AN ASSESSMENT OF THREATENED PLANTS OF INDIA

Edited by

S. K. JAIN and R. R. RAO

BOTANICAL SURVEY OF INDIA

(DEPARTMENT OF ENVIRONMENT)

HOWRAH

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(Proceedings of the Seminar held at Dehra Dun, 14 17 September, 1981).

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EDITORS' NOTE

To create awareness about conservation of threatened plants, the International Union for Conservation of Nature and Natural Resources (IUCN) have published a volume of the Red Data Book dealing with about 250 plants. Some International Symposia have also been held on the subject. A knowledge of Flora is essential for evaluation of threat and rarity, and hence the Botanical Survey of India organised a symposium on Floristic Studies in India in 1977. The full papers of this symposium have also been published (Bull. bot. Surv. India 19, 1977 publ. 1979). The publication of this volume and simultaneously of several fascicles of Flora of India stimulated floristic and taxonomic studies in India. These studies made it evident that (i) precise information on endemism is generally wanting and (ii) the status of threatened taxa needs to be evaluated.

Till few years ago, the studies on endemism and rarity or conservation of plants had received very little attention in our country and except for a few publications, there was very little information on this subject. An acute need was, therefore, felt to assess the present situation, locate important lacunae and stimulate studies on threatened plants on as large scale as possible.

A seminar on 'Threatened Plants of India' was organised at Dehra Dun during 14-17 September 1981. Several useful recommendations were made and these are given after this Note.

In all, over 60 contributions were received representing about thirty educational and research institutions. In the present volume these papers have been put under six groups, viz., (i) north-western Himalayas (ii) western and central India (iii) eastern India (iv) peninsular India and Andaman and Nicobar Islands (v) special groups and (vi) cryptogams.

Some editorial changes have been made in order to bring uniformity in style of presentation. As considerable time had already elapsed since the symposium was held in 1981, to avoid further delay of this publication, proofs could not be sent to authors.

Naturialists in India and aborad would have noted with much satisfaction that the Recommendations of the 1981 Seminar have generated, during last two years, not only much work and data on this subject, but also great awareness, concern and concrete action for study and conservation of endangered biological resources in this region.

We hope that this publication will be useful to all those who are interested in natural heritage of India in general, and the rare and endangered plants and their conservation in particular.

Many institutions, scientists and others helped in the organisation of the seminar, and it is not practicable to thank all of them individually by name. The Department is grateful to all of them. The help rendered by the staff and scholars of the B.S.I. needs particular mention and appreciation.

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S. K. JAIN
R. R. RAO
(Editors)

SEMINAR ON 'THREATENED PLANTS OF INDIA' (DEHRA DUN, 14-17 Sept. '81) RECOMMENDATIONS

It is recommended that :

(1) A very select list of species, which are in immediate danger of extinction and which need protection/rehabilitation, be drawn up after collating the data presented by the various speakers during the Seminar and other available work. This list should identify the following priorities: (a) Species in immediate danger of extinction; (b) Species seriously threatened; (c) Species of rare occurrence and of unique botanical and/or economic interest including endemics.

Assessment be made for each one of these species regarding (a) present status, (b) distribution, (c) habitat and ecology, (d) biology and potential value, (e) cultivation, (f) description and illustrations available. Gaps in available information on the above aspects to be filled by circulating the data sheets to workers in the area concerned. To make it practical, initially a list of 100-200 species be drawn and work started on those species.

(2) that an effective communication be developed between Botanical Survey of India and the University Botany Departments and other research institutions engaged in such studies, to implement the objective outlined in (1) above.

(3) that an effective convention be established for the deposition of specimens/data in regard to the categories of species mentioned under (1), at the Central National Harbarium Calcutta. Duplicates may be deposited in any other recognized herbaria of the country e.g. FRI, NBRI and Blatter Herbarium at Bombay.

(4) that special exploration parties be sent to specified areas for making quantitative assessment of the present status of the species in immediate danger.

(5) that selected, limited areas from all over the country, rich in very rare, botanically interesting, economically important plants including wild relatives of cultivated plants be declared as Sanctuaries where collection of plants is strictly prohibited or regulated. As examples, an Orchid Sanctuary, a Rhododendron Sanctuary, an Alpine Sanctuary, an Island Sanctuary, a desert National monument, sacred groves, etc. are suggested. These are in addition to those areas which are already declared as protected ones (Biosphere Reserves) under various other projects/programmes like MAB, National Parks, etc.

(6) that publicity folders relating to the need for exercising discrimination in collection of scarce material (like fern allies, insectivorous plants, etc.) commonly required for the class room be widely distributed among the institutions so that the students are enabled to appreciate the danger of over-collecting and destruction of habitats due to indiscriminate collection. To create awareness about rare plants, postal stamps be printed on such species, and literature be created for children.

(7) that a permanent coordination cell/unit be set up at the Headquarters of the BSI to oversee the implementation of the above recommendations. If there is no provision for this in the schemes of the Department at present, Government may be approached for necessary action in the present Plan itself. Till then, POSSCEF may coordinate the activities in this regard.

(8) that arrangements be made for wider and more effective distribution of the booklet already prepared by the Deptt. of BSI regarding methodologies of collection of data in the field and Herbarium and clear definitions of the expressions: "Rare", "Threatened", "Endangered", "Endemic flora", etc. be circulated.

(9) that priority be given for the publication of results of the workers in the various scientific institutions/University Deptts. relating to such rare/threatened/endemic species; if need be a special supplement of the Bulletin of the BSI be brought out at periodic intervals.

(10) Some space be provided/allotted in each Botanical and Zoological Garden for growing rare plants. The Zoological gardens be preferably called Biological Gardens.

(11) Cryptogamic flora should also be kept in view in all conservation programmes.

(12) To avoid wastage of effort on superfluous names or doubtful taxa, the taxonomy of threatened species be sorted out.

PROGRESS ON RECOMMENDATIONS

The progress made on these Recommendations in last two years is mentioned below in brief :

1. List of species which are considered rare or threatened have been published for several states or regions of India. Many of these have a mention of status of taxa. A list of one hundred priority species has also been prepared, mainly for the purpose of multiplication of plants.

Work has been initiated on evaluation of threats and occurrence of rare species. An account of rare orchids of northeastern India, illustrated with distribution maps has been prepared.

2. Studies have been taken up jointly with some universities and colleges on detailed microlevel floristic studies in selected districts of the country.

3. Most taxonomists working on higher plants are depositing types of their new taxa in the Central National Herbarium, and isotypes in regional herbaria.

4. Special field work has been done on certain rare or endemic plants like species of *Coptis, Paphiopedilum, Carex, Calanthe, Hedychium, Isachne, Swertia, Sedum, Gentiana,* etc.

5. The Directorate of Wild Life in the Department of Environment and state governments have greatly intensified activities on protected areas and increased the number of national parks and sanctuaries in the country. The ecosystems of some proposed sites for biosphere reserves are under study.

6. Publicity literature has been brought out in the form of picture postcards, calendars, posters and booklets, and programmes like essay competitions, nature study camps and sit-and-draw competitions organised by several official and nongovernmental organisations. Steps have been taken also to include education in conservation in school syllabi.

7. Some plan programmes and funded projects aimed at the study of ecosystems and threatened plants, and for promoting and coordinating conservation activity have been initiated in the Botanical Survey (BSI) and certain other institutions.

8. The Plant Conservation Bulletin started by the POSSCEF in the BSI has articles on definitions of many conservation terms. Four numbers of this Bulletin have been published.

9. A special section called *CONSERVATION SUPPLEMENT* has been added to the Bulletin of BSI; it contains articles only on endemic taxa.

10. The experimental gardens of the BSI have set apart sections for rare plants. The programme has yet to be adopted by Zoological gardens. A directory of Botanic Gardens in India was brought out, as also the draft of a GREEN BOOK containing a list of rare plants being grown in gardens of BSI.

11. Cryptogams, particularly the vascular cryptogams, have received attention now. To facilitate evaluation of their status in India, a Dictionary of Ferns of India has been prepared.

12. A preliminary catalouge of about 800 threatened plants of India has been prepared; and as far as possible the taxonomy and nomenclature have been updated.

It is realized that much more remains to be done in the area of study and conservation of threatened plants of India.

INAUGURAL ADDRESS

Prof. M. B. Raizada. *F.N.A.*,
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It gives me great pleasure to be here in the midst of you all and to have the opportunity of addressing the distinguished gathering of botanists of our country at the inaugural function of the seminar on "Threatened Plants of India" organised here at Dehra Dun by the Botanical Survey of India.

It is now realised all over the world that several thousand species of plants and animals are threatened; many are critically rare and a few already extinct. Studies in some parts of the world have shown that on an average about 10% of vascular plants fall into one or the other category of threatened species. Many countries in the world started taking stock of their rare plants more than a decade ago and have by now developed provisional or fairly accurate lists of their flora. Some work on this aspect has been initiated in our country also and accounts of 108 and 134 such species were recently published by the Forest Research Institute and the Botanical Survey of India, respectively. Ironically, most of the species in the two works are common. Many species of our flora have not been collected for many decades, some over a century. Several species are only known by their type collections; in some cases even these types do not exist in Indian herbaria. It is necessary to bring out all such lacunae in our collections and knowledge so that intensive search may be made for them in the field or in the herbarium. One of the important sources of information on rare plants is personal knowledge and observations of field botanists and foresters. They must get together, discuss the relevant issues and decide the future course of action. This is precisely why this seminar is being organised, which could not have been more timely, considering that it will bring out a fairly correct assessment of our endangered flora which will no doubt be an asset, in the light of the envisaged "Regional Workshop on Conservation of Tropical Plant Resources in South East Asia" which has been sponsored by the Department of Environment, Government of India and will be held in 1982 in Delhi.

India with its varied climate, high mountains in the north and sea on the other three sides, supports a rich flora of tropical, sub-tropical, temperate and alpine vegetation. Our country is third richest in the world after Brazil and the U.S.S.R. in the number of plant species. It is estimated that over 15,000 species of Angiosperms and Gymnosperms occur in India, of which approximately

1/3rd are woody species. It is also common knowledge that our forests with all this vegetation are gradually decreasing. Whereas we should have at least 33% of forest cover in order to have harmonius ecosystems, we are at present left with a mere 23%. Activities such as conservation of flora and afforestation should, therefore, go hand in hand and must be given top priority. Other spheres where concerted efforts are necessary are the preparation of identification manuals, regional and national floras and publications with regard to the development of the habitats, work on endemism and the effects of allien and exotic plants on our native flora. These call for coordinated studies by our Botanists and Forest Officers and their role in these important tasks cannot be over-emphasised.

Increased human population in the last few decades demanding development in various spheres has resulted directly or indirectly in 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 land, shifting cultivation, defence activities and mining operations are examples of direct onslaughts on nature, which have steadily depleted our natural resources. Besides, pollution resulting from urbanisation, industrialisation, excessive use of chemical fertilizers and pesticides have in no small way, contributed to the environmental eco-imbalances, affecting the very survival of Wild Life.

While the rapid disappearance of some beautiful animals due to man's activities resulted in a realisation of the urgent need for protection of such fauna, the situation remains unchanged for flora where surprisingly not much has been said or done to protect our even more valuable wild plant life of India. Conservationists and naturalists gave their attention only to conservation of animal species in the impression that wild life meant animal life! It was only in the year 1968 at a Conference of UNESCO 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 other international and national organisations to initiate work on these problems including the protection and preservation of wild flora in natural habitats/ecosystems by establishment of Nature Reserves.

The questions before us are: (1) How should we know which are the threatened plants? (2) Where do these threatened plants occur? (3) What are the causes of threat? (4) What are the possible measures of conservation? (5) What data are necessary for planning conservation? and finally (6) Why should we worry if some of our many endangered species become extinct? While I have already emphasised on the answer to the last question in sufficient detail, I leave the other questions to be answered by the distinguished botanists who

have come to attend this seminar. I would, however, like to elaborate here on two aspects, viz. causes of threat to plants and protection of their habitats.

It is well known now that several plants have become extinct due to certain natural phenomena such as land up-heavals, vulcanic eruptions, glaciation, protracted periods of rain or drought, expansion of deserts, forest fires and depletion in the geological past. While such natural processes no doubt led to the extinction of plants, the resulting new environmental conditions have also resulted in the evolution, speciation and migration of plants. Besides, thoughtless commercial exploitation of entire plants, roots, rhizomes, tubers, bulbs, seeds and fruits for rapid financial gains has been the prime cause of depletion of economic plants. *Rauvolfia serpentina, Coptis teeta, Dioscorea deltoidea* and *Podophyllum hexandrum* serve as glaring examples. In certain other cases species are said to have become very old or senescent and suffered genetic depletion, thus becoming unable 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 allieon weeds and effects of plant-pests and diseases have also been sources of threat to several native plants. *Mikania, Eupatorium, Parthenium, Eichhornia* and *Lantana* are some familiar examples of exotic plants adversely affecting our native plants. In India the real threat to plants lies especially in areas which are subjected to considerable developmental activities e.g. forests lying in close proximity to villages and agricultural lands. Such areas lie in the entire length and breadth of our country in the hills as well as in the plains. Incidentally, these areas also abound in tourist spots and pilgrimage centres which attract large crowds who cause damage to the flora. It is a matter of relief that the Government of India has lately banned or imposed restrictions on the export of certain species. The forest departments should work as custodians of flora and fauna to check illegal trade in these species.

India is one of the signatories of 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 for strict regulation and control of trade. According to the convention, if a listed species is even smuggled out of a country, the country of destination will cooperate by obstructing the consignment. 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 habitat having natural vegetation. Several such areas have been identified for conservation and preservation as Biosphere Reserves throughout the country. Setting up of Germ Plasm Banks and Gene Sanctuaries to protect areas rich in wild relatives of certain economic and cultivated plants has also been suggested.

The Botanical Survey of India with its main Botanic Garden at Howrah and the Regional Experimental Gardens established at different altitudinal

locations for acclimatisation of plants of different ecological conditions; the Forest Research Institute and Colleges at Dehra Dun and the National Botanical Research Institute at Lucknow and several other Botanical/Horticultural/Forestry Centres in the country have in their holdings many rare, endemic and threatened plants. Several species of Orchids are also under cultivation and protection in the National Orchidaria of the Botanical Survey of India at Shillong, Yercaud and Calcutta. These activities falling under the category of *ex situ* conservation, however, need to be intensified. As a matter of fact both *in situ* and *ex situ* conservation are equally important if, we have to save our precious plant heritage considered as threatened from becoming extinct.

Before I finish, I must emphasize that very vigorous efforts are required to protect remnant populations of the rare and endangered species of plants of our country. Efforts should be made to maintain representative collections of spectacular species that are at present in undisturbed habitats. Encouragement should be given to the establishment of National Parks and Sanctuaries where threatened plants can multiply. Indigenous species of wild plants should be preserved in maximum variety and reasonable abundance. Concentrated efforts should be made to establish natural areas for the preservation of the species, their habitats and representative samples of ecosystems.

In a large country like India, concerted, united and vigorous efforts of all are necessary to ensure that the natural heritage of its rich plant wealth, particularly rare and endangered species of plants is not only protected but continue to survive and serve not only our material but also scientific, aesthetic, cultural and even spiritual needs.

I am confident that the distinguished botanists, foresters and naturalists who have come here from all over the country to take part in this seminar will pay adequate attention to the points made by me, discuss the pertinent issues concerning the conservation of threatened taxa and reach at definite conclusions so that meaningful approach as to the solution of the problems in question are achieved.

It will be then left to the Government to execute the suggestions and recommendations made by this august assembly of scientists. I hope the authorities will rise to the occasion and realising the importance of the subject, will provide necessary facilities and infrastructure to give the ideas a practical shape.

I offer my good wishes to the seminar and wish that its deliberations bring out fruitful results. While congratulating and thanking one and all who have worked hard to organise this conference, I declare the seminar on "Threatened Plants of India" open.

JAI HIND

KEY NOTE ADDRESS

An Insight into the Problem of Threatened Plants*

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&
Principal Investigator, Endangered Flora Project (POSSCEF).

This Seminar on Threatened Plants of India is being held at a time when there is global concern for conservation of environment. Natural causes such as floods, landslides, droughts and technological developments are disturbing the ecological balance resulting in chain reactions with long-range consequences. One of the significant links in this chain is the loss of vegetal cover. The factors causing loss of vegetation in a certain area are not the only factors responsible for loss or threat to certain species. Several other circumstances contribute to it. A reasonably comprehensive list of these factors has been drawn up by the International Union for Conservation of Nature and Natural Resources.

Where do we stand in India with regard to our knowledge about threatened plants or measures for their conservation ? Our information on threatened plants is very poor. Lack of adequate knowledge of the full flora of our country has contributed to this ignorance. More importantly, we have not analysed even the available data from our floras, literature, collections in herbaria, notes in our field books, holdings in the botanical gardens or reports of rarity in scientific publications.

What are the tools for study, or evidences of threat or rarity, to our taxa ? Absence of collections at regular intervals in herbaria, long gaps in collections or sometimes decline in population and failure to locate any particular species under search have been used as signals of rarity. Whereas such analysis could be considered as better than no data at all, these have serious limitations or handicaps. The species might have been originally described on a stray collection from a spot not visited frequently.

Our experience of analysing the cases of several rare or threatened taxa shows that there are many pitfalls in evaluation of rarity or in suspected decline or expansion of distribution, based merely on old herbarium records. A species abundant in other countries and its record or report from our country based on a stray collection should not be treated as rarity of the species.

*In view of wide interest in the subject, a slightly modified version of this Address was also published in the Indian National Science Academy, News Letter No. 66 : 1-3, 1981.

Similarly, distribution of a species in our country must be mentioned when rarity of species is being discussed. It would be appropriate to discuss rarity only for the species which are endemic to India or at least Indian region and which will further qualify by restricted distribution. Only in the case of species heavily collected for commercial purposes, species distributed in several states may be considered adequate for discussion under threatened plants.

Sometimes we are inclined to consider endemism on an even more restricted basis and take only those species as endemics which are confined to one district or State. In such cases, it should be useful to mention the number of endemics for the whole country, represented in the flora of the region, and then the taxa whose total distribution is confined to that State or region alone. To elaborate the point further, under the category : *taxa endemic to India*, one can include sub-groups like species confined only to peninsular India or eastern India or north-western India or species common to more than one of these regions or States.

Some endemic species are restricted to very small areas, e.g., the well-known pitcher plant in Meghalaya or certain species (like *Cycas beddomei*) confined only to Cuddapah Hills in south India. Such species almost automatically qualify for the threatened category. Opposite to the term 'endemic' is the term 'wide' used in phytogeographical discussions. 'Wide' is applicable only when species grow in large parts of the world or at least in several adjacent countries. It would not be proper to use the term wide for a species commonly distributed only within our country.

Our notion of percentage of endemism in India is based on Chatterjee's work which is about half a century old. More than 60 per cent of the dicotyledons were estimated as endemics. Recent analysis of many families, particularly monocotyledons shows that this figure may not be more than 35-40 per cent now.

While talking of extension of distribution of rare taxa, one tends to consider type locality as the centre or even limits of distribution, and collection of taxon from any area other than type locality is considered extension of distribution. In such cases, it is necessary to examine carefully whether in the original protologue any paratypes were mentioned from localities other than the type.

The importance of critical taxonomic evaluation cannot be overemphasized. While making a study of endemism in monocots of India, we recently found that many taxa considered endemic for over a century, were synonymous with the species occurring in far distant places and hence were not really endemics, e.g. *Sarcanthus macrodon* (Tamil Nadu) has been found to be synonymous with *Cleisostoma discolor* of S.E. Asia.

Assessment of Threats

The estimation of threat is mostly qualitative, but sometimes efforts have been made to quantify it. The qualitative assessment is based generally on field observations, a visual decline of species, lesser frequency of collection, long-spaced collections and such other reasons.

Dury (1980) gave three qualitative categories :—

1. Range restricted to isolated localities, yet they occur in large numbers in each locality.
2. Occur in small numbers but in many localities.
3. Occur as few individuals in few localities, or in one locality.

