious woolly herb of high altitude slopes of western Himalaya; rare occurrence.
91. *Saussurea lappa* C.B. Cl. (Asteraceae)
Herb. Endemic to Kashmir and Himachal Pradesh. Extensively exploited from the wild in the past; scarce and needs protection in the wild. The 'Kuth' of commerce now under cultivation.
92. *Schizaea digitata* Sw. (Schizaeaceae)
A perennial fern with discontinuous distribution in Khasi Hills, Chittagong Hills, Sri Lanka and Malaysia; rare occurrence; botanical interest.
93. *Tetracentron sinense* Oliv. var. *himalense* Hara & Kanai (Tetracentraceae)
A primitive vesselless dicotyledonous plant. Distributed in eastern Nepal, Bhutan and Arunachal Pradesh; rare occurrence; of considerable botanical interest.
94. *Thylacospermum rupifragrum* Schrenk (Caryophyllaceae)
Herb. Monotypic cushion-forming plant of alpine Himalaya; rare; of botanical interest.



95. *Vanda coerulea* Griff. (Orchidaceae)
Epiphytic. Blue-Vanda' of Asia, most beautiful of Vandas. Distributed in Khasi & Jaintia Hills and Naga Hills; recently discovered in Tirap district, Arunachal Pradesh. Excessively exploited from the wild for ornamental purpose; now very scarce in the wild.
96. *Vanda pumila* Hook.f. (Orchidaceae)
Epiphytic herb. Occasionally found in Sikkim and Bhutan; rare in the W. Himalaya.
97. *Vanilla ptilifera* Holtt. (Orchidaceae)
Climbing orchid with fleshy leaves and creamy flowers. Garampani sanctuary (Assam); very rare. Also distributed in Malaya.

Vanda coerulea Griff.

Vanilla ptilifera Holtt.



98. *Viola falconeri* Hook. f. & Thoms. (Violaceae)
A pretty herb. Endemic in Kashmir; rare occurrence

99. *Zanthoxylum scandens* Bl. (Rutaceae)
Straggling shrub. Distributed in Khasi Hills; rare occurrence

RAJASTHAN AND GUJARAT

100. *Commiphora wightii* (Arn.) Bhandari
(Burseraceae)
Small tree. Exploited in the past for its gum-resin from the bark. Distributed in Rajasthan and Gujarat in India; reported becoming scarce due to over-exploitation; presently cultivated.

101. *Helichrysum cutchicum* (C. B. Cl.) Rao et Deshpande (Asteraceae)
Herb. Endemic in Gujarat; rare occurrence.

102. *Hyphaene dichotoma* (Baker) Furtado (*H. indica* Becc.) (Arecaceae)
The Indian Doum Palm, curiously branching. Distributed only in W. Coast regions; botanical interest

103. *Rosa involucrata* Roxb. (*R. Iyellii* Lindl.)
(Rosaceae)
Subscandent shrub. Widely distributed in India; reportedly becoming scarce at Mt. Abu in Rajasthan due to clearing of forests.

GANGETIC PLAIN

104. *Aldrovanda vesiculosa* Linn. (Droseraceae)
Aquatic herb, probably monotypic, carnivorous plant of botanical interest. Reported from salt pans near Calcutta; recently reported from Manipur and Bangladesh. Its habitat near Calcutta (Salt Lake Area) is threatened due to reclamation.

PENINSULAR INDIA

105. *Anemia tomentosa* Sw. (Schizaeaceae)
Terrestrial fern. Distributed in Nilgiri, Annamalai, Pulney Hills; rare occurrence.
106. *Apama barberi* Gamble (Aristolochiaceae)
Shrub. Endemic in Tirunelveli Hills; rare occurrence.
107. *Bentinkia condapanna* Berry ex Roxb. (Arecaceae)
A reed-like palm. Endemic in Kerala and Tirunelveli Hills; botanical interest; rare occurrence.
108. *Ceropegia fantastica* Sedgw (Asclepiadaceae)
Slender climber. Described by Sedgwick in 1921, based on a single collection from N. Kanara, and known only from Holotype (Kew) until 1963, when this species was again collected in Goa (BSI-WC); very rare.
109. *Cycas beddomei* Dyer (Cycadaceae)
Palm-like tree. Endemic to Cuddapah Hills, S. India; rare.
110. *Dioscorea wightii* Hook.f. (Dioscoreaceae)
Twining climber with tuberous roots. Endemic in Tirunelveli Hills and recently collected after 100 years from Type locality; very rare.
111. *Entada pursaetha* DC. (Mimosaceae)
Large woody climber with gigantic pods of botanical interest. Distributed in Himalaya, Assam and W. Peninsula; becoming rare due to large scale clearing of forests.