In California, the botanists gave four characters: R—rarity; E—Endangerment; *V*—Vigour and *D*—Distribution.

Perring & Farrel (1977) have given threat numbers (TN) to species.

In Britain, all species are recorded on a 10km² grid. If a species was recorded in *X* no. of squares in the past and is now in only *Y*, *Y*/*X* gives a figure. This figure is taken as :

(*i*) 0 if decline less than 33%
(*ii*) 1 -do- 33-66%
(*iii*) 2 -do- more than -66%

1 sq. km. is considered as one locality for a species. Threat Nos. 0-4 are given depending on 16 (0), 10-15 (1), 6-9 (2), 3-5 (3) or less than 3 localities (4) of occurrence, respectively.

Attractiveness of species contributes to its greater exploitation. Hence a range 0-2 is given for not (0), moderately (1) or very attractive (2) species.

Conservation status is indicated by the presence of the species in protected habitats or in vulnerable habitats. If more than 66 per cent of its localities fall in nature reserves, it is 0, and through degrees, if less than 33 per cent of its localities are in reserves the TN is 3. The relative remoteness and accessibility i.e., the ease with which a species can be reached, collected or exploited are also considered in 3 degrees 0-2, each.

The total of these figures can be a maximum of 15, which means 'Endangered.'

Rate of decline	0, 1, 2	(33-66% of old & new loc.)
Localities of presence	0, 1, 2, 3, 4	(16-1%)
Attractiveness	0, 1, 2	(ornamental)
Conservation (localities in reserves)	0, 1, 2, 3	(66–33%)
Remoteness	0, 1, 2	(for island)
Accessibility	0, 1, 2	(e.g. cliff)

Distribution Maps

In order to have a proper concept of distribution of endemic or rare species, it is necessary to have maps of the country or States, showing distribution of species endemic to the country or to the State respectively. Some countries in the world have made great advances in this regard but very little has been done in our country.

Perhaps the only distribution maps of species available are for certain commercial timbers or other highly economically important species. Maps are

sometimes provided along with the descriptions of new taxa and revisionary accounts. No co-ordinated large-scale or institutionalized programme on species distribution maps exists at present. The need for this cannot be over-emphasized particularly for the evaluation of threatened taxa and monitoring their populations over periods of time.

Extinct Species

It is no easy and pleasant task to declare a living species as extinct, i.e., all of its members and generations are dead for ever. But when after careful study and search, a scientist is satisfied about this unpleasant fact, it has to be reported. Caution is necessary before using the term 'Vanished'. Have all the possible habitats been explored ? Have all the botanical gardens been reasonably checked for their occurrence ? These are some of the necessary questions. *Dichanthium planipedicellatum* was discovered in Manipur. I searched for it in type locality but could not find, and it is probably extinct. Several such instances can be quoted from India. But we can also recall the cases of those species which were declared extinct in the *IUCN Red Data Book*, and soon after the publication of that document, the search started, and their survival in some botanic gardens was reported. *Sophora toromiro* became extinct from its habitat in the Easter island. It was rediscovered in a botanic garden in Sweden. *Bromus interruptus* reported extinct in its natural habitat in Britain, was found in the Royal Botanic Garden, Edinburgh. *Eucalyptus steedmanii* not found for decades and presumed extinct was rediscovered in 1978 in West Australia.

Sacred groves have played a crucial role in the study of threatened plants. Many species considered as non-existent in their normal areas of occurrence, might occur in some sacred groves, reserve forests or even in the National Parks of the vicinity.

The lists of threatened plants, prepared on any criteria (qualitative or quantitative) are not an end in themselves. They provide raw materials or ingredients for designing the recipe of conservation. The study of Threatened Plants may be divided into two broad phases: the basic and the dynamic. Lists of rare plants or even the Red Data Books are mainly basic, derived from analyses of existing data from the literature, herbarium and preliminary observation in field. The dynamic aspect will include critical study of taxonomy, phenology, reproductive system, breeding, pollination and reproductive potential or vigour and finally a model for conservation or rehabilitation.

Future Work

Those interested in contributing to research on threatened plants and their conservation would find the following guidelines useful :

1. To find out which taxa endemic to India, occur in their region, state or district.
2. What is the general distribution of those species in the country ?
3. Whether any of these species are endemic only to their area of work ?
4. Whether any of these species are of commercial importance and are in trade (large scale or small scale) ?

5. Detailed data on their distribution in the area of work and type of rarity, i.e., (i) few plants at few spots; (ii) few plants at many distant places; or (iii) many plants but only in one or few spots.
6. Data on their past distribution and trends of shrinkage of populations or extinction.
7. Causes of threat: if possible quantification of threat.
8. Detailed data on the biology of those species, i.e., reproduction, pollination, fruit-set, diseases (pests and pathogens, etc.). This will lead to a study of biological causes of rarity i.e., genetic erosion and non-adaptability to habitat, species competition, etc.
9. Suggested measures for conservation.
10. Information on the species concerning its sustained utilization.
11. Detailed data for its inclusion in national or international *Red Data Book*, and Appendices of CITES.
12. Conservation of its germ-plasm in some 'Rescue Centres.' Some species may not be able to expand in a particular locality due to competition with hardier species there, but may colonise better elsewhere.

It will be useful if workers on Regional Floras could concentrate on 20 or 30 species and make detailed observations on them on these lines. Similarly, monographers can very usefully contribute :

(*a*) by discussing about endemism in their accounts on family (ies) genera and species.

(*b*) by emphasizing the taxonomic validity of endemic or threatened (and rare) taxa.

(c) by focussing attention on any special biological characteristics of the taxa which would influence their regeneration and survival.

Other general areas of work are :

1. to find out what rare endemics are being grown in botanic gardens :
2. to study the status of Linnean taxa in our country:
3. to study the effect of introduced exotics such as *Eucalyptus, Casuarina* on populations of rare taxa; and
4. to study the effect of exotic weeds like *Eupatorium, Mikania, Parthenium* and *Eichhornia* on rare species.

After the full data are collected on the threatened plants of various parts of our country, it will be possible even to draw large phytogeographical conclusions such as : Are endemic plants confined or more common only to certain regions of our country ? Do many threatened plants occur only in certain regions of our country ?

Data gathered carefully will greatly help in supporting the cause of conservation through biosphere reserves, sacred groves and other diversity—rich areas of our country. The task is stupendous but if the professional and the amateur botanists will accept it as a challenge, there is every hope of saving our unique flora.

1

Plants of Northwestern Himalayas with Restricted Distribution—A Census

P. K. HAJRA, *POSSCEF, Botanical Survey of India, Dehra Dun*

The Northwestern Himalayas for the present study have been extended to include all parts from Chitral to Western Nepal.

Botanically certain regions of the Northwestern Himalayas are relatively well explored. The names of C. B. Clarke, H. Collett, J. F. Duthie, H. Falconer, G. A. Gammie, W. Gollan, G. Govan, W. Griffith, T. Hardwicke, V. Jacquemont, U. N. Kanjilal, W. Koelz, J. F. Royle, Schlagintweit brothers, J. L. Stewart, R. R. Stewart, H. Strachey, R. Strachey, T. Thomson, J. E. Winterbottom etc. may be mentioned among the pioneers who have made remarkable and interesting collections from this region. Recently scientists of the Regional Research Laboratory, Central Drug Research Institute, Botanical Survey of India and teachers from some of the universities have made collections from different localities of the Northwestern Himalayas.

A review of the existing literature published by different workers shows that a number of species of flowering plants are known only from this region. These species with restricted distribution are of considerable phytogeographical interest. Based on the study of literature and herbarium of Botanical Survey of India, Northern Circle (BSD) a preliminary list of such species is given in this paper; their status will be confirmed by further consulting literature and other herbaria.

Future explorations may show some of the plants with restricted distribution as to be wide spread.

ENUMERATION

(Endemic genera are marked with asterisk)

RANUNCULACEAE

Aconitum atrox (Bruhl) Mukerjee
Distrib. N. W. Himalayas including NEPAL.

A. clasmanthum Stapf ex Holmes
Distrib. Kashmir.

Aconitum deinorrhizum Holmes ex Stapf
Distrib. N. W. Himalayas.

A. falconeri Stapf
Distrib. Garhwal.

A. heterophyllum Wall. ex Royle
Distrib. N. W. Himalayas.

A. kashmiricum Stapf ex Coventry
Distrib. Kashmir.
A. moschatum (Bruhl ex Duthie) Stapf
Distrib. Kashmir.
Anemone falconeri Thoms.
Distrib. West temperate Himalayas.
Batrachium flavidum Hand. – Mazz.
Distrib. Kashmir.
Callienthemum cachemirianum Camb.
Distrib. N. W. Himalayas.
C. rutaefolium C. A. Mey
Distrib. Kashmir.
Delphinum himaleyanse Chowdhury
Distrib. Uttar Pradesh.
D. koelzii Munz
Distrib. Punjab, Uttar Pradesh.
Isopyrum ludlowii Temura et Lauener
Distrib. Kashmir.
Thalictrum pauciflorum Royle
Distrib. N. W. Himalayas.
T. pedunculatum Edgew.
Distrib. N. W. Himalayas.

BERBERIDACEAE

Berberis kashmiriana Ahrendt
Distrib. Kashmir.
B. lambertii Parker
Distrib. N. W. Himalayas.
B. osmastonii Dunn
Distrib. Uttar Pradesh.
B. petiolaris Wall. ex G. Don var. *garhwalana* Ahrendt
Distrib. Kumaon, Garhwal.
B. pseudoumbellata Parker
Distrib. N. W. Himalayas.

PAPAVERACEAE

Meconopsis aculeata Royle
Distrib. N. W. Himalayas.
M. latifolia (Prain) Prain
Distrib. Kashmir.
M. robusta Hook. f. et Thoms.
Distrib. N. W. Himalayas.
Papaver himalicum Cretz.
Distrib. Kashmir.
Stylophorum lactucoides Baill.
Distrib. Garhwal Himalaya, Eastern Kumaon: (Nepal).

FUMARIACEAE

Corydalis elegans Wall. ex Hook. f. & Thoms.
Distrib. Kumaon.
Fumaria montana Pugsley
Distrib. Himachal Pradesh & Uttar Pradesh.

BRASSICACEAE

Arabis tenuirostris Schulz
Distrib. Kashmir.
Arabidopsis stewartiana Jafri
Distrib. Western Himalayas.
Cardamine loxostemonoides Schulz
Distrib. N. W. Himalayas.
Christolea stewartii (T. Anders.) Jafri
Distrib. N. W. Himalayas (incl. Tibet).
Cochlearia minutissima Schulz
Distrib. Uttar Pradesh.
Draba amoena Schluz
Distrib. Uttar Pradesh.
D. aubrietoides Jafri
Distrib. Kashmir.
D. dayastra Gilg et Schulz
Distrib. Kashmir.
D. ludlowiana Jafri
Distrib. Kashmir.
Erophila tenerrima (O.E. Schluz) Jafri
Distrib. Kashmir.
Erysimum schlagintweitianum Schluz
Distrib. N. W. Himalayas (Tibet)
Matthiola tenera K. H. Rechinger
Distrib. Kashmir.
Microsisymbrium bracteosum Jafri
Distrib. Kashmir.
Thlaspi andersonii (Hook. f. et Thoms.) Schluz
Distrib. Kashmir.

VIOLACEAE

Viola falconeri Hook. f. et Thoms.
Distrib. N. W. Himalayas.
V. himalayensis W. Beck
Distrib. Kashmir.
V. kunawarensis Royle
Distrib. N. W. Himalayas.

CARYOPHYLLACEAE

Arenaria ferruginea Duthie ex Williams
Distrib. Western Himalayas.
Dianthus cachemiricus Edgew.
Distrib. Western Himalayas.
D. jacquemontii Edgew.
Distrib. Western Himalayas.
Silene cancellata (Jacq. ex Edgew. & Hook. f.) Majumdar
Distrib. Western Himalayas.
S. stewartii (Edgew.) Majumdar
Distrib. Western Himalayas.
S. eduardi Bocquet
Distrib. Western Himalayas.
S. falconeriana Benth.
Distrib. W. Himalayas.
S. kumaonensis Williams
Distrib. Western Himalayas.
S. kunawarensis Benth.
Distrib. W. Himalayas
S. laxantha Majumdar
Distrib. Western Himalayas.
S. setaesperma Majumdar
Distrib. Western Himalayas.
Stellaria himalayensis Majumdar
Distrib. Western Himalayas.
S. semivestita Edgew.
Distrib. Western Himalayas.

GERANIACEAE

Geranium kishtrariense R. Kunth
Distrib. Western Himalayas.
G. rectum Trauty.
Distrib. Kashmir.
G. tubereria Camb.
Distrib. Temperate Western Himalaya.

BALSAMINACEAE

Impatiens glauca Hook. f. et Th.
Distrib. Western Temperate Himalaya.
I. harrissii Hook. f.
Distrib. Western Himalaya.
I. jaeschkei Hook f.
Distrib. Western Himalaya.
I. langeana Hook. f.
Distrib. Western Himalaya.
I. methildae Chior.
Distrib. Western Himalaya.
I. meeboldii Hook. f.
Distrib. Kashmir.
I. micranthemum Edgew.
Distrib. Temperate Western Himalaya.
I. pahalgamensis Hook. f.
Distrib. Kashmir.
I. podocarpa Hook. f.
Distrib. Western Himalaya.
I. polysciadia Hook. f.
Distrib. Western Himalaya.
I. reidii Hook. f.
Distrib. Western Himalaya.
I. stoliczkai Hook. f.
Distrib. Western Himalaya.
I. vexillaria Hook. f.
Distrib. Western Himalaya.

CELASTRACEAE

Gymnosporia championi Dunn
Distrib. Uttar Pradesh.

RHAMNACEAE

Rhamnella gilitica Mansf & Meich.
Distrib. Kashmir.

VITACEAE

Vitis hexandra Gagnep.

Distrib. Uttar Pradesh.
V. parkeri Gagnep. ex Osmaston
Distrib. Uttar Pradesh.
V. pedicellata Laws.
Distrib. Western Himalaya; NEPAL.
Tetrastigma affine (Gagnep. ex Osmaston) Raizada & Saxena
Distrib. Uttar Pradesh.
I. indicum M. Maulik
Distrib. Uttar Pradesh.

ACERACEAE

Acer molle Pax
Distrib. Western Himalaya.
A. pentaponitum J. L. Stewart ex Brand.
Distrib. Western Temperate Himalaya.

SABIACEAE

Sabia paniculata Edgew.
Distrib. Subtropical W. Himalaya.

ANACARDIACEAE

Rhus punjabensis Stewart
Distrib. N W Himalaya.

FABACEAE

Amphicarpaea edgeworthii Benth.
Distrib. Western Himalaya.
Astragalus aegacanthoides Parkar
Distrib. Kumaon.
A. amomalus Bunge
Distrib. Ladakh.
A. bakeri Ali
Distrib. Kashmir.
A. flemingii Ali
Distrib. Punjab.
A. gilgitensis Ali
Distrib. Kashmir.
A. inconspicuous Baker
Distrib. Uttar Pradesh.
A. imitensis Ali
Distrib. Kashmir.
A. kashmirensis Bunge.
Distrib. Kashmir, Uttar Pradesh.
A. maddenianus Benth. ex Baker
Distrib. Kashmir, Uttar Pradesh.
A. malacophyllus Benth. ex Bunge
Distrib. Kashmir, Himachal Pradesh, Uttar Pradesh.
A. maxwellii Royle ex Benth.
Distrib. Kashmir & Himachal Pradesh.
A. multiceps Royle
Distrib. Uttar Pradesh; (NEPAL).
Atylosia grandiflora Benth. ex Baker
Distrib. Uttar Pradesh.
Alysicarpus meeboldii Schindl.
Distrib. Kashmir.
Argyrolombiu album Bhattacharyya
Distrib. Punjab.
Butea pellita Hook. f.
Distrib. N. W. Himalaya.
Campylotropis meeboldii (Schindler) Schindler
Distrib. Western Himalaya.
Caragana polyacantha Royle
Distrib. Uttar Pradesh.
C. gerardiana Royle ex Benth.
Distrib. Uttar Pradesh, Himachal Pradesh; (NEPAL, PAKISTAN)
C. hoplitis Dunn
Distrib. Uttar Pradesh.
Derris macrocarpa Thoth.
Distrib. Uttar Pradesh.
Hedysarum alpinum L. var *laxiflorum* (Benth. ex Baker) Taterhi.
Distrib. Western Himalaya (including W. Tibet).
H. astragaloides Benth. ex. Baker
Distrib. Kashmir, Himachal Pradesh.
H. cachemirianum Benth. ex Baker
Distrib. Kashmir.
H. kumaonense Benth. ex Baker
Distrib. Kashmir, (NEPAL, TIBET).
H. microcalyx Baker
Distrib. Western Himalaya.
H. pseudomicrocalyx Ohasi
Distrib. Western Himalaya.

Indigofera cedrorum Dunn
Distrib. Kashmir, Himachal Pradesh.
I. himalayensis Ali
Distrib. Western Himalaya.
I. silvesteri Pampen.
Distrib. Parbati valley.
Lespedeza elegans Camb.
Distrib. Kashmir.
Oxytropis densa Benth. ex Bunge
Distrib. Kashmir, (W. TIBET.)
O. duthieana Ali
Distrib. Uttar pradesh, (NEPAL)
O. mollis Royle ex Benth.
Distrib. N. W. Himalaya.
Piptanthus leiocarpus Stapf.
Distrib. N. W. Himalaya.
Pueraria stracheyi Baker
Distrib. Uttar Pradesh.
Rhynchosia falconeri Baker
Distrib. Uttar Pradesh.
R. pseudo-cajan Camb.
Distrib. N. W. Himalaya.
Trigonella gracilis Benth.
Distrib. N. Western Himalaya.
Vicia bakeri Ali
Distrib. N. W. Himalayas.
V. benthamiana Ali
Distrib. Kashmir.
V. rigidula Royle
Distrib. N. W. Himalaya.

ROSACEAE

Alchemilla cashmeriana Rothmaler
Distrib. N. W. Himalaya.
A. trollii Rothmaler
Distrib. N. W. Himalaya.
Cotoneaster cashmiriensis Klotz
Distrib. Kashmir.
C. garhwalensis Klotz
Distrib. Garhwal, Kumaon.
C. neuselii Klotz
Distrib. Garhwal, Kumaon (W. Nepal).
C. schubertii Klotz
Distrib. Kashmir.

SAXIFRAGACEAE

Chrysosplenium tenellum Hook. f. & Thoms.
Distrib. N. W. Himalayas
C. trichospermum Edgew. ex Hook. f. & Thoms.
Distrib. N. W. Himalayas.
Saxifraga asarifolia Sternb.
Distrib. N. W. Himalayas.
S. kumaunensis Engl.
Distrib. N. W. Himalayas.
S. meeboldii Engl. et Irmsch.
Distrib. N. W. Himalayas.
S. microvirides Hara
Distrib. N. W. Himalayas.
S. polunimiana H. Sm. var. *mucronata* Bhatt. et Viswanathan
Distrib. Garhwal.
S. stolitzkae Duthie ex Engl. et. Irmsch.
Distrib. N. W. Himalayas. (Kumaon and Nepal).
S. subspathulata Engle. et Irmscher
Distrib. N. W. Himalayas (Kumaon).

PHILADELPHACEAE

Deutzia amurensis Airy Shaw
Distrib. N. W. Himalayas.
D. macrantha Hook. f. & Thoms.
Distrib. N. W. Himalayas.
D. staurothrix Airy Shaw
Distrib. N. W. Himalayas.

PARNASSIACEAE

Parnassia kumaonica Nekrassova
Distrib. Garhwal & Nepal.

CRASSULACEAE

Sedum duthie Foderstrom
Distrib. Kumaon.
S. garhwalicum Foderstrom
Distrib. N. W. Himalayas.
S. heterodontum Hook. f. & Thoms.

Distrib. N. W. Himalayas (Kashmir, Kumaon, NEPAL, TIBET).
S. holei R. Hamet.
Distrib. N. W. Himalayas (Kumaon).
S. jacquemontii Foderstrom
Distrib. N. W. Himalayas.
S. magae R. Hamet
Distrib. N. W. Himalayas (Kumaon).
S. saxifragoides Foderstrom
Distrib. N. W. Himalayas.
S. tillaeoides Duthie
Distrib. N. W. Himalayas.
S. viguieri R. Hamet ex Foderstrom
Distrib. N. W. Himalayas (Kashmir).

ONAGRACEAE

Epilobium chitralense Raven
Distrib. N. W. Himalayas (Kashmir).
E. glaciale Raven
Distrib. N. W. Himalayas (Kashmir).
E. rhynchospermum Hausskn.
Distrib. N. W. Himalayas (Kashmir to Punjab).
E. stracheyanum Hausskn.
Distrib. N. W. Himalayas (Kumaon).
E. wattianum Hausskn.
Distrib. N. W. Himalayas (Ladakh to Kumaon).

APIACEAE

Bupleurum dalhousieanum (Clarke) K.
Distrib. Himachal Pradesh, Uttar Pradesh.
B. maddeni Clarke
Distrib. Himachal Pradesh, Uttar Pradesh.
B. thomsonii Clarke
Distrib. Kashmir, Himachal Pradesh.
Chaerophyllum acuminatum Lindl.
Distrib. N. W. Himalaya.
C. cachemiricum Clarke
Distrib. Himachal Pradesh.
C. capnoides (Decne) Clarke
Distrib. Garhwal to Kashmir.
Chamaesciadium garhwalicum (Wolff) Norman.
Distrib. Uttar Pradesh, Himachal Pradesh.
Eriocycla caespitosa (Edgew.) Wolff.
Distrib. N. W. Himalaya.
E. nuda Lindl.
Distrib. N. W. Himalaya.
E. stewartii (Dunn) Wolff.
Distrib. N. W. Himalaya.
E. thomsoni (Clarke) Wolff.
Distrib. N. W. Himalaya.
Heracleum cachemiricum Clarke
Distrib. Garhwal to Kashmir.
H. canescens Lindl.
Distrib. Mussoorie to Kistwar.
H. jacquemontii Clarke.
Distrib. N. W. Himalaya.
H. thomsonii Clarke.
Distrib. Kashmir, Himachal Pradesh.
Ligusticum marginatum Clarke
Distrib. N. W. Himalayas.
**Meeboldia selinoides* Wolff.
Distrib. Nainital. Known only from type locality.
Peucedanum dehradunensis Babu
Distrib. Dehra Dun.
P. thomsonii Clarke.
Distrib. Kashmir.
Pimpinella acuminata (Edgew.) Clarke
Distrib. N. W. Himalayas.
P. stracheyi Clarke
Distrib. Kumaon.
Pleurospermum densiflorum (Lindl.) Clarke
Distrib. N. W. Himalayas.
P. erosa (DC.) P. K. Mukh.
Distrib. Kumaon.
P. stylosum Clarke.
Distrib. Kashmir and Himachal Pradesh.
Scaligera aitchisonii Wolff
Distrib. N. W. Himalayas.
S. indica Wolff

Distrib. Kashmir.
Selinum elatum (Edgew.) Clarke
Distrib. Garhwal.
S. vaginatum (Edgew.) Clarke
Distrib. N. W. Himalayas.
Seseli trilobum (Edgew.) Clarke.
Distrib. N. W. Himalayas

RUBIACEAE

**Clarkella nana* Hook. f.
Distrib. N. W. Himalayas.

ASTERACEAE

Aster falconeri (C. B. Clarke) Hutch. subsp. *falconeri*.
Distrib. N. W. Himalayas (Kashmir).
A. indumellus Grierson
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Uttar Pradesh) & NEPAL.
A. laka C. B. Clarke
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
A. peduncularis Wall. ex Nees subsp. *peduncularis*.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Uttar Pradesh) & NEPAL.
**Catamixis baccharoides* T. Thoms.
Distrib Siwaliks, Garhwal
Taraxacum hooftii van Soest.
Distrib. N. W. Himalayas (Kashmir).
T karakoricum van Soest.
Distrib. N. W. Himalayas (Kashmir).
T kashmirense van Soest.
Distrib. N. W. Himalayas (Kashmir).

ASCLEPIADACEAE

Ceropegia hotii Raizada
Distrib. N. W. Himalayas (Uttar Pradesh).

GENTIANACEAE

Gentiana spitiensis Nair

BORAGINACEAE

Anoplocaryum brandisii Brand.
Distrib. N. W. Himalayas including PAKISTAN.
Arnebia benthamii (Wall. ex G. Don) Johnst.
Distrib. N. W. Himalayas including PAKISTAN & NEPAL.
A. guttata Bunge var. *thomsonii* (C. B. Clarke) Kazmi
Distrib. N. W. Himalayas.
Cordia vestita (DC.) Hook. f. & Thoms.
Distrib. N. W. Himalayas including PAKISTAN.
Cynoglossum flexuosum (Brand) Kazmi.
Distrib. N. W. Himalayas (Kashmir).
C. microglochin Benth.
Distrib. N. W. Himalayas including PAKISTAN.
C. nervosum Benth. ex C. B. Clarke var. *petiolatum* (Hook. f.) Kazmi
Distrib. N. W. Himalayas (Kashmir).
C. stewartii Kazmi.
Distrib. N. W. Himalayas including PAKISTAN.
Hackelia macrophylla (Brand) Johnst.
Distrib. N. W. Himalayas including PAKISTAN.
H. meeboldii Brand
Distrib. N. W. Himalayas (Kashmir).
H. stewartii Johnst.
Distrib. N. W. Himalayas (Kashmir).
Lindelophila longiflora (Benth.) Baill.
Distrib. N. W. Himalayas including PAKISTAN.
Mattiastrum himalayense (Klotz) Brand. var. *himalayense*.
Distrib. N. W. Himalayas.
M. tibeticum (C. B. Clarke) Brand.
Distrib. N. W. Himalayas (Kashmir).

Onosma bracteatum Wall.
Distrib. N. W. Himalayas including NEPAL.
O. hypoleucum Johnst.
Distrib. N. W. Himalayas including PAKISTAN.
O. thomsoni C. B. Clarke
Distrib. N. W. Himalayas including PAKISTAN.
Pseudomertensia drummondii Kazmi
Distrib. N. W. Himalayas (Kashmir) including PAKISTAN.
P. echioides (Benth.) Riedl var. *echioides*.
Distrib. N. W. Himalayas (Kashmir) including PAKISTAN.
P. echioides (Benth.) Riedl var. *lahulensis* (Brand) Kazmi
Distrib. N. W. Himalayas.
P. elongata (Dcene.) Riedl
Distrib. N. W. Himalayas (Kashmir) including PAKISTAN.
P. racemosa (Royle) Kazmi.
Distrib. N. W. Himalayas including PAKISTAN.

SCROPHULARIACEAE

Alectra parasitica A. Rich var. *Chitrakutensis* M. A. Rau
Distrib. Uttar Pradesh.
Euphrasia alba Penn.
Distrib. N. W. Himalayas (Himachal Pradesh, Ladakh).
E. aristulata Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir).
E. densiflora Penn.
Distrib. N. W. Himalaya (Kashmir, Garhwal).
E. flabellata Penn.
Distrib. N. W. Himalayas (Kashmir) Himachal Pradesh.
E. foliosa Penn.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
E. incisa Penn.
Distrib. N. W. Himalayas (Kashmir).
E. jaeschkei Wettst.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
E. kashmiriana Pungsley.
Distrib. N. W. Himalayas (Ladakh).
E. laxa Penn.
Distrib. N. W. Himalayas (Ladakh, Himachal Pradesh).
E. microcarpa Penn.
Distrib. N. W. Himalayas (Himachal Pradesh).
E. multiflora Penn.
Distrib. N. W. Himalayas (Himachal Pradesh).
E. pauciflora Wettst.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
E. platyphylla Penn.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
E. remota Penn.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
E. schlagentweitii Wettst.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Uttar Pradesh).
E. secundiflora Penn.
Distrib. N. W. Himalayas (Kashmir).
E. speciosa Penn.
Distrib. N. W. Himalayas.
E. subpetiolaris Pugsley
Distrib. N. W. Himalayas.
Odontites himalayica Penn.
Distrib. N. W. Himalayas (Kashmir).
Pedicularis brevirostris Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir including Ladakh).
P. canescens Tsoong
Distrib. N. W. Himalayas (Kashmir).
P. multiflora Penn.
Distrib. N. W. Himalayas (Kashmir).
P. nodosa Penn.

Distrib. Uttar Pradesh (Almora).
P. stewartii Penn.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh).
Scrophularia dentata Royle
Distrib. N. W. Himalayas (Jammu & Kashmir, Himachal Pradesh).
S. edgeworthii Benth.
Distrib. N. W. Himalayas (Garhwal & Kumaon).
S. himalayensis Royle
Distrib. N. W. Himalayas (Himachal Pradesh, Garhwal, Kumaon).
S. nudata Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir).
S. obtusa Edgew.
Distrib. N. W. Himalayas (Uttar Pradesh).
S. polyantha Royle
Distrib. N. W. Himalayas (Jammu & Kashmir, Himachal Pradesh).
Veronica cachemerica Gan.
Distrib. W. Himalayas (Kashmir).
V. koelzii Penn.
Distrib. N. W. Himalayas (Ladakh).
V. lasiocarpa Penn.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Uttar Pradesh).
V. nana Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir).
V. salina Schur.
Distrib. N. W. Himalayas (Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh).
V. secunda Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir), Himachal Pradesh, NEPAL.
V. stewartii Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir, Himachal Pradesh).
V. uncinata Penn.
Distrib. N. W. Himalayas (Jammu & Kashmir, including Ladakh).
Wulfenia himalaica (J. D. Hooker) Pennell
Distrib. Kumaon, Nepal.

LAMIACEAE

Ajuga brachystemon Maxim.
Distrib. N. W. Himalayas (Himachal Pradesh, Garhwal, Kumaon).
Elsholtzia densa Benth.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Kumaon; NEPAL). E. Afghanistan, Tibet.
Marrubium alternidens Reichb. f.
Distrib. Kashmir.
Micromeria hydaspidis Falc. ex Benth.
Distrib. Kashmir.
Nepeta campestris Benth.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Kumaon).
N. ciliaris Benth.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Garhwal).
N. duthie Prain and Mukerjee
Distrib. N. W. Himalayas.
N. elliptica Royle ex Benth.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Kumaon).
N. eriostachya Benth.
Distrib. N. W. Himalayas (Kashmir, Garhwal).
N. gilesii Mukerjee
Distrib. N. W. Himalayas.
N. leucolaena Benth. ex Hook f.
Distrib. Jammu & Kashmir (Ladakh).
N. leucophylla Benth.
Distrib. Uttar Pradesh (Kumaon & Garhwal).
N. multicaulis Mukerjee
Distrib. Kashmir.
N. nervosa Royle ex Benth.
Distrib. Kashmir.

N. pauciflora Mukerjee
Distrib. Kashmir.
N. thibetica Benth.
Distrib. Jammu & Kashmir (Ladakh).
Phlomis Bracteosa Royle ex Benth.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Kumaon, Garhwal).
Plectranthus stracheyi Benth. ex Hook. f.
Distrib. Uttar Pradesh (Kumaon).
**Roylea cinerea* (D. Don) Baill.
(*R. calycina* (Roxb.) Briq.
Distrib. N. W. Himalayas (Kashmir, Punjab, Himachal Pradesh, Uttar Pradesh).
**Salvia asperata* Falc. ex Benth.
Distrib. Kashmir.
**S. hians* Royle ex Benth.
Distrib. N. W. Himalayas, (Kashmir, Garhwal).
**Scutellaria prostrata* Jacquem. ex Benth.
Distrib. N. W. Himalayas (Kashmir, Himachal Pradesh, Uttar Pradesh).

ARISTOLOCHIACEAE

Aristolochia dilatata N. W. Brown
Distrib. Kumaon.
A. gourigangaica N. C. Nair
Distrib. Kumaon.
A. punjabensis Lace
Distrib. Kashmir, Kumaon.

EUPHORBIACEAE

Euphorbia sharmae U. C. Bhatt.
Distrib. Garhwal.

ULMACEAE

Ulmus chumila Melville et Heyle
Distrib. N. W. Himalayas.
U. wallichiana Planch. var *tomentosa* Melville et Heyle.
Distrib. Kashmir.

ORCHIDACEAE

Aphyllorchis gollani Duthie
Distrib. Uttar Pradesh.
Bulbophyllum rau Arora
Distrib. Uttar Pradesh.
Cymbidium mackinnoni Duthie
Distrib. Uttar Pradesh.
Dendrobium normale Falc.
Distrib. Uttar Pradesh.
Eulophia obtusa Hook. f.
Distrib. Uttar Pradesh.
Eulophia mackinnoni Duthie
Distrib. Uttar Pradesh.
Gastrodia orobanchoides Benth.
Distrib. North western Himalaya.
Herminium duthiei Hook. f.
Distrib. N. W. Himalayas (Garhwal to Nepal).
Liparis diodon Reichb. f.
Distrib. Uttar Pradesh.
L. rostrata Reichb. f.
Distrib. N. W. Himalaya (Simla to Nepal).
Listera inayati Duthie
Distrib. N. W. Himalayas.
L. kashmiriana Duthie
Distrib. Kashmir.
L. mucroglottis Duthie
Distrib. Uttar Pradesh.
L. mucronata Panigrahi & J. J. Wood
Distrib. Uttar Pradesh.
Malaxis mackinnoni (Duthie) Ames.
Distrib. N. W. Himalaya.
**Oreorchis indica* Hook. f.
Distrib. N. W. Himalayas.
O. rolfei Duthie
Distrib. Uttar Pradesh.
**Nervilia mackinnonii* (Duthie) Schlechter.
Distrib. Uttar Pradesh.

ZINGIBERACEAE

Cautleya petiolata Baker
Distrib. Uttar Pradesh.

IRIDACEAE

Iris duthiei Foster
Distrib. Western Himalayas.
I. milesii Foster
Distrib. N. W. Himalayas.

LILIACEAE

Allium auriculatum Kunth
Distrib. Uttar Pradesh.
A. lilacinum Royle
Distrib. N. W. Himalayas.
Asphodelus comosus Baker
Distrib. Himachal Pradesh.
Polygonatum graminifolium Hook. f.
Distrib. N. W. Himalayas.

CYPERACEAE

Carex kashmirensis C. B. Clarke.
Distrib. Kashmir.
C. myosurus Nees var. *praestena* (C. B. Clarke) Kunth
Distrib. Uttar Pradesh.
C. stracheyi Boott.
Distrib. N W. Himalayas (Kumaon, Nepal).
C. winterbottomi C. B. Clarke
Distrib. N. W. Himalayas (Kumaon, Nepal).
Kobresia nitens C. B. Clarke
Distrib. N. W. Himalayas.
K. duthiei C. B. Clarke
Distrib. N. W. Himalaya.
K. trinervis (Nees) Boack. var *foliosa* (C. B. Clarke) Kukenth.
Distrib. Garhwal.
Microschoenus duthiei C. B. Clarke
Distrib. N. W. Himalayas.

POACEAE

Agropyron duthiei Melderis
Distrib. N. W. Himalayas.
Calamagrostis decora Hook. f.
Distrib. Kashmir.
Colpodium himalaicum (Hook. f.) Bor
Distrib. N. W. Himalayas.
Cymbopogon ladakhensis B. K. Gupta
Distrib. N. W. Himalaya.
C. osmastonii R. N. Parker
Distrib. N. W. Himalayas.
C. parkeri Stapf
Distrib. N. W. Himalaya,
C. ramnagarensis B. K. Gupta
Distrib. N. W. Himalayas.
Deyeuxia kashmeriana Bor
Distrib. N. W. Himalayas.
F. lucida Stapf
Distrib. N. W. Himalayas.
Ischnochloa falconeei Hook. f.
Distrib. N. W. Himalayas.
Lophochloa clarkeana (Domin) Bor
Distrib. Kashmir.
Melica scaberrima (Nees ex Steudel) Hook. f.
Distrib. N. W. Himalaya (Kashmir to Nepal and Pakistan).
Oryzopsis stewartiana Bor
Distrib. N. W. Himalayas (Himachal Pradesh).
Poa pseudamoena Bor
Distrib. Uttar Pradesh.
P. rhadina Bor
Distrib. Uttar Pradesh.
P. stapfiana Bor
Distrib. N. W. Himalayas (Nepal, W. PAKISTAN).
P. stewartiana Bor
Distrib. N. W. Himalayas, W. PAKISTAN.
Pseudodenthonia himalaica (Hook. f.) Bor e. Hubbard
Distrib. N. W. Himalayas.

Schizachyrium impressum (Hack.) A Camus
Distrib. Kashmir.
Spodiopogon dubius Hack.
Distrib. N. W. Himalayas.
Stipa duthiei Hook. f.
Distrib. N. W. Himalayas (Garhwal, Nepal).
Trisetum micans (Hook. f.) Bor
Distrib N W. Himalayas.
Tripogon purpurascens Duthie
Distrib. N. W. India (Nepal).

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2

Rare Flowering Plants of Garhwal Himalaya

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Introduction

The Garhwal Himalayas due to their magnificent floral wealth, beautiful valleys and many holy shrines have evoked wonder, honour and praise; this has found expression in ancient literature.

Tehri is one of the five districts of Garhwal region and apart from the plants of medicinal and economic importance it has many interesting and valuable plants from scientific point of view. Today many areas in Tehri Garhwal are subjected to considerable changes which affect its natural heritage.

Several factors are leading to extinction of taxa and the rapid changes in ecology have been emphasised by many botanists (Santapau, 1971; Raizada, 1977, 1980; Jain, 1976; Rau, 1981; Maheshwari, 1980 & Sahni, 1973). Plants are destroyed by various activities like over-grazing, shifting cultivation and fire. Many are disappearing due to indiscriminate collection of entire plants, roots, rhizomes, tubers, corms, seeds, fruits and flowers for commercial purposes. The natural habitats of several others have been disturbed by unplanned deforestation, road construction, biocides and pollutants, plant pests, soil erosion, glaciation and avalanches.

A few adventive weeds mark the native himalayan vegetation and flora (Nayar, 1977; Rao, 1977) in many regions namely *Ageratum conyzoides* L., *A. houstonianum* Mill., *Tridax procumbens* L., *Eupatorium adenophorum* Spr., *Parthenium hysterophorus* L., *Galinsoga parviflora* Cav., *Lantana camara* L., *Xanthium strumarium* L., etc.

Though endemism is undoubtedly a specific criterion for considering the rarity of species but in case of the species stated to be endemic to Himalaya in India (Chatterjee, 1940) need a changing outlook due to modification of political boundaries of the country. The ten species isolated as rarely known from Garhwal Himalaya have a wide distribution as mentioned in the literature no doubt, but the herbarium studies and field observation reveal that they have been collected very occasionally during the last 50 years.

Most of the species included in this report are gathered from the Bhillangna valley which has a very rich plant wealth and should be declared as a natural reserve for the conservation of rare plants. The species reported there have not been included in the lists of rare and threatened plants published by Jain & Sastry, 1980 & Sahni, 1980.

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1. THALICTRUM CHELIDONII DC. Prodr. 1: 11. 1824. (Ranunculaceae).

Tall branched herbs upto 1 m tall with muricated bulbils in leaf axils. Flowers white-lilac, 2-8 in panicles. *Fls. & Frts.*: July-Sept.

Occasional on moist shady slopes in *Quercus-Rhododendron-Abies* forests alongwith *Roscoea, Codonopsis;* on way to Khatling 2800-3000 m, *Goel* 64474.

Dist. : Kashmir to Kumaon, Nepal, Sikkim & Bhutan.

It occurs on shady slopes of thick forests along the N-S river valleys and the frequency of their occurrence in the field was observed as very poor. Hardly one or two plants could be located at one place. Regeneration of this species takes place mostly by bulbils and the achenes are generally seedless. At the onset of summer the vegetative upper portions of the plants are indiscriminately exploited by local people for fodder purposes; thus deforestation are possibly the causes of its depletion.