112. *Frerea indica* Dalz. (Asclepiadaceae)
Undershrub. Endemic in W. Ghats, S. India, rare occurrence.
113. *Gnetum ula* Brongn. (Gnetaceae)
Extensive woody climbing gymnosperm of botanical interest. Chiefly distributed in W. Ghats; becoming rare due to large scale clearing of forests.
114. *Hoya wightii* Hook f (Asclepiadaceae)
Large perennial climber, often becoming totally epiphytic. Endemic to W. Peninsula; becoming scarce due to clearing of forests and habitat destruction.
115. *Lilium neilgherrense* Wt. (Liliaceae)
The Nilgiri-lily. Endemic to the Nilgiris and a few high mountain ranges in S. India, rare occurrence.
116. *Lobelia nicotianaefolia* Roth ex Roem. & Schult. (*L. excelsa* Leschen.) (Lobeliaceae)
Herb. Distributed in W. Ghats, rare occurrence.

Frerea indica Dalz.

117. *Loeseneriella bourdillonii* (Gamble) Ramam. (*Hippocratea bourdillonii* Gamble) (Hippocrateaceae)
Climbing shrub. Endemic to S.W. India; rare occurrence.
118. *Manisuris divergens* (Hack.) Kuntz. (Poaceae)
Tufted grass. Endemic to Peninsular India; collected after 130 years from Coorg district; rare occurrence. All the 12 species of *Manisuris* found in India are endemic, ten of them confined to South India.
119. *Piper barberi* Gamble (Piperaceae)
Climbing shrub with pinnately-veined leaves; endemic in Tirunelveli Hills; botanical interest; rare occurrence.
120. *Podocarpus wallichianus* Presl (Podocarpaceae)
Tree. The only native Peninsular conifer of India, also occurs in E. Himalaya, Khasi Hills and Nicobar Island; rare occurrence.
121. *Pterocarpus santalinus* Linn. f. (Papilionaceae)
Tree. Endemic in Cuddapah district, S. India; the Red Sanders of commerce, exploited much in the past for its beautiful red wavy-grained wood. Export already banned.
122. *Pterospermum obtusifolium* Wt. (Sterculiaceae)
Tree. Distributed in Malabar and Karnataka; rare occurrence.
123. *Santalum album* Linn. (Santalaceae)
Tree. Usually semi-parasitic. Occurs in Peninsular India. Sandal wood of commerce, much exploited in trade, becoming rare (now cultivated).

ANDAMAN & NICOBAR ISLANDS

124. *Ailanthus kurzii* Prain (Simaroubaceae)
Tall tree. Endemic in Andaman Islands; becoming rare due to clearing of forests and not collected during the recent botanical explorations in these islands.
125. *Canarium mannii* King (Burseraceae)
Tree. Distributed in Middle Andaman Island. Parkinson reports it as not uncommon but this species has not been collected during the recent botanical explorations; probably becoming rare.
126. *Dipterocarpus kerrii* King (Dipterocarpaceae)
Tall tree. Occurs in South Andaman. Seen only in the Goplakabang Valley, where a sample plot of

it has been made'' (Parkinson, For Fl. Andaman Island, p. 93, 1923). This species has not been collected during the recent botanical explorations in Andaman Islands; rare.

127. *Hippocratea nicobarica* Kurz (Hippocrateaceae)
Climbing shrub. Sparsely distributed in tropical forests of eastern coast of Katchall Island (Nicobar group); rare occurrence; not collected during recent botanical explorations.
128. *Lagerstroemia hypoleuca* Kurz (Lythraceae)
Tree. Widely distributed in Andamans. This species is one of the important timber yielding trees and has been exploited much; becoming scarce in wild.
129. *Myristica andamanica* Hook. f. (Myristicaceae)
Tree. Distributed in Middle Andaman, South Andaman and Porlob Islands; becoming scarce due to clearing of forests. Not collected in the recent botanical explorations.
130. *Ophioglossum pendulum* Linn. (Ophioglossaceae)
Epiphytic herb with long ribbon like fronds. Recently reported from Campbell Bay, Great Nicobar Island; rare occurrence; botanical interest.
131. *Podocarpus neriifolius* D. Don (Podocarpaceae)
Tree. The only conifer of the Andamans, although widely distributed; exploited for its valuable timber; becoming scarce in these Islands.
132. *Psilotum complanatum* Sw. (Psilotaceae)
Epiphytic pendulous herb. Recently reported from Great Nicobar Island; rare occurrence; botanical interest.
133. *Symplocos odoratissima* (Bl.) Choisy ex Zoll. (*S. chengapae* Raizada & Sahni) (Symplocaceae)
A shrub or tree. Distributed in Great Nicobar Island; rare occurrence. Also occurs in Indonesia, Malaya, Singapore and Philippines.
134. *Uvaria nicobarica* Raizada & Sahni (Annonaceae)
Woody climber. Endemic in Great Nicobar Island; rare occurrence.