2. T. ROSTELLATUM Hook. f. & Thoms. Fl. Ind. 1: 15. 1855. (Ranunculaceae).

Tall herbs with ternately compound leaves. Flowers small, white. Achenes stalked tapering into a beak. *Fls. & Frts.*: June-Sept.

Rare on open slopes in *Quercus-Rhododendron* forests; Kalyani 3000-3500 m, *Goel*, 64458.

Dist.: Himachal Pradesh, Garhwal, Sikkim & Bhutan.

This species occurs occasionally from Simla to Tehri Garhwal and is frequently used by villagers for fodder purposes. As a result, the flowering and fruiting takes place very rarely and prevent its free dispersal and distribution.

3. BERBERIS PETIOLARIS Wall. ex G. Don var. GARHWALANA Ahrendt in Jour. Bot. Lond. 80: 82. 1942 & in Jour. Linn. Soc. Lond. 57: 94. 1961. (Berberidaceae).

Shrubs ± 2.5 m high. Leaves obovate, acute with spinulose margins. Flowers yellow in umbels. Berries ellipsoid with ± 0.5 mm long styles. *Fls. & Frts.*: May-July.

Occasional in *Quercus-Rhododendron-Betula* forests; Tali 3500-4000 m, *Goel* 66624.

Dist.: Garhwal & Kumaon.

Ahrendt (l.c.) described this variety on the basis of two specimens gathered from Garhwal and Kumaon by Strachey and Winterbotton and by Blinkworth respectively, which are at BM. Subsequently there is no record of this variety at CAL, DD and BSD herbaria excepting the present collection which denotes its restricted distribution. During the explorations the authors too could locate only very few plants in the said locality.

4. MEGACARPAEA POLYANDRA Benth. in Kew Jour. Bot. 7: 356.t.7.1855. (Brassicaceae).

Robust ± 1.5 m tall herbs with fistular stems. Flowers white-cream coloured Siliculae large, suborbicular, bilobed. *Fls. & Frts.*: June-Sept.

Occasional on sunny grassy slopes; Boniudiyar 4000 m, *Goel* 67914.
Dist.: Kashmir to Kumaon & Tibet.

The studies of old materials housed at DD, CAL and BSD herbaria reveal that earlier this taxon was not rare from Kumaon to Kashmir but during the last 25 years only two gatherings have been made from Kumaon and Garhwal and there is no recent collection from Kashmir and H. P. Therefore, it seems that it is becoming rare due to intensive grazing at higher elevations and subjected to heavy exploitation for medicinal and other purposes by the local inhabitants.

5. THLAPSI ANDERSONII (Hook. f. & Thoms.) O. E. Schulz in Anzeiger, Akad. Wiss. Wien., Math.-Nat. Kl. 43: 98, 1926. *Iberidella andersonii* Hook. f. & Thoms. (Brassicaceae).

Procumbent or ascending herbs with runners having dimorphic branches. Flowers pinkish-white in racemes. *Fls.* & *Frts.:* April-June.

Occasional on moist shady or open grassy slopes alongwith *Euphorbia, Pedicularis* & *Anemone;* Panwali 4000 m, *Goel* 66654; Tali 4300 m, *Goel* 66620.
Dist.: Kashmir to Kumaon, Nepal, Sikkim, Bhutan and S. Tibet.

This species is very rarely distributed in alpine and subalpine regions in Garhwal and is subjected to over-grazing. Soil erosion on such slopes has caused its rarity.

6. CHRYSOPLENIUM TRICHOSPERMUM Edgew. ex Hook. f. et Thoms. in Jour. Linn. Soc. 2: 73. 1858. (Saxifragaceae).

Procumbent, fragile aquatic herbs. Flowers green with yellow anthers. Seeds globose, chestnut brown, covered with golden pappilae. *Fls.* & *Frts.:* April-June.

Occasional on shady boulders in the bed of flowing temperate streams. Govana 1500 m, *Goel,* 67726.
Dist.: Kashmir, Garhwal & Kumaon, Nepal.

A scrutiny of the specimens of this species at CAL, DD, BSD as well as field observations reveals that it has got a very rare and isolated distribution in one habitat as mentioned above. The plants are fragile, succulent and subjected to easy destruction by sudden flood in the torrents.

7. DORONICUM FALCONERI Clarke ex Hook. f. Fl. Brit. Ind. 3: 333. 1881. (Asteraceae).

Stout herbs ± 50 cm high. Heads radiate, 1-2, yellow. Achenes of ray florets epappose and of the disc pappose. *Fls.* & *Frts.:* July-Sept.

Chinpul 14-15000 ft (4400-4800 m), *Duthie* 849 (DD).
Dist.: Kashmir to Kumaon & Western Tibet.

From the study of specimens at CAL, DD and BSD herbaria it is observed that this species was not uncommon from Kashmir to Kumaon in the past but has not been gathered during last four decades and last collection in DD is

by R. R. Stewart in August 1940 from Kashmir; its population needs monitoring.

8. D. ROYLEI DC. Prodr. 6: 321. 1838. (Asteraceae).

Erect herbs up to 1 m high with cordate leaves. Heads many, radiate, yellow, glandular pubescent with turbinate base. *Fls.* & *Frts.:* June-Oct.

Occasional on open grassy north facing slopes near boulders; Boniudiyar 3500 m, *Goel* 66092.

Dist.: Kashmir to Kumaon.

The study of old specimens at CAL, DD and BSD herbaria reveals that it was fairly well distributed but during recent explorations this could be occasionally located due to habitat disturbance.

9. SCROPHULARIA OBTUSA Edgew. ex Hook. f. Fl. Brit. Ind. 4: 254. 1883. (Scrophulariaceae).

Erect herbs up to 90 cm high. Flowers green in cymes. Capsules subglobose. *Fls.* & *Frts.:* July-Oct.

Occasional in damp shady places; Dhanaulti 2440 m, *Royle* or *Jamison* s.n. (DD).

Dist.: Garhwal & Kumaon.

The distribution of this species is known only from Kumaon and Garhwal. Though this species was earlier collected from Dhanaulti but this could not be gathered during recent years from the same locality and also from other areas of Garhwal.

10. INCARVILLEA EMODI (Royle ex Lindl.) Chatterjee in Kew Bull. 1948: 185. 1949. *Amphicome emodi* Royle ex Lindl. (Bignoniaceae).

Gregarious scapigerous herbs with thick leafy rootstocks and large showy rosy pink flowers. *Fls.* & *Frts.:* Feb.-June.

Occasional on east facing shady steep slopes in rock crevices; Lamgbaon 1400 m, *Goel* 65851.

Dist.: Kashmir to Kumaon, Nepal, Pakistan & Afghanistan.

The study of old specimens at CAL and DD reveals that earlier it was frequently distributed from Kumaon to Kashmir but from recent collections and the study of literature it is observed that presently it is occasionally distributed in very few localities on steep rocky habitats near road sides and disturbed due to road construction and quarrying.

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3

Some Remarkable Features of Endemism in Kashmir Himalayas

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Introduction

The phytogeographic analysis of the flora of Kashmir Himalayas—which forms a part of north-west Himalayas—reveals that it supports a large number of endemic species.

Kanai (1963) in his extensive review on the phytogeography of Japano-Himalayan elements did not mention anything about the endemism of two related regions.

So far as the endemism in the Himalayan flora is concerned Banerji (1963) has dealt with this aspect rather meagerly in his analysis on Nepal Himalayas. This work has since been supplemented by Dobremez (1972) who studied the floristic, climatological and phytogeographical aspects of Nepal Himalayas.

However, it may safely be said that except for the classical work of Chatterjee (1939) no other critical assessment of the extent of endemism in varied phytogeographical domains of Indian subcontinent has been undertaken.

The west Himalayan endemics remained almost unworked except for the analysis of the phytogeographical aspects of the flora of Kashmir Himalayas by Dhar (1978); and Dhar and Kachroo (1981).

The present study gives a review of endemism in Kashmir Himalayas with emphasis on the threatened species.

SPECIES COMPOSITION

It is difficult to assess the extent of endemism in a particular family unless both species and varieties (putting together) and species only are taken into consideration (Table 1). There are some genera which are confined to the Himalaya only but there is no such record of its distribution restricted to Kashmir Himalayas, therefore the present study is confined to the specific endemism.

In so far as the monocots (Graminae excluded) are concerned the extent of endemism in Kashmir Himalayas seems to be neglegible; extending not more than 15.94— on the average. The overall mean percentage of the endemic taxa in dicots amounts to 31.38% of the total flora.

Table 1 : Percentage of endemic species in different families of Kashmir Himalayas.

Name of the family	Percentage endemic species (50% or more)		Name of the family	Percentage endemic sp. (Less than 50%)	
	Spp. and var.	Spp. only		Spp. and var.	Spp. only
Saxifragaceae	58.57	32.14	Ranunculaceae	29.30	21.74
Fumariaceae	52.00	52.09	Caprifoliaceae	29.17	16.67
Violaceae	50.00	33.33	Asclepiadaceae	28.57	28.57
Rutaceae	50.00	50.00	Euphorbiaceae	28.57	28.57
Valerianaceae	50.00	37.50	Lamiaceae	27.46	23.46
Dipsacaceae	50.00	50.00	Chenopodiaceae	26.32	15.42
Campanulaceae	50.00	33.33	Boraginaceae	25.77	19.59
Gentianaceae	49.09	32.73	Orobanchaceae	25.00	25.00
Apiaceae	45.16	24.19	Urticaceae	25.00	-
Scrophulariaceae	44.71	37.65	Crassulaceae	21.74	21.74
Balsaminaceae	42.86	35.71	Polygonaceae	20.63	11.11
Asteraceae	39.82	39.82	Tamaricaceae	20.00	
Primulaceae	39.53	30.23	Ericaceae	20.00	20.00
Fabaceae	39.20	34.40	Caryophyllaceae	19.44	19.44
Berberidaceae	38.89	27.78	Rubiaceae	19.05	14.29
Aceraceae	33.33	33.33	Rosaceae	18.27	11.54
Parnassiaceae	33.33	--	Onagraceae	17.39	8.70
Boraginaceae	31.34	22.39	Papaveraceae	16.67	8.33

ALPINES VIS-A-VIS ENDEMICS

There seems to be a direct correlation between alpines and endemics in Kashmir Himalayas. A comparative study of the predominant alpine families and their extent of endemism (in percentage) is given in Table 2.

Table 2 : Percentage of endemic taxa in predominantly alpine families of Kashmir Himalayas

S.No.	Name of the family	Percentage alpine species (of total flora)	Percentage endemics (of total flora)	
			Spp. and var.	Spp. only
1.	Primulaceae	58.13	39.53	30.23
2.	Saxifragaceae	57.14	53.57	32.14
3.	Fumariaceae	56.00	52.00	52.00
4.	Dipsacaceae	50.00	50.00	50.00
5.	Scrophulariaceae	47.05	44.71	37.65
6.	Asteraceae	37.72	39.82	33.82
7.	Parnassiaceae	33.33	33.33	—
8.	Gentianaceae	32.72	49.09	32.73

ENDANGERED ENDEMICS

The study of the endemic species not only helps in assessing the age of an area where they occur but is also important in applied botany. About 40— of the endemic species in Kashmir Himalayas are endangered and some of these which are exploited for their economic value in gardens and drug farms are listed below.

1. *Aconitum kashmiricum* Stapf ex Coventry: Flowers blue. July-August. Lidderwat, Apharwat, Amarnath. MEDICINAL.
2. *Acquilegia nivalis* Falc. ex Jackson: Flowers blue. July-August. Apharwat. ORNAMENTAL
3. *Trollius acaulis* Lindl. : Flowers yellow. June-July. Mahdev, Gumri. ORNAMENTAL and FOOD for cattle.
4. *Meconopsis aculeata* Royle: Flowers blue. July-August. Simthan Pass, Rajdhani Pass. ORNAMENTAL.
5. *Corydalis cashmeriana* Royle: Flowers blue. June-July. Mahdev. ORNAMENTAL.
6. *Magacarpaea bijida* Benth.: Flowers yellow. May-June. Apharwat. FOOD for cattle.
7. *Saxifraga jacquemontiana* Decne.: Flowers yellow. July-August. Damamsar. ORNAMENTAL.

8. *Cremanthodium arnicoides* (Wall. ex DC.) R. Good: Heads yellow, drooping. August. Apharwat. ORNAMENTAL.
9. *Saussurea sacra* Edgew.: Creamy heads. August. Harmukh mts. MEDICINAL.
10. *Primula minutissima* Jack ex Duby: Flowers blue. June-July. Apharwat mts. ORNAMENTAL
11 *Gentiana vensuta* Wall. ex Grisch : Flowers blue. July-Aug. Apharwat mts. ORNAMENTAL
12 *Gentiana cachemirica* Decne.: Flowers blue. July-August. Kounsarnag. ORNAMENTAL.
13. *Arnebia benthamii* Benth.: Flower head dirty white. July-August. Tunnel Top. MEDICINAL.
14. *Picrorhiza kurrooa* Royle ex Benth.: Flowers dirty white with exserted stamens. August. Gumri, Rajdhani Pass, MEDICINAL.
15. *Fritillaria roylei* Hook.: Flowers purple. June. Khillanmarg. ORNAMENTAL.

HABITAT STRUCTURE OF ENDANGERED SPECIES

Generally the endangered endemic species are perennials and have a very brief period of growth. They are almost always exposed to ultra violet radiations and face drastic climatic conditions. So, the reproductive capacity and in consequence the natural regeneration and proliferation are reduced.

REHABILITATION OF ENDEMIC ENDANGERED SPECIES

The rehabilitation of endemic endangered species in Kashmir Himalayas can achieve a breakthrough if Botanical Survey of India and other related organizations take the following points into consideration.

(i) Establishment of alpine botanical reserves in Kashmir Himalayas, where a plant taxonomist, cytologist, plant ecologist, plant physiologist and an expert of soil science will work together and study the ecosystem of particular area and thus assess the factors responsible for extinction of such plant species.

(ii) Commercial exploitation of such plants may be stopped and their conservation brought about by appropriate legislative means.

(iii) Agencies responsible for the export of the propagules of ornamental endemics (under the cover of "OF NO COMMERCIAL IMPORTANCE") may be uncarthed and foreign tourists should not be allowed to carry such plant species for cultivation.

(iv) Check-list of such endangered species should be prepared and communicated to various organizations engaged in botanical researches. They may be directed to study the productivity of such species.

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4

New Observations on Distribution of Plants Endemic to India

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Field observations and studies on exsiccata about habitat, altitude and phenology etc. of *Falconeria himalaica* Hook. f., *Chonemorpha griffithii* Hook. f. and *Clarkella nana* (Edgw.) Hook. f. have been made. It is analysed that *F. himalaica* Hook. f. and *C. griffithii* Hook. f. are found at Chamoli and Pithoragarh districts respectively in Western Himalayas, which are altogether new localities, from the earlier known ones on record. As such it is expected that *Clarkella nana* (Edgw.) Hook. f. hitherto represented by very few collections in Indian herbaria may also be spotted from other places of similar altitudes and habitats in the intervening parts of Kumaon and Garhwal. As it has been evidenced in respect of the first two viz., *Falconeria himalaica* Hook. f. & *Chonemorpha griffithii* Hook. f.

Till 1958 *Falconeria himalaica* Hook. f. was known by two collections only, one the classical type material of Falconer and the other by Strachey & Winterbottom, both from Kumaon himalayas. Dr. T. A. Rao rediscovered this monotypic plant at Kalamuni Pass (Pithoragarh District) in 1958. Further between the years 1963 to 1971 various botanists from Botanical Survey of India, Dehra Dun made five collections of this rare element. The latest collection of 1971 at Botanical Survey of India, Dehra Dun from Tungnath area of Chamoli district shows the further extension of this botanical curiosity in Garhwal himalayas.

It will be not out of the way to mention a record of this plant at Central National Herbarium, Howrah; Brandis 1531 from Deoban area (Chakrata).

In 1963 by collection of P. C. Pant 28249, it is observed that *Falconeria himalaica* Hook. f. grows in association with *Bergenia* sp., *Polygonum sphaerocephalum* and *Chamabainia* sp. as an undergrowth of *Quercus-Rhododendron* and *Arundinaria* sp. on moist shady habitat amidst rocky boulders.

Looking into altitudinal range and phenological period, it is observed that this plant occurs between 2500 m -3800 m from third week of April to second week of June in flowering stages. Only in collection of June 1958 and June 1963 fruiting and post fertilization stages respectively are found. Therefore, development of fruits and setting in of seeds thereupon is quite an important point to study and for arriving at conclusion, whether development of fruiting material and seed seeting is a phenomenal behaviour of this rare endemic plant or a matter of chance that all exsiccata till date in Botanical Survey of India have been collected before the fertilization process.

CHONEMORPHA GRIFFITHII Hook. f.

This liana with showy white, fragrant flowers is known for its restricted distribution in Khasia Hills, Sikkim and north-eastern region of Himalayas in the altitudinal range of 1500 m to 1800 m. In 1963 the occurrence of this Apocynaceous liane along Nachni-Tejum in Pithoragarh district at ± 2400 m in an opposite corner to its previous records from north-eastern India is quite an interesting find. A careful study in field and herbarium may provide further new areas of its record in other localities of Western himalayas.

CLARKELLA NANA (Edgw.) Hook. f.

This small Rubiaceous herb is represented till date from Kumaon and Garhwal regions of Western Himalayas. A search of the exsiccata of this herb has revealed that only eight collections of this plant have been made till now viz., two collections between 1884-1957 in 73 years duration from Kapkot/ Loharkhet and same in Kumaon Himalayas; five collections between 1891-1934 in 43 years duration from Mussoorie in Garhwal Himalayas and a solitary collection in 1891 from Rajpur in Dehra Dun.

In spite of active plant collection both in Kumaon and Garhwal regions, long by the botanists of various organizations and other plant collectors, it is interesting to note that, till date only a few number of *Clarkella nana* (Edgw.) Hook. f. exsiccata are on record. All the specimens stated above of this endemic element have been collected in flowering and fruiting stages between August to October ir an altitudinal range of 1650 m to 2000 m as a lithophytic herb.

However if few other intervening pockets in Kumaon and Garhwal region of similar altitude, habitat and climate, as presently known for *Clarkella nana* (Edgw.) Hook f. if explored at right time (since life span of this herb is short), it is hoped that our present number of *Clarkella nana* (Edgw.) Hook. f. collections can be enriched.

5

Rare and Little Known Taxa of Carex Linn. from N. W. Himalaya

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The genus *Carex* L. is unique in its distribution. Most of the carices are found to be growing at very high altitudes which are difficult to be frequently collected. The alpine habitats of many such taxa are rarely stable due to constant glacial activities and subjected to very harsh conditions for their survival.

While revising this genus of N. W. Himalaya (within Indian political boundaries) the authors came across a few taxa which appear to be very rare or await fresh collection. In spite of many botanical explorations even in their type localities these are known either by their mention in literature (Clarke, 1894; Kukenthal, 1909 & Rau, 1975) and types (marked with an asterisk) or have been collected after many decades. Such taxa are enlisted below.

**Carex annulata* Kukenthal, *C. haematostoma* Nees var. *submacrogyna* Kukenthal, **C. munroi* Clarke and **C. praestans* Clarke.

The first three are not represented in Indian herbaria. We may safely keep the above taxa in the category of 'insufficiently known plants' and as these are endemic to their type localities this threatened state may result in their total loss.

Although it has not been possible to study all of them but in order to look forward for their conservation, a short description with flowering and fruiting period (where possible) and distribution is provided here.

1. C. ANNULATA Kukenthal in Engler, Pflanzenr. Ht. 38: 494. 1909. *C. oligocarpa* Clarke in Hook. f. Fl. Brit. Ind. 6: 746. 1894 (err. typ. *oligocarya*), non Schkukr.

Rhizomes woody, oblique, caespitose. Stems 12-24 cm, triquetrous, scabrous above. Leaves shorter than the stem, 1.2 mm broad, leaf-sheaths brown. Spikes 2-4, terminal one wholly male, subsessile. Female spikes peduncled with 4-1 utricles. Utricles obovoid-ellipsoid, pilose, suddenly narrowed into a long deeply notched beak, Stigma 3.

Distribution : N. W. TIBET: Dras to the Karakorum.

So far known only from the types. Clarke no. 30436 & 30533 collected from Karakorum and Dras-Skardo respectively.

2. C. HAEMATOSTOMA Nees var. SUBMACROGYNA Kukenthal in Engler, Pflanznr. Ht. 38: 561. 1909; Stewart in Bull. Bot. Surv. Ind. 9: 153. 1967. *C. macrogyna* Boott, Illustr. 1: 22. t. 7. 1858, non Turez.

Spikes 3-4, approximate, upper ones sessile, lower distant and shortly peduncled. Female glumes obovate, apex thin.
Distribution: KASHMIR.

Thomson collected this variety from West Tibet. As regards to the date of Thomson's collection, following remark about his botanical trip in this area as recorded by Burkill (1965) is valuable.

Page 128 "———he was called in 1847 from the medical charge of troops to serve as one of three Commissioners who were to report on the geography and general conditions of the Kashmir-Tibet border'.

In recent years Stewart has added to the collection of this variety. He collected it from Satpura and the date of this collection is 1.8.1940. His collections are deposited at KEW only.

3. C. MUNROI Clarke in Hook. f. Fl. Brit. Ind 6: 738 1894; Kukenthal in Engler, Pflanzenr. Ht. 38. 660. 1909; Rau High Altitude Fl. Plts. 191. 1975.

Stems up to 90 cm. Leaves shorter than the stem, 3 mm broad. Spikes 5-6, lowermost remote on capillary peduncles, terminal male with one utricle at the base, linear. Female glumes ovate, acute, hardly mucronate. Utricules ellipsoid, trigonous, imperfectly nerved, thin, glabrous. Stigma 3.
Distribution: HIMACHAL PRADESH: Kanpur.

This species is based on the single collection made by Munro (no. 2431). After Munro, this has never been collected. Unfortunately it has not been possible to trace where Munro's collections are deposited.

4. C. PRAESTANS Clarke in Hook. f. Fl. Brit. Ind. 6: 723. 1894. *C. mysurus* Nees var. *praestans* (Clarke) Kukenthal in Engler, Pflanzenr. Ht. 38: 259. 1909.

Robust sedges. Stems up to 3 ft. Leaves as long as the stem. Inflorescence 2 ft. long. Spikes many, peduncled, androgynaeceous with 6-7 female flowers below only. Female glumes elliptic-lanceolate, hardly mucronate, pale, longer than the utricles. Utricles ovoid-trigonous, minutely hairy above, beak short. Stigma 3.
Flowering & Fruiting –July.
Distribution: Kumaon.

Known only from the collection made by Duthie (no. 6118). Duthie's collection on 15.7.1886 is in DD herbarium.

Acknowledgements

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6

Delphinium uncinatum Hook. f. & Thoms. (Ranunculaceae) and Lilium wallichianm Schultes f. (Liliaceae)—Two Rare Finds from North-West Himalayas

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Delphinium uncinatum Hook. f. & Thoms. and *Lilium wallichianum* Schultes f. have been rediscovered from Chamba district (Himachal Pradesh) and Chamoli district (Uttar Pradesh) respectively after over a century. There is no record of their recent collections from the North-West Himalayas in BSD, DD and CAL herbaria. The rarity of these species and information on their distribution other than the type locality is significant phytogeographically. The possibility of their occurrence in other similar sectors of the North-West Himalayas can not be ruled out.

The description, habit, habitat and other observations of these two species are reported and discussed in the present paper.

DELPHINIUM UNCINATUM Hook. f. & Thoms. in Hook. f., Fl. Brit. Ind. 1: 24. 1872; Munz in J. Arnold Arb. 48: 300 1967.

Erect herbs, ± 90 cm tall.

The species was described by Hook. f. & Thoms *(loc. cit.)*, based on the collection from the Salt Range of Pakistan by Vicary and from Banihal to Marri, West Himalaya by Winterbottom. Subsequently, there appears to be no report of its collection from India, Munz *(loc. cit.)* has included this species in his 'Synopsis of the Asian species of *Delphinium*' and reported its distribution in West Pakistan (Punjab, Beluchistan), Afghanistan and Kashmir, but there is no citation of its recent collection from India. The authors, inspite of a thorough search could not trace a single herbarium specimen in the Indian herbaria.

The varied rich flora of Chamba district has attracted the plant explorers since the 18th century (Gammie 1898, Shabnam 1964, Gupta 1964, 1971). A large number of specimens collected from this region are represented in Indian as well as foreign herbaria. Interestingly, *Delphinium uncinatum* Hook. f. & Thoms. could not be collected until the senior author (BSA) relocated it in April 1979 during his tour to this area for the collection of plants for the biological screening programme of the Institute; this rare species was found in

the shady slopes of *Quercus-Rhododendron* forest, about 1 km from the main Chamba township.

The plant has a short life span (April-May) and probably escaped the notice of the earlier plant collectors, most of whom visited the area in the months of June-October. This extremely rare and interesting species, which has been recollected after a lapse of over 10 decades, represents the only collection from India and is preserved in the herbarium of the Central Drug Research Institute, Lucknow.

Specimens examined : Himachal Pradesh: Chamba district-1 km from Chamba town (1500 m), 23 April 1979, *B. S. Aswal* 11913 (CDRI).

LILIUM WALLICHIANUM Schultes f., Syst. Pl. 7: 1689. 1830; Hook. f., Fl. Brit. Ind. 6: 349, 1892; Duthie, Cat. Pl. Kumaon 188, 1906.

A bulbous, unbranched, erect herb with creeping rootstock.

Schultes f. (1830) described this species, based on the collection from Nepal by Wallich. Hook f. *(loc. cit.)* reports its distribution in Kumaon and Nepal. Duthie *(loc. cit.)* has reported its presence in Kumaon. A perusal of the literature and a thorough search in the herbaria (BSD, DD, CAL) have shown that this species neither reported nor collected from the North-West Himalayas during the 19th century. The recollection of this interesting, rare sweet-secented lily from Sonprayag in Chamoli district (U.P.) after a lapse of over 13 decades represents the only recent collection from North-West Himalayas and is significant.

Specimens examined : Uttar Pradesh : Chamoli district, Sonprayag (1600 m), 21 Aug. 1977, *B. N. Mehrotra* 5897 (CDRI); Mussorie, 10 Sept. 1845; *Duthie*, s.n. (DD); Kumaon, below Dwalee, 16 Oct. 1848, *Strachey & Winterbottom* 1 (CAL); Kumaon, *Wallich* 5076, 5076A, 5076B (CAL).

DISCUSSION

In view of the recent recollection of the two rare plants *Delphinium uncinatum* Hook. f. & Thoms. and *Lilium wallichianum* Schultes f. from the North-West Himalayas, the authors suggest the following points to be given due consideration in ascertaining an endemic, threatened or rare status of a taxon.

The taxon believed to be rare, endemic or threatened should be thoroughly searched in the field from where it was collected and in the herbarium from where it was reported. Extensive as well as intensive search should be made in the similar eco-climatic zones to explore the possibility of its occurrence.

Exploratory tours should be arranged after due consideration of the season of occurrence, habit, habitat and association of a taxon, to rule out the possibility of its escaping notice.

A taxon should not be considered to be rare, endemic or threatened simply on the basis of its old herbarium records, single report or the old literature.

A taxon may be rare in one place but it may not be so in the other place. For example, the occurrence of *Ferula jaeschkeana* Vatke is rare in Garhwal but

common in Lahul valley, Himachal Pradesh. A careful search in other similar geographical regions may throw more light on the broader distribution as well as in deciding the status of those plants which are rare in herbarium records.

The causes of rarity of a taxon should be investigated and suitable protective measures should be taken to ensure its survival in the natural habitat.

Acknowledgements

The authors are thankful to the authorities of Central National Herbarium, Calcutta, Forest Research Institute, Dehra Dun and Botanical Survey of India, Dehra Dun for permission to consult their herbaria, and to the Director, Central Drug Research Institute, Lucknow for the facilities provided.

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7

Endemic Species of Poaceae in N. W. Himalaya

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The Indian NW Himalaya comprises Jammu & Kashmir, Himachal Pradesh States and Garhwal & Kumaon divisions of Uttar Pradesh State. Earlier Chatterjee (1940) has studied the endemic flora of India and Burma. For the present investigation, the decision regarding the endemic species has been made on the basis of works of Hooker (1897), Bor (1960), Gupta (1970) and Birari (1973) and after screening them through other floras either of different regions or of neighbouring countries. The herbarium of the Botanical Survey of India, Northern Circle, Dehra Dun, a representative of recent collections from NW Himalaya, has been consulted. The species available in this herbarium have been indicated by the acronym BSD in paraenthesis.

ENUMERATION OF SPECIES

1. *Agropyron cognetum var. ahingoense* Melderis
   Distr.—Jammu & Kashmir; Shingo valley.
2. *Agropyron duthiei* Melderis
   Distr.—Himachal Pradesh; Simla.
3. *Agropyron deutatum* Hook. f. var. *elatum* Hook. f.
   Distr.—Jammu & Kashmir.
4. *Agropyron dentatum* Hook. f. var. *kashmiricum* Melderis
   Distr.—Jammu & Kashmir.
5. *Agropyron semicostatum* Nees ex Steud. var. *thomsonii* Hook. f.
   Distr.—Himachal Pradesh; Kinnore, Spiti.
6. *Agropyron striatum* Nees ex Steud. (BSD).
   Distr.—Jammu & Kashmir.
7. *Agropyron striatum* Nees ex Steud. var. *validum* Melderis
   Distr.—Jammu & Kashmir; Srinagar.
8. *Agrostis pilosula* Trin. var. *royleana* (Trin.) Bor
   Distr.—Jammu & Kashmir; Himachal Pradesh; Simla.
9. *Arundinaria falcata* Nees
   Distr.—Himachal Pradesh; Simla.
10. *Arundinaria jaunsarensis* Gamble
    Distr.—Garhwal; Jaunsar.
11. *Arundinaria spathiflora* Trin.
    Distr.—West Himalaya.

12. *Bromus japonicus* Thunb. var. *falconeri* (Stapf) Stewart (BSD)
    Distr.—NW Himalaya.
13. *Calamagrostis pseudophragmites* (Hall. f.) Koeler var. *tartarica* (Hook. f.) Bor. (BSD).
    Distr.—Jammu & Kashmir; Himachal Pradesh; Lahul.
14. *Calamagrostis stolizkai* Hook. f.
    Distr.—Jammu & Kashmir; Ladakh, Zanskar.
15. *Catabrosa aquatica* (L.) P. Beauv. var. *angusta* Stapf
    Distr.—Jammu & Kashmir; Ladakh.
16. *Cymbopogon distans* (Nees ex Steud.) Wats. var. *mundensis* B. K. Gupta
    Distr.— Jammu & Kashmir; Upper Munda.
17. *Cymbopogon ladakhensis* B. K. Gupta
    Distr.—Ladakh.
18. *Cymbopogon motia* B. K. Gupta
    Distr.—Kumaon; Haldwani.
19. *Cymbopogon parkeri* Stapf var. *jammuensis* B. K. Gupta
    Distr.—Jammu & Kashmir; Jammu.
20. *Cymbopogon ramnagarensis* B. K. Gupta
    Distr.—Jammu & Kashmir; Ramnagar.
21. *Deyeuxia kashmeriana* Bor
    Distr.—Jammu & Kashmir; Astor valley.
22. *Deyeuxia simlensis* Bor (BSD).
    Distr.—Himachal Pradesh; Simla.
23. *Digitaria sanguinalis* (L.) Scop. subsp. *aegyptiaca* var. *furmentacea* Henr.
    Distr.—Jammu & Kashmir valley.
24. *Digitaria stewartiana* Bor
    Distr.—Jammu & Kashmir; Ladakh.
25. *Elymus nutans* Griseb. var. *albidus* Melderis
    Distr.—W. Himalaya.
26. *Eulalia hirtifolia* (Hack.) A. Camus
    Distr.—NW Himalaya.
27. *Eulaliopsis duthiei* P. R. Sur
    Distr.—Garhwal; Tehri.
28. *Festuca levingei* Stapf
    Distr.—Jammu & Kashmir.
29. *Festuca lucida* Stapf
    Distr.—Himachal Pradesh: Lahul; Garhwal: Jaunsar.
30. *Festuca modesta* Steud.
    Distr.—NW Himalaya.
31. *Festuca nitidula* Stapf
    Distr.—Jammu & Kashmir: Ladakh (Nubra); Kumaon.

32. *Festuca rubra* L. ssp. *kashmiriana* (Stapf) st. Yves (BSD).
Distr. --NW Himalaya.
33. *Imperata cylindrica* (L.) P. Beauv. var. *latifolia* (Hook. f.) C. E. Hubbard
Distr. - Garhwal; Dehra Dun; Kumaon.
34. *Ischnochloa falconeri* Hook. f.
Distr.—Garhwal: Mussoorie.
35. *Lophochloa clarkeana* (Domin) Bor
Distr. -Jammu & Kashmir.
36. *Oryzopsis humilis* Bor
Distr.-- Garhwal; Deoban.
37. *Oryzopsis stewartiana* Bor
Distr.- -Himachal Pradesh: Parbatti valley.
38. *phalaris minor* Retz. var. *nepalensis* (Trin.) Bor
Distr.—Garhwal.
39. *Poa koelzii* Bor (BSD).
Distr.—Jammu & Kashmir: Ladakh.
40. *Poa lahulensis* Bor (BSD).
Distr.—Jammu & Kashmir: Ladakh; Himachal Pradesh; Lahul.
41. *Poa nepalensis* Wall. ex Duthie (BSD).
Distr. - -Himachal Pradesh: Dalhousie, Kulu; Garhwal: Tehri.
43. *Poa pseudamonena* Bor
Distr.—Garhwal: Tehri.
44. *Poa stapfiana* Bor var. *stapfiana* Bor (BSD).
Distr.- NW Himalaya.
45. *Poa stapfiana* Bor var. *micranthera* (stapf) Bor
46. *Pogonatherum santapaui* P. R. Sur
Distr.— Garhwal.
47. *Pseudodanthonia himalaica* (Hook. f.) Bor
Distr. -Himachal Pradesh: Kinnore: Garhwal: Jaunsar, Tehri.
48. *Puccinellia thomsonii* (Stapf) Stewart
Distr. -Jammu & Kashmir: Pugha valley, Rupahu.
49. *Schizachyrium impressum* (Hack.) A. Camus
Distr. Jammu & Kashmir: Kishtwar.
50. *Sehima notatum* (Hack.) A. Camus
Distr. -Himachal Pradesh: Chamba; Kumaon: Almora.
51. *Spodiopogon dubius* Hack. (BSD).
Distr.-- NW Himalaya.
52. *Stipa duthiei* Hook. f.
Distr.—Garhwal: Tehri.
53. *Themeda decurzii* Birari
Distr. Garhwal: Mussoorie.
54. *Trisetum micans* (Hook. f.) Bor (BSD).
Distr.-- Garhwal: Tehri.

Conclusion

A study on endemic flora of Poaceae in Indian NW Himalaya reveals that 54 taxa (51 species with 2 subspecies and 17 varieties) belonging to 28 genera are endemic. An analysis reveals that only 8 taxa are common to all states/regions; while most of them exhibit restricted distribution *viz.* 20 in Jammu & Kashmir, 10 in Garhwal, 5 in Himachal Pradesh and 2 in Kumaon. A few genera *viz. Agropyron* Gaertn., *Cymbopogon* Spreng., *Festuca* L., *Poa* L. etc. have many endemic species need taxonomic revision. A further consultation of BSD herbarium, which comprises of recent collection shows that only ±20 of the endemic species could be re-collected suggesting for a thorough extensive and intensive collection programme for this family. Many endemic species not collected for long time are envisaged at the verge of extinction.

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8

Is Sahastradhara a Threatened Type Locality ?

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Sahastradhara lies between 30°23" N and 78.8" E. It is 15 Km from Dehra Dun and is situated at an altitude of about 800 m. It is a renowned picnic spot and large number of people frequent the place to have dip in the sulphur springs.

From the early part of the 19th Century many eminent botanists including J. F. Royle visited this place for plant collection and described many new species from Sahastradhara. He wrote "The low range of hills is covered with trees and the herbaceous vegetation and the valley of Deyra, in the uncleaned parts with dense and almost impenetrable forests. "

Now this situation is a thing of the past. The vegetation is degraded and there are no primary forests around Dehra Dun. With a view to find out the distribution of species originally described from Sahastradhara, the author selected three species viz., *Pittosporum eriocarpum* Royle, *Sophora mollis* (Royle) Baker, and *Itea nutans* Royle. The field studies show that they are not common. This may be safely attributed to biotic factors. A tourist spot that Sahastradhara is, it continues to face the devastating affects of human interference and lime quarrying has been an exacerbating factor. It is suggested that before these species disappear adequate measures be taken to protect them in their original home by preserving the locality.

A short description is provided for each species so that others can locate them in other adjoining areas.

PITTOSPORUM ERIOCARPUM Royle, Illustr. Bot. Himal. 1:77. 1834; Hook f. & Thoms. in Hook. f. Fl. Brit. India 1: 199. 1872 (Pittosporaceae).

Shurbs or small trees, stem, leaves and inflorescence tomentose; leaves broadly obovate-oblong to oblanceolate-oblong; capsules 2-valved.

Fls.: March-May; Frts.: April-Oct.
Distrib.: Uttar Pradesh: endemic to Garhwal-Kumaon.
Uses : The bark, aromatic when freshly cut is said to possess narcotic properties and is used locally in chronic bronchitis. The wood is used only for fuel.

That this species was common in Dehra Dun, Mussoorie and Sahastradhara is evident from literature and herbarium hoardings. Inspite of my four visits to Sahastradhara I could not locate even a single plant of this species. Either the

plant has become extremely scarce and is left only in very small pockets needing a thorough combing of the place or perhaps wiped out? The combined affect of biotic factors such as large scale developmental work going on in this region, lime quarrying, construction of roads, lopping of trees for fire wood may be the cause for the rarity.

SOPHORA MOLLIS (Royle) Baker in Hook. f. Fl. Brit. India 2:251. 1878. *Edwardsia mollis* Royle, Ill. Bot. Himal. 196. t. 32. f. 2, 1835.

Shrubs 1-2.5 m high, Leaflets 21-35, elliptic, finely downy. Flowers in short dense axillary racemes. Corolla yellow. Pods moniliform, 4-6 seeded.
Fls. & Frts: March to June.
Distribution: INDIA: Western Himalayas. (Uttar Pradesh, Himachal Pradesh); PAKISTAN, AFGHANISTAN.
USES : The wood is used for fuel and the leaves and twigs for fodder.
Habitat: On open hill slopes along with *Murraya koenigii, Phoenix humilis, Mallotus philippensis, Cocculus laurifolius, Eupatorium* sp. etc

Though the species is found to occur in different localties of N W. Himalaya, it has become rare, in its type locality. During my visit I could locate a group of less than a 100 plants. Though my visits were made during the flowering and friuting season, I could see only a few plants in flowers but not in fruits. The goats are apparently fond of this plant and most of the plants are trimed of their tender shoots, leading to poor flowering and fruiting.

ITEA NUTANS Royle, Illustr. Bot. Himal. 226. 1835; C. B. Clarke in Hook. f. Fl. Brit. Ind. 2:408. 1878.

Shrubs or small trees. Leaves elliptic-oblong, veins conspicuous on both sides. Racemes solitary, elongate, exceeding the leaves. Petals white.
Fls. & Frts.: April-July.
Distrib.: North-western Himalayas.
Habitat: On open hill slopes along with *Cocculus laurifolius, Murraya koenigii* etc.

This species is becoming scarce in vicinity of Dehra Dun due to large scale developmental works taking place in this region.

In conclusion it is emphasized that Sahastradhara is not only the type locality of the species mentioned above, but also harbour many species occuring in higher altitude as well as species of the plain. Many of these species are rare ones. That being the case it is only necessary to preserve the whole locality.