WORK DONE IN INDIA ON THREATENED SPECIES AND THEIR HABITATS

In recent years, the interest in botanical exploration work in the country gained importance and several botanical accounts of different unexplored and underexplored regions in the country detailing vegetation and floristic lists have been published by botanists from

Botanical Survey of India and other research institutions. Although no direct mention of rare and endangered plants and their habitats was generally made in such papers, some data did exist on rare plants, endemics and biotic factors in those areas.

The 11th Technical meeting of the International Union for Conservation of Nature and Natural Resources held at New Delhi in November 1969, marked the beginning of the new thinking on the subject in its proper perspective. In this four-day meeting, papers were presented by several Indian scientists (Maheshwari 1970, Qureshi & Kaul 1970, Sahni 1970, Santapau 1970 and Subramanyam & Sreemadhavan 1970). These papers were based mostly on information contained in the earlier botanical papers and some studies in herbaria. Subsequently more papers have been published on rare and endangered plants of India (Subramanyam & Jain 1972, Jain 1976 & 1978 a,b, and Jain & Hajra 1976).

Recently, the National Seminar on "Resources, Development and Environment in the Himalayan Region" organized by the National Committee on Environmental Planning and Coordination provided a forum for discussions on aspects of conservation of natural resources in the Himalayan region. Several recommendations were made with regard to Plant and Animal Resources,

Agriculture, Forests & Forestry, Soil and Water Management, Human Settlements, Tourism, Roads, Energy, General Recommendations and Training to local people (Anon. 1978).

GAPS IN OUR KNOWLEDGE ON RARE AND ENDANGERED INDIAN PLANTS

The main lacunae in our knowledge with regard to this subject lie in the present actual status of the species, i.e. the exact number and location of populations of these species occurring in the wild, quantities or the numbers collected for economic exploitation or other purposes, their capacity to reproduce and propagate themselves in nature and their populations or representatives in cultivation under artificial conditions in farms or experimental gardens.

Such observations can be made by repeated visits to the field and need concerted efforts of several botanists and constant monitoring. It is naturally a huge task for a country of the size of a sub-continent. A recent close study of the orchid genus *Coelogyne* serves as a good example (Das & Jain 1979). Four species of the genus, viz. *C. albo-lutea*, *C. treutleri*, *C. brevifolia* and *C. assamica*, are known only by their mention in literature and types (specimens/illustrations). These could not be

located even in their Type localities, inspite of several recent botanical explorations and are believed to have become extinct. Excepting the types, even their preserved specimens are not available in any herbarium. Only such intensive library, field and herbarium studies can reveal the real status of our threatened taxa. Similarly, the recent discovery of the Indian Pitcher Plant, *Nepenthes khasiana* in Garo Hills near Tura, a locality other than its known type locality near Jowai, also highlights the need for intensive botanical explorations and constant monitoring of the floras in the country.

ACTION TAKEN TO SAVE THE RARITIES OF INDIAN FLORA

On the recommendations of the Botanical Survey of India and other concerned agencies, the Government of India has imposed restrictions or complete ban on the export of certain species (a list appended). The Wild Life Wardens/Chief Conservators of Forests in each State have been appointed as custodians of flora and fauna to check illegal trade practices in these species. They can be exported only when certified by specified authorities (presently the Director Wild Life)

India is also one of the signatories to the Convention on the International Trade in Endangered Species of Wild

Fauna and Flora (CITES, 1973); it has been ratified so far by 43 countries of the world, for strict regulation and control of trade. The names of such species are included in Appendices I, II & III in the Convention Hand-book. The whole family Orchidaceae is included in the Appendix. According to the Convention, if a listed species is even smuggled out of a country, the country of destination will co-operate by obstructing the consignment (Anon. 1976).