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9

Exploitation and Threat to Survival of some High Altitude Plants in Garhwal Himalaya

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Himalaya have been the source of cultural, spritual, physical and biological wealth, of which, biological aspects are predominant. Many workers have paid attention to the study of vegetation of this area (Duthie, 1906; Osmaston, 1927; Rau, 1961; Semwal and Gaur, in press). With the development of civilization our dependence on plants have increased many fold in many ways, coupled with the dependence on plants certain developmental processes i.e. Tourism, Natural Parks, Reserves etc., have also greatly influenced the vegetation of this part. It is therefore essential to understand the vegetational pattern with reference to modern requirements and developments. Under these circumstances many of the plants are facing difficulties in their normal living pattern. Thus, they are facing the danger of extinction.

The authors are engaged on the systematic study of plants of high altitude for many years and the present communication is based on the floristic and ecological study of high altitude plants with continuous observations on the factors resulting the limitations in the distribution of plants.

Though, studies were conducted on the high altitude plants in Garhwal Himalaya covering about 308 species, the present data (Table-1) includes only those plants which are facing different types of pressures for their normal perpetuation and distribution.

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Table—1 : PLANT SPECIES FACING RARITY. Those marked with an asterisk are already rare in their natural habitat, although, not under heavy Biotic Pressure.

Plant species	Range of distribution (x100 m)	Biotic pressure	Frequency index in nature	Flowering season
RANUNCULACEAE				
Aconitum balfourii Stapf	30-40	M,O	-	August-Sept.
A. heterophyllum Wall. ex Royle	-do-	M,O	R	-do-
Caltha palustris L.	-do	M, O, Re	+ +	May-June
Delphinium vestitum Wall.	30-45	M, O	-R	Sept.-Oct.
**Thalictrum alpinum* L.	30-50	M	R	June-July
**T. chelidonii* DC.	25-35	M, O	R	Sept.-Oct.
BERBERIDACEAE				
Berberis spp.	10-50	M, E, O	+ +	March-June
Podophyllum hexandrum Royle	25-45	M, O, E	R	May-June
CIRCAEASTERACEAE				
**Circeaster agrestis* Maxim.	34-36	O	R	July-Aug.
GERANIACEAE				
**Geranium polyanthes* Edgew.	25-35	O	R	-do-
RUTACEAE				
Skimmia laureola Sieb. & Zucc.	20-32	M, O	R	June-July
ROSACEAE				
**Fragaria daltoniana* Gay	25-35	E, O, E	R	June-July
**Potentilla eriocarpa* Wall.	25-40	O	R	Aug.-Sept.
**P. gelida* C. A. May.	25-35	O, N	R	July-Aug.
SAXIFRAGACEAE				
**Saxifraga filicaulis* Wall.	30-45	O	R	July-Aug.
**S. hispidula* D. Don	-do-	O	R +	-do-
VALERIANACEAE				
Nardostachys jatamansi DC.	30-40	M, O	+ +	July-Aug.
ASTERACEAE				
Saussurea gossipiphora D. Don	40-50	M, O; Re	+	Aug.-Sept.
S. obvallata DC.	38-48	M, O, Re	+ +	-do-
ERICACEAE				
**Rhododendron lapidotum* Wall.	25-40	O, M, Re	+	June-July
PRIMULACEAE				
**Primula reidii* Duthie	29-38	O	R	July-Aug.
**P. macrophylla* D. Don	30-48	O	+	June-July
SCROPHULARIACEAE				
**Falconeria himalaica* Hook. f.	30-36	O	R	-do-
OROBANCHACEAE				
**Boschniakia himalaica* Hook f.	25-32	O, M	R	-do-
ORCHIDACEAE				
**Cypripedium elegans* Reichb. f.	32-38	O	R	June-July
**Orchis latifolia* L.	25-39	M, O	+ +	July-Aug.
SCITAMINACEAE				
Roscoea alpina Royle	25-36	M, O	+ +	June-July
LILIACEAE				
**Nomocharis nana* Klotzsch	30-38	O	R	May-June

Abbreviations and Signs : M-Medicinal; O-Ornamental; E-Edible; Re-Religious; R-Rare; + + —Near to rarity; +—Very near to rarity.

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10

Endangered Medicinal & Aromatic Taxa of U. P. Himalaya

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The U.P. Himalaya (also known as Kumaon or Garwal Himalaya) is a mountain range of 320 km, and forms a part of Western Himalaya, that extends between river Kali in the East and the great defile of Sutlej in the West. The major portion of this region is mountainous and there is no peak over 8000 metres. The topography of this region is undulating and characterised by high hills, spreading high valleys and snow capped mountain ranges that cover an area of about 38,000 km. This region comprises of eight hilly districts, Pithoragarh, Chamoli, and Uttarkashi (all together known as Uttarkhand), Almora, Nainital, Pauri, Tahri and Dehradun.

The range of altitude, temperature, rainfall and soil result in an abundance of varied plant life including wild growing medicinal and aromatic plants. Geographically also it is an important zone as it joins the Central and the Western Himalayas.

In this region traditional exploitation of medicinal and aromatic plants, has its roots in the remote past. And, at present about 200 items of assorted medicinal and aromatic plants are extracted and traded from this region (Shah, 1975). Obviously, the continued exploitation has caused depletion of certain taxa of this region and these will be considered in this communication as endangered.

Different authors like Ayensu (1974), Given (1976) and Jain & Sastry (1980) have laid out certain criteria for selecting endangered, threatened and rate taxa etc. But, in this communication only those taxa have been selected that are potentially becoming rare due to over exploitation and urgently need protection and monitoring. However, this region in particular does not contain any other endemic medicinal and aromatic plant taxa except *Aconitum falconeri*.

The endangered taxa have been enumerated here with their local names, parts used, habit and habitat, general distribution and remarks.

List of the endangered medicinal and aromatic taxa :

Gentiana kurooa Royle (Gentianaceae)

Local name	: Karu
Trade name	: Indian Gentian
Parts used	: Roots & rootstock
Uses	: Used in unani system of medicine and in liquor industry.

Habit & habitat : A decumbent herb reported to occur from 1000 to 3000 m.
General distribution : Reported from Western Himalaya 1200 to 3000 m.
Remarks : This plant was reported by Stachey & Duthie (1906) from Shioli and Rajhoti and Atkinson (1882) had reported its collection for trade purpose from this region. Recent floristic and medicinal plant surveys have not recorded this plant from this region.

Cinnamomum glanduliferum Meisson (Lauraceae)
Trade name : Sucandh kokila, Malgiri
Parts used : Fruits
Uses : The fruits are aromatic and used in preparation of 'Attar'.
Habit & habitat : A small tree about a meter girth found in oak forest. Reported from Eastern portion of Almora.
General Distribution : Central Himalaya
Remarks : This plant was reported by Osmaston (1927) from Pithoragarh, after that there is no record of its collection from this region.

Aconitum heterophyllum Wall. (Ranunculaceae)
Local name : Atees
Trade name : Atees, Meethi atees
Parts used : Tuberous root
Uses : Used in ayurvedic and unani system of medicine and also by the local inhabitants in medicine. Shah & Joshi (1971).
Habit & habitat : An erect herb found in forest and open meadows above 3000 m.
General Distribution : Western & Central Himalayas 2000 to 4000 m.
Remarks : In recent years this plant has been mercilessly extracted from this region. It is difficult to find the plant in open meadows owing to indiscriminate exploitation by the local inhabitants and due to unrestricted grazing. Shah & Yadav (1970) report that the destribution of this taxa is receding to upper limits in U.P. Himalayas due to over exploitation.

Aconitum balfourii Stapf
Aconitum falconeri Stapf : (Ranunculaceae)
Local name : Gobaria vish and Telia vish respectively, Meetha.
Trade name : Aconite, Bachnag
Parts used : Tuberous roots.

Uses : Used in ayurvedic and unani system of medicine. Roots are poisonous.

Habit & habitat : These are tall herbs found as undergrowth in the alpine forest above 3000 to 4000 m.

General Distribution : *A. balfourii* in U.P. Himalaya and Central Himalaya and *A. falconeri* U.P. Himalaya. (Endemic to this region).

Remarks : Though the extraction of aconites is prohibited in the U.P. Himalaya the local inhabitants exploit the drug as it fetches good market price.

Angelica glauca Edgew. (Umbelliferae)

Local name : Chora, Gandrayan.

Trade name : Angelica.

Parts used : Roots and rootlets.

Uses : Used by the local inhabitants for seasoning curry etc. and also in medicine. Recently its essential oil has also come into market which is used for flavouring purpose.

Habit & habitat : A tall stout herb growing as undergrowth in open oak forest.

Remarks : The local inhabitants indiscriminately exploit this plant and the roots are sold in the local market about Rs. 2/-a tola.

Shah & Mitra (1974) reported, "In Kedarnath at a distance of about 3 miles in the north west there is a small lake known as 'Chorabarital'. According to local people the surrounding slopes of this lake were full of 'Chora', and hence, the name 'Chorabarital. But, one of the authors (Shah) visited the place in 1969 and found that there was no trace of the species due to indiscriminate collection by the local inhabitants. The name of the place has recently been changed from 'Chorabarital' to 'Gandhi sarovar".

Dioscorea deltoidea Wall. (Dioscoreaceae)

Local name : Kin, Gun, Shingri mingri (Garwal).

Trade name : Dioscorea.

Parts used : Tuberous rhizome.

Uses : Tuberous rhizomes are used for extracting steroidal saponin, diosgenin. Diosgenin is a precursor of cortisone, hydro-cartisone, sex hormone and anti fertility drugs largely used in modern medicine.

Habit & habitat : A tuberous perennial climbing herb with twining annual stem. Generally found in forest and open fields on *Berberis*, *Zanthoxylum* and *Principia utilis* shrubs from 1500 to 3200 m.

General Distribution : Western & Central Himalaya upto Sikkim, Indo China and West China.

Didymocarpus pedicillata R. Br.
and *Didymocarpus aromatica* Wall. ex D. Don (Gesneriaceae)

Local name : Pather chatta, pather leong.

Trade name : Kumu kum

Parts used : Young aromatic curled leaves.

Uses : Mainly used in perfumery industry.

Habit & habitat : A small herb with spreading radical leaves found usually in rock crevices or surface mostly on shady and moist places from 1000 to 2000 m.

General Distribution : *D. aromatica* from U.P. Himalaya to Sikkim and *D. pedicillata* from Punjab Himalaya to Bhutan.

Remarks : While picking the young curled leaves the whole plant is taken out by the local inhabitants and this practice destroys the plant.

Jurinea macrocephala Benth. (Compositae)

Local name : Guggul

Trade name : Guggul dhoop, Dhoop.

Parts used : Roots.

Uses : Used by the local inhabitants as incense and traded for preparation of 'Attar'.

Habit & habitat : A woody perennial herb with radical leaves and without aerial stem. Roots aromatic. Found usually on open meadows above 3000 m.

General Distribution : Western Himalaya.

Remarks : The roots are extracted by the local inhabitants and thus destroying the entire plant. In Himachal Pradesh (according to Gupta et al., 1961) "The plant is found to grow on all types of soil and topography but flourishes well in open sunny localities on deep, moist, well drained loamy alpine pasture soil. It prefers the northern slopes".

Microstylis wallichii Lindl. (Orchidaceae)

Local name : Lahsunia.

Trade name : Jivak, Rishvhak.

Parts used	:	Tuberous roots.
Uses	:	Used in ayurvedic system of medicine as one of the ingredient of 'ashtawarga' used in tonic preparations.
Habit & habitat	:	A small herb about 20 cm high, found in the open pine or oak forests from 2000 to 2500 m.
General Distribution	:	Punjab himalaya to Eastern Himalaya and also in Travancore and Andaman.
Remarks	:	The plant is becoming rare day by day due to indiscriminate exploitation

Nardostachys jatamansi DC. : (Valerianaceae)

Local name	:	Mansi, Jatamansi
Trade name	:	Spikenard, Jata mansi, Balchand.
Parts used	:	Rhizome
Uses	:	It is used in ayurvedic system of medicine and in perfumery. Local inhabitants use it like incense. It is also exported.
Habit & habitat	:	An erect hairy rhizomatous herb. Usually found on the rocky slopes in the alpine meadows above 3000 m.
General distribution	:	U.P. Himalaya to Eastern Himalaya.
Remarks	:	To meet the demand of the country and for export purpose more than 1200 quintals of this drug is annually obtained from Nepal apart from country's own sources that are depleting day by day.

Orchis habernarioides King and Pantl. (Orchidaceae)
Orchis latifolia Linn.

Local name	:	Salam Panja, Hatha Jori
Trade name	:	Salam panja, Salep.
Parts used	:	Tuberous roots.
Uses	:	Salep is used extensively in the ayurvedic & unani tonic preparations.
Habit & habitat	:	A herb mostly found in *Quercus* and *Betula* forests on moist and humus soil and also in meadows. 2500 to 3000 m.
General distribution	:	*O. habernarioides* in Western, Central and Eastern Himalaya. *O. latifolia* Western Himalaya to Central Himalaya from 2500 to 3500 m. Afghanistan, N. Africa, Europe and North Asia.
Remarks	:	Both the taxa are rare in this region. Stating about the distribution of *O. latifolia* Gupta (1966)

remarked "Poor distribution of the plant in its natural habitat in India, which once might have had rich growth may invariably be due to lack of protection against grazing and probably due to continued exploitation of the tubers". India meets its major demand of the Salap by export (Shah, 1981).

Polygonatum verticillatum Alloni (Liliaceae)
Polygonatum cirrhifolium Royle

Local name	:	Banchuri, Salam misir.
Trade name	:	Meda and Mahamada, Salammisri.
Parts used	:	Rhizome.
Uses	:	Used in ayurvedic and Unani tonic preparation.
Habit & habitat	:	*P. verticillatum* is a tall perennial herb 1·5 to 1·75 m. high with stout rhizome, found usually as under growth in open forest 2500 to 3200 m. *P. cirrhifolium* is comparatively smaller herb 0·9 to 1 m. high found near tree line. Rhizome chain is thinner than the former.

Rheum emodi Wall. ex Meissn. : (Polygonaceae)
R. spiciforme Royle
R. webbianum Royle

Local name	:	Dolu, archu
Trade name	:	Rewand chini, Rhubarb.
Part used	:	Root & rootstock.
Uses	:	Used in ayurvedic and unani medicine as laxative and tonic. Local inhabitants also use in cuts and burns. (Shah & Joshi, 1971).
Habit and habitat	:	Stout and tall herbs found 3500 to 4000 m. in rocky meadows and open forests.
General distribution	:	*Rheum emodi* & *R. webbianum* Western and Central Himalaya. *R. spiciforme*.—Western Himalaya.
Remarks	:	It is becoming rare in this region due to extraction of the roots.

Valeriana jatamansi DC.	:	(Valerianaceae)
Local name	:	Samyo, Sumya.
Trade name	:	Sugandhbala, Muskbala, Tagar, Asaru.
Parts used	:	Roots without rootlets.
Uses	:	Used in ayurvedic and unani medicine and, also in allopathic system as tincture; used in perfumery; incense and tobacco industry. It is also exported.

Habit & habitat	: An hairy dacumbent herb found in moist and shady localities from 2000 to 2500 m.
General distribution	: Western, Central and Eastern Himalaya; Afghanistan and China.
Remarks	: Due to brisk demand in the market it has been so indiscriminately extracted from this region that it is seldom seen in those localities where it was found in abundance.

Discussion

It augurs well that the Forest Department of U.P. had realized the need of protecting some of the wild growing medicinal and aromatic plants and banned 10 species which were getting rare (Sinha, 1975). The order to bar their export for three years came into force from 1-10-1974. The banned species are as under :

Name of plant	*Vernacular name*	*Area banned for extraction*
1. *Aconitum heterophyllum*	Atis	Barhat range, Uttar Kashi
2. *Berberis* spp. (roots)	Kilmora	Throughout hills
3. *Didymocarpus latifolia*	Pathar laung	Manora (Nainital Mamuna Shivpur range (Mussoorie)
4. *Ephedra* spp.	Som	Chakrata
5. *Eulophia* spp.	Salib misri	Ukhimath
6. *Nardostachys jatamansi*	Jatamansi	Ukhimath
7. *Polygala crotalarioides*	Mirgu	Throughout hills
8. *Polygonatum* spp.	Meda	Ukhimath
9. *Orchis* spp.	Salapmsri	Throughout hills
10. *Rheum webbianum*	Archu, Revan-dchini	Bhillangana Range

The extraction of medicinal and aromatic taxa for trade purpose is not the only cause of depletion but, activities such as development of townships clearing of forests for agriculture, etc. also add to this.

Conclusion and Recommendations

The list of the endangered taxa presented in this communication is not at all comprehensive. What we presently require is a complete checklist of endangered or threatened medicinal and aromatic taxa from this region drawn after a careful assesment. This will enable the conservation status of each

taxon with reasonable confidence and will provide a basis for future management and monitoring to the concerned authorities.

The only way of ensuring the survival of the endangered taxa is by habitat preservation and rotational extraction and cultivation of species.

Habitat preservation must be given highest priority particularly in this region to provide suitable protection to the endangered species. Rao (1981) has pleaded for at nature reserve for such a protected habitat.

The Forest Department of U.P. in consultation with the Forest Research Institute, the Botanical Survey of India, the Central Institute of Medicinal & Aromatic Plants, and Garwal and Kumaon Universities should chalk out a plan to identify the critical habitats and to give a resting period for 3 to 4 years to the endangered taxa. This would allow the taxa a time for natural regeneration and growth for maturity.

Legislation may be framed to allow the collection of herbs only in the proper season, specially of those species from which roots, rhizomes, tubers are collected. Defaulters may be heavily penalised and fined. Collection of herbs will in proper season not only give time for dispersal of their fruits and seeds for regeneration but also improve the quality of the drugs, which are, at present collected at immature stages.

In the closed and protected habitat, artificial planting of tubers, roots rhizomes and cutting may be carried out along with the artificial dissemination of seeds or fruits, as already suggested by Shah (1980). Enrichment should be carried out where the population is reduced to few individuals and the taxa is at the verge of depletion.

Obviously, the above stated management and monitoring would be a hard task under present condition both for economic reasons and lack of adequate information about the critical habitat of the depleting taxa.

Ideally, it would further require detailed information on distribution, size and structure of population, ecological needs, physiological tolerances, breeding systems, pollination and dispersal ecology, germination competivity in the adult and seedling stage and several other aspects of autecology. To get the information on distribution, size and structure of population a survey of the area in small parts may be undertaken and mapping be done. Shah (1979) emphasised on systematic survey of medicinal plants which could provide data like enumeration, distribution, phenology, availability, data of annual extraction and also information on threatened and endangered drug plant species. Maps depicting the distribution of medicinal plant species that are in constant demand be prepared. Such maps would be useful not only for assessing the herbal wealth of the region but also provide protection to the critical habitat and finally would keep a graphic record for posterity.

The main difficulty, in practice would be to find sufficient man power with required skill and knowledge, who could undertake and make the people aware of the problems of management, monitoring and protection and laying out the policies.

In this paper, I have only chalked out very meagre and substantial technical details, which could only be taken as a vista of a starting point. Now, the whole task of weighing the same against the feasibility, planning, monitoring, coalation etc. perforce left for the competent authorities, institutions etc. directly or indirectly connected with the conservation policies of the threatened taxa of medicinal and aromatic plants.

Before concluding I would like to quote from a resolution carried unanimously by the Systematic Botany Plant Utilization and Biosphere Conservation Symposium in Uppsala in 1977'." Although plants are the world's basic life support system, our plant knowledge is not adequate to be able to make satisfactory suggestions for plant conservation in any but a few temperate areas of the world. For many countries. no basic documentation is available on which plant conservation recommendations and action plans can be based with any certainity. It is of the utmost importance that immediate increased support both financial and academic is provided for the developing world to produce Floras and detailed checklists before it is too late! It is also urgent to provide increased facilities for training and study in the relevant Botanical sciences to produce the expertise necessary to correct this deficiency".

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11

Rare Species with Restricted Distribution in South Gujarat

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South Gujarat lies between 20°7′55″ and 20°57′15″ to 21°25′ and 21°59′ and 72°43′5″ and 73°29′38″ to 74° to E. It's boundary in north is Baroda district, in east and south State of Maharashtra and on the west Arabian sea. The south-eastern boundary of South Gujarat is a hilly track, clothed with dense forests, the highest altitudes in Dangs being 1050 m at Saputara. The central part of South Gujarat is almost a plain country of scrub forests or of rugged hillocks of 50 to 150 m high. The entire forest area of South Gujarat is divided into Bulsar forest division (including the forests of Dharampur), Dangs forest division and Rajpipla forest division.

During the course of the botanical exploration to the various forest divisions of South Gujarat, it is found that nearly 168 species are endemic to South Gujarat. Of these species 97 are restricted to Dangs Forest Division, 14 to Rajpipla forest division, 10 to Bulsar forest division, 7 to Dharampur forests and 2 each to Broach and Surat. 36 species are well spread only in South Gujarat forests. Out of 97 species endemic to Dangs forest, nearly 30— of such species are found only Malegaon-Saputara region, which is densely forested with highest altitudes of hilly region in Dangs. Further the larger numbers of restricted species in Dangs belong to Orchidaceae (15), Poaceae (14) and Fabaceae (10).

Some of the rare species of South Gujarat are also found in the adjacent Central Zone. They are 51, with 29 species in Chhotaudepur forest division, 11 in Pavagadh, 7 in Panchmahals and 4 in Baroda or near about it. Of these species 24 species are found in one locality of South Gujarat and Central Gujarat, whereas the rest, though rare, in two or more localities of South Gujarat but only in one locality of Central Gujarat.

Similarly 27 species are common to Saurashtra and South Gujarat. 20 of these are found only in one locality of South Gujarat. The number of species common to South Gujarat and North Gujarat and South Gujarat and Kutch are 4 and 2 respectively. The following is the list of species restricted to different forest divisions.

Dangs Forest Division

RANUNCULACEAE: *Clematis gouriana* Roxb. FLACOURTIACEAE: *Casearia esculenta* Roxb. MALVACEAE: *Hibiscus furcatus* Willd., *Hibiscus surattensis* L.

STERCULIACEAE: *Eriolaena candollei* Wall. MALPHIGIACEAE: *Aspidopteris cordata* Juss. ANACARDIACEAE: *Semecarpus anacardium* L. f. FABACEAE: *Crotalaria chinensis* L., *Geissaspis cristata* W. & A., *Indigofera spicata* Forsk., *Moghania macrophylla* (Willd.) O. Ktze., *Moghania praecox* (Cl. ex Prain) L. var *robusta* Muk., *Sesbania javanica* Miq., *Smithia bigemina* Dalz., *S. sensitiva* Ait. var. *flava* (Dalz.) Cooke, *S. setulosa* Dalz., *Vigna khandalensis* (Sant.) Bole & Shah, *V. umbellata* (Thunb.) Ohwi & Ohashi. CAESALPINIACEAE: *Cassia leschnaultiana* Wall. ex DC., *C. mimosoides* L., *Piliostigma foveolatum* (Dalz.) Thoth. UMBELLIFERAE: *Peucedanum grande* Cl., *Pimpinella heyneana* Wall. ex Dalz., *P. tomentosa* Dalz. RUBIACEAE: *Thecagonum ovalifolium* (Cav.) Babu, *Wendlandia heynei* (R. & S.) Sant. & Merch. ASTERACEAE: *Synedrella nodiflora* (L. ex Willd.) Gaertn., *Tricholepis amplexicaulis* Cl., *Vernonia divergens* (Roxb.) Edgew., *Vicoa cernua* Dalz. CAMPANULACEAE: *Wahlenbergia marginata* (Thunb.) A. DC. LOBELIACEAE: *Lobelia nicotianaefolia* Roth ex R. & S. EBENACEAE: *Diospyros moniana* Roxb. GENTIANACEAE: *Swertia minor* (Griseb.) Cooke. BORAGINACEAE: *Cynoglossum meeboldii* Brand. SOLANACEAE: *Nicandra* physalodes (L.) Gaertn. SCROPHULARIACEAE: *Sopubia trifida* Buch.-Ham. ACANTHACEAE: *Barleria gibsoni* Dalz., *Justicia betonica.*, *Dyschoriste erecta* (Burm. f.) O. Ktze., *Nearacanthus trinevius* Wt. LABIATAE: *Colebrookea oppsifolia* Sm., *Plectranthus mollis* (Ait.) Spr. AMARANTHACEAE: *Alternanthera ficoidea* (L.) R. Br. LORANTHACEAE: *Dendrophthoe falcata* (L. f.) Ettings, var. *pubescens* (L. f.) Sant & Herb. EUPHORBIACEAE: *Euphorbia perbracteata* Gage, *E. pycnostegia* Boiss., *Sapium insigne* Bth. var. *malabarica* (Wt.) Hk. f. UTRICACEAE: *Boehmeria scabrella* (Roxb.) Gaud. MORACEAE: *Ficus heterophylla* L. f. ORCHIDACEAE: *Dendrobium barbatulum* Lindl., *D. microbulbon* A. Rich., *D. ovatum* (Willd.) Kranz., *D. peguanum* Lindl., *Habenaria furcifera* Lindl., *H. grandi-floriformis* Blatt. & McC., *H. longicorniculata* Grah., *H. marginata* Coleb. var. *fusifera* (Hk. f). Sant., *Malaxis mackinonii* (Duthie) Ames, *Nervilia aragoana* Gaud, *N. discolor* (Bl.) Schltr., *Oberonia falconeri* Hk.,f., *Peristylus plantagineus* Lindl., *P. stocksii* (Hk. f) Kranz., *Plantanthera susannae* (L.) Lindl. ZINGIBERACEAE: *Zingiber cernuum* Dalz. AMARYLLIDACEAE: *Pancratium triflorum* Roxb., *Hypoxis aurea* Lour. DIOSCORIACEAE: *Dioscorea wallichii* Hook. f. LILIACEAE: *Chlorophytum borivilianum* Sant. & Fernand., *C. malabaricum* Baker, *Scilla hyacinthina* (Roth) Macbr. COMMELINACEAE: *Commelina suffruticosa* Bl. ARACEAE: *Arisaema tortuosum* (Wall.) Schott. ERIOCAULACEAE: *Eriocaulon achiton* Koern. *E. quinquangulare* L. CYPERACEAE: *Cyperus cyperoides* (L.) var. *subcompositus* (Cl.) Kukenth. *C. distans* L. f. , *C. kyllinga* Endl., *C. malabaricus* (Cl.) Cooke, *Fimbristylis dichotoma* (L.) Vahl var. *pluristiata* (Cl.) Happer, POACEAE: *Arthraxon hispidus* (Thunb.) Makino, *Capillipedium parviflorum* (R. Br.) Stapf, *Digitaria seligera* Roth, *Ischaemum goebelii* Hack., *I. santapaui* Bor, *I. timorense* Kunth, *Oryza minuta* J. S. Presl., *Panicum paludosum* Roxb., *Paspalum compactum* Roth, *Pennisetum purpureum* Schum., *Pseudosorghum fasciculare* (Roxb.) A. Camus, *Sorghum controversum* (Steud.) Snowden, *Themeda tremula* (Nees ex Steud.) Hack., *Tripogon lisboae* Stapf.

Bulsar Forest Division

MALVACEAE: *Hibiscus lunarifolius* Willd. TILIACEAE: *Grewia columnaris* Sm., *G. disperma* Rottl. ex Spr. FABACEAE : *Dunbaria glandulosa* (Dalz. & Gibs) Prain, UMBELLIFERAE: *Pimpinella adscendens* Dalz., *P. candolleana* W. & A., *Zosimia anethifolia* DC. LENTIBULARIACEAE: *Urticularia coerulea* L. EUPHORBIACEAE: *Bridelia hamiltoniana* Wall. ORCHIDACEAE: *Habenaria commelinifolia* Wall.

Dharampur Forests Division

RUBIACEAE: *Neoanotis rheedii* (Wall. ex W. & A.) W. H. Lewis. LENTIBULARIACEAE: *Utricularia gibba* L. var. *exoleta* (R. Br.) Taylor ACANTHACEAE: *Blepharis asperrima* Nees PIPERACEAE: *Peperomia pellucida* (L.) H. B. & K. MORACEAE: *Ficus drupacea* Thunb. var. *pubescens* (Roth) Cor. AMARYLLIDACEAE: *Crinum brachynema* Herb. ERIOCAULACEAE: *Eriocaulon dianae* Fyson var. *dianae*.

Rajpipla

FABACEAE: *Tephrosia collina* Sharma var. *lanuginocarpa* Sharma CAESALPINIACEAE: *Phanera integrifolia* (Roxb.) Bth. MIMOSACEAE: *Albizia amara* Bov. SCROPHULARIACEAE: *Mazus pumilus* (Burm. f.) Steenis AMARANTHACEAE: *Amaranthus tricolor* L. var. *tristis* (Prain) Nayar. EUPHORBIACEAE: *Homonoia retusa* (Grah.) Muell.-Arg., *Sebestiania chamaelea* (L) Muell.-Arg.MORACEAE: *Ficus nervosa* Heyne, *Ficus rumphii* Bl. CYPERACEAE: *Fimbristylis microcarya* F. Muell. POACEAE: *Cleistachne sorghoides* Bth. *Cynodon barberi* Rang. *Sorghum miliaceum* (Roxb.) Snowden, *Themeda laxa* (Anders.) A. Camus.

Broach

CRUCIFERAE: *Eruca sativa* Mill. LABIATAE: *Orthosiphon pallidus* Royle.

Surat

CYPERACEAE: *Rhynchospora glauca* Vahl POACEAE: *Eragrostis ciliata* (Roxb.) Nees.

South Gujarat in general

BALSAMINACEAE: *Impatiens kleinii* Wt. FABACEAE: *Crotalaria nana* Burm. f., *Dalbergia volubilis* Roxb., *Derris scandens* (Roxb.) Bth., *Desmodium alysicarpoides* Knaap van Meeuvan, *D. heterocarpon* (L.) DC., *D. motorium* (Houtt.) Merr.,

D. triangulare var. *congestum* (Prain) Sant., *Indigofera trita* L.f. subsp. *trita* var. *maffei* (Chiov.) Ali, *Smithia salsuginea* Hance, *Rhynchosia rothii* Bth. ex Aitch. CAESALPINIACEAE: *Caesalpinia decapetala* (Roth) Alst. BARRINGTONIACEAE: *Careya arborea* Roxb. RUBIACEAE: *Pavetta crassicaulis* Bremek. ASTERACEAE: *Blumea belangeriana* DC., *Wedelia urticaefolia* DC. EBENACEAE: *Diospyros chloroxylon* Roxb. *Diospyros macleodii* Hk.f. OLEACEAE: *Jasminum malabarium* Wt. SCROPHULARIACEAE: *Centranthera indica* (L.) Gamble, *Torenia indica* Saldhana. OROBANCHACEAE: *Aeginetia indica* L. BIGNONIACEAE: *Dolichandrone atrovirens* (Heyne ex Roth) Sprague, *Heterophragma quadriloculare* (Roxb.) K. Schum. ACANTHACEAE: *Dyschoriste detzelli* (T. Anders. ex Bedd.) Ktze. AMARANTHACEAE: *Psilostachys sericea* Hk. f. EUPHORBIACEAE: *Antidesma ghaesembilla* Gaertn., *Homonoia riparia* Lour. URTICACEAE: *Distemon indicum* Wedd., *Elatostema cuneatum* Wt. HYDROCHARITACEAE: *Blyxa echinosperma* (Cl.) Hk. f. ORCHIDACEAE: *Peristylus lawii* Wt. ARACEAE: *Cryptocoryne retrospiralis* (Roxb.) Kunth. CYPERACEAE: *Cyperus compactus* Retz. POACEAE: *Arthraxon meeboldii* Stapf, *Capillipedium assimile* (Steud.) A. Camus, *Chrysopogon serrulatus* Trin.

South Gujarat and Central Gujarat

DILLENIACEAE: *Dillenia pentagyna* Roxb. BRASSICACEAE: *Cochlearia cochlearioides* (Roth) Sant. FLACOURTIACAE: *Flacourtia montana* Roxb. TILIACEAE: *Triumfetta annua* L. COCHLOSPERMACEAE: *Cochlospermum religiosum* (L.) Alst. LINACEAE: *Linum mysurense* Heyne ex Bth. MELIACEAE: *Melia composita* Willd. OPILIACEAE: *Cansjera rheedii* Gmel. FABACEAE *Butea parviflora* Roxb., *Desmodium rotundifolium* Baker, *Millettia racemosa* Bth., *Trigonella hamosa* L. subsp. *lineata* (Boiss. & Noe) Townsend, *Uraria rufescens* (DC.) Schindl. CAESALPINIACEAE: *Piliostigma malabarica* (Roxb.) Bth. LYTHRACEAE: *Rotala densiflora* (Roth) Koehne APIACEAE: *Sesili diffusum* (Roxb. ex Sm.) S. & W. RUBIACEAE: *Spermadictyon suaveolens* Roxb. ASTERACEAE: *Blumea malcomii* (Cl.) Hk. f., *Centipeda minima* (L.) A. Br. & Aschers., *Senecio grahami* Hook. f. ASCLEPIADACEAE: *Tylophora fasciculata* Ham. GENTIANACEAE: *Canscora concanensis* Cl. LOGANIACEAE: *Buddleja asiatica* Lour. BORAGINACEAE: *Trichodesma sedgwickianum* Banerjee. CONVOLVULACEAE: *Argyreia strigosa* (Roth) Roberty, *Evolvulus nummularis* (L.) L., *Ipomoea triloba* L. SCROPHULARIACEAE: *Buchnera hispida* Buch.-Ham., *Mecardonia procumbens* (Mill.) Sm. BIGNONIACEAE: *Oroxylum indicum* (L.) Vent., *Radermachera xylocarpa* (Roxb.) K. Schum., *Stereospermum suaveolens* (Roxb.) DC. ACANTHACEAE: *Nelsonia canescens* (Lam.) Nees, *Thelepaepale ixiocephala* (Bth.) Bremek. LAMIACEAE: *Anisomeles heyneana* Bth., *Leucas martinicensis* (Jacq.) R. Br. AMARANTHACEAE: *Altermanthera paronychioides* St. Hil. POLYGONACEAE: *Rumex dentatus* L. EUPHORBIACEAE: *Acalypha lanceolata* Willd., *Phyllanthus lawii* Grah. ULMACEAE: *Trema politoria* Planch.

ORCHIDACEAE: *Aerides maculosum* Lindl., *Habenaria gibsonii* Hook. f. var. *foliosa* (A. Rich.) Sant., *Vanda tessellata* (Roxb.) Hook. f., *Vanda testaceae* (Lindl.) Reichb. ZINGIBERACEAE: *Costus speciosus* (Koen. ex Retz.) Sm. MUSACEAE: *Ensete superbum* (Roxb.) Cheesm. ARACEAE: *Arisaema neglectum* Schott CYPERACEAE: *Fimbristylis lanciana* (Boeck.) Kern. POACEAE: *Digitaria biformis* Willd., *Eulalia trispicata* (Schult.) Henr. *Isachne globosa* (Thunb.) Ktze.

South Gujarat and Saurashtra

RANUNCULACEAE: *Clematis triloba* Heyne ex Roth MALVACEAE: *Abelmoschus moschatus* Medic., *Hibiscus punctatus* Dalz. TILIACEAE: *Microcos paniculata* L. RHAMNACEAE: *Zizyphus glaberrima* Sant. FABACEAE: *Alysicarpus pubescens* Laws. ex Wt., *Butea superba* Roxb., *Desmodium triquetrum* (L.) DC., *Indigofera coerulea* var. *occidentalis* Gillett & Ali, *I. tenuifolia* Rottl. ex W. & A. A., *Tephrosia jannagerensis* Sant. COMBRETACEAE: *Calycopteris floribunda* (Roxb.) Lam., *Terminalia chebula* Retz. AIZOACEAE: *Zaleya decandra* Burm. f. RUBIACEAE: *Gardenia turgida* var. *turgida* ASTERACEAE: *Blumea bovei* (DC.) Vatke ASCLEPIADACEAE: *Tylophora dalzellii* Hk. f. CONVOLVULACEAE: *Ipomoea illustris* (Cl.) Prain. SCROPHULARIACEAE: *Lindernia multiflora* (Roxb.) Muk. LENTIBULARIACEAE: *Utricularia striatula* Sm. BIGNONIACEAE: *Stereospermum personatum* (Hassk.) Chatt. ACANTHACEAE: *Eranthemum purpurascens* Nees, *Justicia micrantha* Heyne ex Wall. CHENOPODIACEAE: *Salicornia brachiata* Roxb. LAURACEAE: *Cassytha filiformis* L. ERIOCAULACEAE: *Eriocaulon dianae* Fyson var. *longibracteatum* Fyson POACEAE: *Sorghum purpureo-sericeum* (Hochst. ex A. Rich.) A. & S.

South Gujarat and North Gujarat

CYPERACEAE: *Cyperus hyalinus* Vahl, *C. metzii* (Hochst. ex Steud.) Mat. & Kuk., *Scirpus triangulatus* Roxb. POACEAE: *Polypogon monspeliensis* (L.) Desf.

12

A Preliminary census of Rare and Threatened Plants of Rajasthan

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A large number of plants and animals have little future, unless immediate steps are taken to arrest the causes leading to biological impoverishment. It is estimated by the IUCN that about 20,000—25,000 of the world's vascular plant species are dangerously rare or under threat. The extinction of hundreds and thousands of life forms, which are likely to vanish, if the current trend in population, land use and pollution of air and water continues, will bring about irreversible alteration in the biosphere. The problem of habitat distruction is particularly serious in a country like India where a remarkable variety of species still awaiting discovery. Large areas must, therefore, be set aside as biological reserves, if massive extinctions are to be avoided. The establishment of the Desert National Park in Jaisalmer and Barmer districts of Rajasthan will certainly prove to be beneficial in preserving some of the rare and threatened species of plants of W. Rajasthan.

The threat to environmental survival is now engaging the attention of many countries. A list of threatened and endemic plants of the countries of Europe has been compiled by the IUCN (IUCN, 1976). There is a Red Data Book in respect of native plant species to be protected in the U.S.S.R. (Takhtajan, 1975). Recognising that man's activities have caused the extinction or severe reduction in numbers of numerous plant species in many parts of the world, plant conservation was a dominant concern of the 12th International Botanical Congress held in Leningrad, U.S.S.R. in 1975. The Smithsonian Institution report (1975) on the endangered and threatened plant species of the United States is said to have been a major stimuli towards increased public interest in endangered plants in the U.S. This list has been revised by Ayensu and DeFilipps (1978). An International Symposium was sponsored by the New York Botanic Garden in 1976, in commemoration of the Bicentennial of the United States of America, on threatened and endangered species of plants of America at which the present and future significance of those plants in their ecosystems was considered in detail (Prance & Elias, 1977). The IUCN Red Data Book gives an account of 250 selected plants on a world scale (Lucas & Synge, 1978). There are several other publications dealing with the endangered plants of different countries and Miasek and Long (1978) have compiled a bibliography on endangered plant species of the world and their habitats.

The eleventh technical meeting of the IUCN was held in New Delhi in 1969 (IUCN, 1970) to discuss the problems of threatened species. In this meeting Sahni (1970) presented a paper on Protection of rare and endangered plants in the Indian flora in which he included the following species, whose distribution extends to Rajasthan: *Commiphora wightii* (Arn.) Bhandari, *Rosa involucrata* Roxb. (=*R. lyellii* Lindl.) and *Teconella undulata* (Sw.) Seem. Jain and Sastry (1980) also consider *Commiphora wightii* and *Rosa involucrata* as threatened.

For the task of preserving our rare and endangered species we must first of all have a list of such plants. The present account is based on the collections deposited in the various herbaria in India, published literature and field observations particularly in W. Rajasthan. A critical study of some of the taxa included here will, however, have to be undertaken to determine their taxonomic status. Further work will prove it necessary to add or delete some species from the list. Search for certain taxa in their original habitats will also have to be carried out to ascertain if they are already extinct or in danger of extinction.