The National Committee on Environmental Planning and Coordination (NCEPC)* and the National Committee on Man and Biosphere (MAB) have also been concerned with the protection of habitats having natural vegetation. Several such areas have been identified for conservation and preservation as 'Biosphere Reserves', throughout the country. It is also proposed to set up 'Germ Plasm Banks' and 'Gene Sanctuaries' to protect the areas rich in wild relatives of certain economic and cultivated plants.

The Botanical Survey of India with its main Botanic Garden at Sibpur, and the regional experimental gardens established at different altitudinal situations to suit the acclimatization of plants occurring in different ecological

*Professor B.P. Pal, F.R.S. is Chairman of the NCEPC. The Secretariat of the NCEPC and MAB are in the Department of Science and Technology, New Mehrauli Road, New Delhi-110 029.

conditions in the country, have in their holdings rare, endemic and threatened plants. Several species of orchids are also under cultivation and protection in the National Orchidaria at Shillong, Yercaud and Calcutta. Of these, *Vanda coerulea* (Blue Vanda), *Dendrobium nobile*, *Cymbidium grandiflorum*, *Renanthera imschootiana* and species of *Paphiopedilum* and *Pleione* growing in Shillong deserve special mention.

The Government of Meghalaya State has taken action on the recommendation of the Botanical Survey of India, and declared the *Nepenthes khasiana* habitats as 'protected areas' to preserve the plants *in situ*.

FUTURE PROGRAMME OF WORK IN THE BOTANICAL SURVEY OF INDIA

In order to fill the gaps in our knowledge on threatened plants, the following studies are being undertaken by the Survey:

1. A review of literature and study of herbarium specimens of endangered or rare species deposited in the various herbaria of the country to collect data on the distribution, abundance and frequency.

2. Fresh explorations to areas for collection of plants and data on rare/endangered species with regard to their

present distribution, abundance, frequency and phenological data.

3. Collection of live plants for introduction into the botanical gardens for protection and further studies on propagation.

4. Preparation of distribution maps of rare and endangered plants.

5. Preparation of an illustrated book on rare and endangered plants.

6. Preparation of an identification manual of plants banned for export, to facilitate proper identification and for education of public.

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**LIST OF IMPORTANT SPECIES THE EXPORT OF WHICH IS BANNED
OR RESTRICTED OR NEEDS SPECIAL EXPORT PERMIT**

<i>Aconitum</i> spp.	<i>Lobelia nicotianaefolia</i> Roth ex Roem. & Schult.
<i>Angiopteris evecta</i> (Forst) Hoffm.	<i>Lycopodium phlegmaria</i> Linn.
<i>Botrychium virginianum</i> Sw.	<i>Magnolia pterocarpa</i> Roxb.
<i>Bursera dalpechiana</i> Poiss. ex Engl.	<i>Meconopsis betonicifolia</i> Franch.
<i>Colchicum luteum</i> Baker	<i>Nardostachys grandiflora</i> DC.
<i>Coptis teeta</i> Wall.	<i>Nepenthes khasiana</i> Hook.f.
<i>Cyathea</i> spp. (<i>Alsophila</i>)	Orchids (All spp. from the wild)
<i>Cycas beddomei</i> Dyer	<i>Orthosiphon stamineus</i> Benth.
<i>Dioscorea deltoidea</i> Wall. ex Kunth	<i>Osmunda regalis</i> Linn.
<i>D. prazeri</i> Prain et Brkill	<i>Podophyllum hexandrum</i> Royle
<i>Dischidia rafflesiana</i> Wall	<i>Primula</i> spp. of the Himalayas
<i>Drosera</i> spp.	<i>Psilotum nudum</i> Wt.
<i>Garcinia echinocarpa</i> Thw.	<i>Pterocarpus santalinus</i> Linn.f.
<i>Gnetum scandens</i> Roxb.	<i>Pterospermum obtusifolium</i> Wt.
<i>Helminthostachys zeylanica</i> Hook.	<i>Rauvolfia densiflora</i> Benth. ex Hook.f.
<i>Hippocratea</i> spp.	<i>R. serpentina</i> (Linn.) Benth. ex Kurz
<i>Inula racemosa</i> Hook. f. p.	<i>R. tetraphylla</i> Linn.
<i>Isoetes coromandelina</i> Linn.	<i>Rheum emodi</i> Wall. ex Meissn.
<i>I. sahyadrii</i> Mahabale	<i>Santalum album</i> Linn.
<i>I. sampathkumaranii</i> Rao	<i>Saussurea lappa</i> C. B. Cl.
(Jute Seeds)— <i>Corchorus</i>	<i>Schizaea digitata</i> (Linn.) Sw

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