In the enumeration 41 taxa of Angiosperms and one species of Gymnosperm are listed, alphabetically. For each taxa, the type (in the case of endemics) and the maximum known range of distribution are given, followed by notes, if any.

ENUMERATION

ABUTILON BIDENTATUM Hochst. var. MAJOR (Blatt. & Hallb.) Bhandari, Fl. Indian Desert 60. 1978. *Vern. name* : Imarti (Malvaceae).

Type : India : Rajasthan, Amarsagar, Jaisalmer, *Blatter* & *Hallberg* 5644 (BLAT).

Distribution : Endemic to W. Rajasthan in Barmer, Jaisalmer and Jodhpur districts.

A. FRUTICOSUM Guill. & Perr. var. CHRYSOCARPA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 277. 1918. (Malvaceae).

Type : India : Rajasthan, Vinjorai, on rocks, Jaisalmer dt., *Blatter* & *Hallberg* 5660 (BLAT).

Distribution : Endemic to W. Rajasthan in Jaisalmer district. Furits golden-yellow, densely stellately hairy.

ALYSICARPUS MONILIFER (L.) DC. var. VENOSA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 240. 1918. (Fabaceae).

Type : India : Rajasthan, Bada Bag, Jaisalmer, *Blatter* & *Hallberg* 7226 (Lectotype), 7225 (BLAT).

Distribution : Endemic to W. Rajasthan in Jaisalmer district. Pods conspicuously reticulately veined, often 8-jointed.

AMMANNIA DESERTORUM Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 25: 213. 1918 & 26: 527. 1919. *Vern-name* : Moto-Jal-Bhangro (Lythraceae).

Type : India : Rajasthan, Devikot, Jaisalmer dt., *Blatter* & *Hallberg* 3341; near Devilot, Jaisalmer dt., *Blatter* & *Hallberg* 3342. 3343; Vinjorai, Jaisalmer dt., *Blatter* & *Hallberg* 3344; Kotda near Seu, Jodhpur dt., *Blatter* & *Hallberg* 3345; near Badka on wet ground, *Blatter* & *Hallberg* 3346, 3347 (BLAT).

Distribution : Pakistan, India (Rajasthan, Gujarat). Plants papillose.

ANOGEISSUS SERICEA Brandis var. NUMMULARIA King ex Duthie, Fl. Upper Gang. Pl. 1: 340. 1903; Scott in Kew Bull. 33: 559. 1979. (Combretaceae).

Type : India : Rajasthan, *Duthie*, 4663. (K, BM, both Isotypes).

Distribution : W. Rajasthan. Punjab and Gujarat. A very rare species.

ANTICHARIS GLANDULOSA Asch. var. CAERULEA Blatt. & Hallb. (in Journ. Bombay Nat. Hist. Soc. 26: 549. 1919 *nom. nud.*) ex Santapau in Journ. Bombay Nat. Hist. Soc. 56: 280. 1959; Bhandari, Fl. Indian Desert 279. f. 103. 1978 1978 (Scrophulariaceae).

Type : India : Rajasthan, Jaisalmer, on rocks, *Blatter* & *Hallberg* 10284 (Lectotype); Bada Bag, Jaisalmer, *Blatter* & *Hallberg* 10282; Jaisalmer rocky plateau, *Blatter* & *Hallberg* 10283; Vinjorai, Jaisalmer dt., *Blatter* & *Hallberg* 10285 (BLAT).

Distribution : Endemic to W. Rajasthan in Jaisalmer district.

ARISTIDA ROYLEANA Trin. & Rupr. Sp. Gram. Stip. 160. 1842 & in Mem. Acad. Petersb. ser. 6. 7: 160. 1843. (Poaceae).

Distribution : Pakistan (Baluchistan, Sind, N.W.F.P.), N.W. India. A very rare species.

BARLERIA PRIONITIS L. var. DIACANTHA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 811. 1919. (*non B. diacantha* Nees, 1847); Bhandari, Fl. Indian Desert 299. 1978 (Acanthaceae).

Type : India : Rajasthan, Barmer on rocky hill sides, *Blatter* & *Hallberg* 9165. This specimen is no longer available in Blatter Herbarium and is presumably lost or destroyed.

Distribution : Endemic to W. Rajasthan in Barmer and Jodhpur disticts.

BONNAYA BRACTEOIDES Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 25: 416. 1918; Bole & Almeida in Journ. Bombay Nat. Hist. 74: 617. 1979 (Scrophulariaceae).

Type : India : Rajasthan, Mt. Abu, Sirohi dt., *Blatter* & *Hallberg* 1514, Lectotype (BLAT), 1515, 1516.

Distribution : Endemic to Rajasthan in Mt. Abu.

CARALLUMA EDULIS (Edgew.) Benth. & Hook. f. Gen. Pl. 2: 782. 1876; Bhandari in Journ. Bombay Nat. Hist. Soc. 68: 296. 1971 & Fl. Indian Desert 220, f. 70. 1978. *Boucerosia edulis* Edgew. in Journ. Linn. Soc 6: 205 Pl 1. f. 1-8. 1962. *Vern. name* : Pimpa (Asclepiadaceae).

Distribution : Pakistan, India (W. Rajasthan in Jaisalmer district).

Very rare in W. Rajasthan.

CENCHRUS PRIEURII (Kunth) Maire var. SCABRA Bhandari, Fl. Indian Desert 395. 1978 (Poaceae).

Type : India : Rajasthan, CAZRI area, Massuria, Jodhpur, *Bhandari* 1689 (JAC).

Distribution : Endemic to W. Rajasthan in Barmer, Jaisalmer and Jodhpur districts.

This variety can be recognised by the inner bristles being not ciliate towards the base, but scabrous throughout.

C. RAJASTHANENSIS Kanodia & Nanda in Geobios 5: 157. 1978 (Poaceae).

Type : India : Rajasthan, sandy plains 25 km enroute Mawa-Nachna, Jaisalmer dt., *Kanodia* 2354 A; Isotypes : *Kanodia* 2354 B-F (C.A.Z.R.I. Herb., Jodhpur).

Distribution : Endemic to W. Rajasthan in Jaisalmer and Jodhpur districts. Bristles of the involucre antrosely as well as retrosely scabrid.

CLEOME GYNANDRA L. var. NANA (Blatt. & Hallb.) Bhandari in Bull. Bot. Surv. India 6: 327. 1965 & Fl. Indian desert 40. 1978. *Gynandropsis pentaphylla* DC. var. *nana* Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 221. 1918 (Cleomaceae).

Type : India : Rajasthan, Vinjorai, Jaisalmer dt., *Blatter* & *Hallberg* 5741 (BLAT).

Distribution : Endemic to W. Rajasthan in Jaisalmer and Jodhpur districts.

COMMIPHORA WIGHTII (Arn.) Bhandari in Bull. Bot. Surv. India 6: 327. 1965 & Fl. Indian Desert 95. f. 34. 1978. *Vern. name* : Gugal, Guggal (Burseraceae)

Distribution : Arabia, Pakistan (Baluchistan, Sind), India (Rajasthan, Gujarat)

Sahni (1970) and Jain and Sastry (1980) consider this species as threatened. It is the source of Guggal or Indian Bedellium, a gum-resin of pale brown or dull-green colour exuded from the bark in cold season which is largely used as an incense and in local medicine.

CONVOLVULUS AURICOMUS (A. Rich.) Bhandari var. FERRUGINOSUS Bhandari, Fl. Indian desert 245. 1978 (Convolvulaceae).

Type : India : Rajasthan, common in Balarwa, Jodhpur dt., *Bhandari* 363 (JAC); Isotype : *Bhandari* 363-A (CAL).

Distribution : Endemic to W. Rajasthan in Barmer, Jaisalmer and Jodhpur districts.

C. AURICOMUS (A. Rich.) Bhandari var. VOLUBILIS (C. B. Clarke) Bhandari in Bull. Bot. Surv. India 6: 1965 & Fl. Indian Desert 244. f. 83. 1978. *Vern. name* : Rota bel, Ratanjot (Convolvulaceae).

Distribution : Pakistan (Sind), India (W. Rajasthan, Gujarat).

C. BLATTERI Bhandari in Bull. Bot. Surv. India 6: 327. 1965 & Fl. Indian Desert 245. 1978. (Convolvulaceae).

Type : India : Rajasthan, Amarsagar, Jaisalmer, *Blatter* & *Hallberg* 3515, Lectotype (BLAT); North of Jaisalmer, *Blatter* & *Hallberg* 3514; Balarwa, Jodhpur dt., *Blatter* & *Hallberg* 7312.

Distribution : Endemic to W. Rajasthan in Jaisalmer district.

C. SINDICUS Stocks in Kew Journ. Bot. 4: 173. 1852. *Vern. name.* : Kaland (Convolvulaceae).

Type : Pakistan : Sind (CAL 313569).

Distribution : Pakistan (Baluchistan, Sind), India W. Rajasthan in Barmer district).

C. STOCKSII Boiss. Fl. Orient. 4: 110. 1879. (Convolvulaceae).

Distribution : Turkestan, Pakistan (Sind, Baluchistan), India (Gujarat, Rajasthan).

DICLIPTERA ABUENSIS Blatt. in Journ. & Proc. Asiat. Soc. Bengal (n.s.) 26: 347. 1931. (Acanthaceae).

Type : India : Rajasthan, Mt. Abu, *Hallberg* 22856 (BLAT).

Distribution : Endemic to Rajasthan in Mt. Abu.

EPHEDRA FOLIATA Boiss. & Kotschy ex Boiss. Diagn. ser. 1. 7: 101. 1846 & Fl. Orient. 5: 716. 1881. *Vern. name*: Andho-khimp, Lana, Suo-phogaro (Gnetaceae).

Distribution : Syria, Afghanistan, Pakistan, India (Punjab, Rajasthan).

This is the only Gymnosperm reported from the Rajasthan desert.

EUPHORBIA JODHPURENSIS Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 971. 1920. *Vern. name*: Dudheli (Euphorbiaceae).

Type : India : Rajasthan, Jodhpur, *Blatter* & *Hallberg* 9228 (BLAT).

Distribution : Pakistan (Sind), India (W. Rajasthan in Barmer and Jodhpur districts).

This species closely related to *E. clarkeana* Hook. f. but can be differentiated by its erect habit, dichotomous branching and by the leaf margins being spinulose-serrate throughout.

FARSETIA MACRANTHA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 220. 1918. *Vern. name* : Motio-hiran chabbo (Brassicaceae).

Type : India : Rajasthan, behind Mataji's temple in Barmer on rocks, *Bhandari* 507, Neotype (JAC).

Distribution : Known only from the type locality, endemic.

In the type description the colour of flowers (petals) has been given as whitish-purple, but the present authors have observed the colour of flowers to be white or creamy-white. The whole plant is often copper-tinged, particularly the older leaves.

This species differs from *Farsetia hamiltonii* Royle in having much larger flowers, larger and differently shaped leaves and biseriate seeds.

GISEKIA PHARNACIOIDES L. var. PSEUDOPANICULATA Jeffrey in Kew Bull. 14: 235. 1960. (Aizoaceae).

Distribution : Africa, India (W. Rajasthan in Barmer and Jodhpur districts).

This variety has been recorded outside Africa for the first time by Bhandari (Fl. Indian Desert. 1979. 1978.)

IPOMOEA CARICA (L.) Sweet var. SEMINE-GLABRA (Blatt. & Hallb.) Bhandari, Fl. Indian Desert 253. 1978. (Convolvulaceae).

Type : India : Rajasthan, Vinjorai, Jaisalmer dt., *Blatter* & *Hallberg* 6675
Distribution : Not collected after the type collection, endemic.

MELHANIA FUTTEYPORENSIS Munro var. MAJOR (Blatt. & Hallb.) Santapau in Journ. Bombay Nat. Hist. Soc. 56: 278. 1959. (Sterculiaceae).

Type : India : Rajasthan, Barmer, rocks, *Blatter* & *Hallberg* 7286 (Lectotype), 7295, 7296 (BLAT).

Distribution : Barmer, Chittourgarh, Jodhpur and Kota districts, Rajasthan.

M. MAGNIFOLIA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 228. 1918. (Sterculiaceae).

Type : India : Rajasthan, Kailana, Jodhpur, *Blatter* & *Hallberg* 7285 (Lectotype), 7279; Osian, Jodhpur dt., *Blatter* & *Hallberg* 7280 (BLAT).

Distribution : Barmer, Jodhpur, Kota and Jhalawar districts, Rajasthan.

MONSONIA HELIOTROPIOIDES (Cav.) Boiss. Fl. Orient. 1: 897. 1867. *Vern. name* : Mayur-shikha (Geraniaceae).

Distribution: Egypt, Pakistan (Sind), India (W. Rajasthan in Bikaner district).

A very rare species.

PAVONIA ARABICA Hochst. ex Steud. var. GLUTINOSA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 227. 1918. (Malvaceae).

Type : India : Rajasthan, Kailana, Jodhpur, *Blatter* & *Hallberg* 5669 (Lectotype), 5668; Bada Bag, Jaisalmer, *Blatter* & *Hallberg* 4667; Barmer on rocks, *Blatter* & *Hallberg* 5685 (BLAT).

Distribution : Endemic to W. Rajasthan in Barmer, Jaisalmer and Jodhpur districts.

The whole plant is densely viscous-pubescent.

P. ARABICA Hochst. ex Steud. var. MASSURIENSIS Bhandari, Fl. Indian Desert 69. 1978 (Malvaceae).

Type : India : Rajasthan, common on rocky plateau of Massuria, Jodhpur, *Bhandari* 4A (JAC).

Distribution : Known only from the type locality, endemic.

PSORALEA ODORATA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 238. *Vern. name* : Jhil (Fabaceae).

Type : India : Rajasthan, Barmer, sand, *Blatter* & *Hallberg* 7005 (Lectotype); near Kotda, *Blatter* & *Hallberg* 7003; Devikot, Jaisalmer dt., *Blatter* & *Hallberg* 7004; near Bap, Jodhpur dt., *Blatter* & *Hallberg* 7002 (BLAT).

Distribution : Pakistan, India (W. Rajasthan).

Corolla white with purple tips. A rare species.

PULICARIA RAJPUTANAE Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 535. 1919. *Vern. name* : Dhola-ligru (Asteraceae).

Type : India : Rajasthan, Balsamand, Johpur, *Blatter* & *Hallberg* 10039 (Lectotype); Kailana, Jodhpur, *Blatter* & *Hallberg* 10043; 10044; Mandor, Jodhpur, *Blatter* & *Hallberg* 10050, 10051; near Badka, *Blatter* & *Hallberg* 10046; between Phalodi and Bap, Jodhpur dt., *Blatter* & *Hallberg* 10047; near Jaisalmer, *Blatter* & *Hallberg* 10045; Devikot, Jaisalmer dt., *Blatter* & *Hallberg*

10048; Vinjorai, Jaisalmer dt., *Blatter* & *Hellberg* 10049, 10052, 10053 (BLAT).

Distribution : Endemic to W. Rajasthan in Barmer, Jaisalmer and Jodhpur districts.

ROSA INVOLUCRATA Roxb. Fl. Ind. 2: 513. (Rosaceae).

Distribution : Along the base of the Himalaya eastward to Bengal and Burma; also on Mt. Abu in Rajasthan and Mysore.

Sahni (1970) and Jain & Sastry (1980) consider this species as endangered.

SIDA TIAGII Bhandari, Fl. Indian Desert 74. f. 24. 1978. *Vern. name* : Bal (Malvacea).

Type : India : Rajasthan, common on open sandy ground, near Mungaria, Barmer dt., *Bhandari* 1570-A (CAL); Isotypes : *Bhandari* 1570-B (K); *Bhandari* 1570-C (JAC); 1570-D (BSI).

Distribution : Pakistan, India (W. Rajasthan in Barmer, Jaisalmer and Jodhpur districts).

Closely related to *Sida ovata* Forssk. but differs in having the mericarps quite different and larger; calyx much larger, looosly but completely enclosing the mature mericarps.

STROBILANTHES HALLBERGII Blatt. in Journ. &. Proc Asiat. Soc. Bengal (n.s.) 26: 345. 1931 (Acanthaceae).

Type : India : Rajasthan, Mt. Abu, *Hallberg* & *Blatter* 22675 (BLAT).

Distribution : Endemic to Rajasthan in Mt. Abu.

TAVERNIERA CUNEIFOLIA Arn. in Wight, Ic. 3(4): 2. t. 1055. 1846; (Fabaceae).

Distribution : Afghanistan, Pakistan (Sind), India (Punjab, Saurashtra, Rajasthan).

TECOMELLA UNDULATA (Sm.) Seem. in Ann & Mag Nat. Hist. ser. 3. 10: 30. 1862 & in Journ. Bot. 1: 18. 1863. *Vern. name* : Rohiro, Rohira (Bignoniaceae).

Distribution : Arabia, Pakistan (Baluchistan, Sind), India (Maharashtra, Gujarat, Rajasthan).

Sahni (1970) considers this species to be threatened. It is known as the 'desert teak'. The wood is soft, tough and durable and used in furniture, persian wheels, lacquered toys etc. The leaves are eaten by cattle and goats.

TEPHROSIA FALCIFORMIS Ramaswami in Journ. Asiat. Soc. Beng. 12: 125. 1916. *Vern. name* : Rati Biyani (Fabaceae).

Type : Pakistan : Sind, Mohibal Dero forests, collected by Div. Forest Officer, Comm. by *R. S. Hole* (CAL); Isotype (K).

In Rajasthan this species is rare.

TRIBULUS RAJASTHANENSIS Bhandari & Sharma in Bot. Notiser 129: 367. 1977. (Zygophyllaceae).

Type : India : Rajasthan, common on rocky plateau of Massuria, Jodhpur, *Bhandari* 537-A (CAL); Isotypes: *Bhandari* 537-B (K), *Bhandari* 537-C (JAC), *Bhandari* 537-D (BSI).

Distribution : Endemic to W. Rajasthan in Jaisalmer and Jodhpur districts.

VERONICA ANAGALLIS L. var. BRACTEOSA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 25: 427. 1918. (Scrophulariaceae).

Type : India : Rajasthan, Mt. Abu, Sirohi dt., *Blatter* & *Hallberg* 1633 (BLAT).

Distribution : Endemic to Rajasthan in Mt. Abu.

WITHANIA COAGULANS (Stocks) Dunal in DC. Prodr. 13(1): 685. 1852. *Vern. name* : Paneer-bandh (Solanaceae).

Distribution : Afghanistan, Pakistan (Baluchistan, Sind), India (W. Rajasthan in Ajmer, Jaisalmer and Jodhpur districts).

This species is very rare in W. Rajasthan.

ZIZIPHUS TRUNCATA Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 26: 234. 1918. *Vern. name* : Borti (Rhamnaceae).

Type : India : Rajasthan, Kailana, Jodhpur, *Blatter* & *Hallberg* 5803 (BLAT).

Distribution : Endemic to W. Rajasthan.

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13

A Census of Rare and Endemic Flora of South-East Rajasthan

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South-eastern Rajasthan is geographically located between 75°15′ to 77°20′E longitude and between 23°-47′ to 25°-55′N latitudes. The soil varies from gravel to sandy-loam or black cotton soil. The average annual rainfall vary from 792-990 mm., probably the highest in the state of Rajasthan. The variation in temperature is very large, from 5.7°C (during January) to 42.7° (in May). Physiographically it is more or less a hilly area on account of the Vindhyan ranges.

Although, administratively a part of Rajasthan, this "Hadoti" region resembles Deccan plateau in edaphic and climatic features. It covers the Kota, Jhalawar and Bundi districts of Rajasthan.

Chatterjee (1940), while dividing India into 8 phytogeographic regions, placed the major portion of the state of Rajasthan in the "Indus Plains" (region No. 3), except a small north-eastern part, which was assigned to the "gangetic plain" (region No. 4). Other authors (*fide* Hooker, 1906, *c.f.* Sharma, 1980), however, prefer to divide Rajasthan mainly into two halves on the basis of soil types, rainfall, luxuriance of vegetation and the Aravallis being the structure bisecting them. The south-eastern region, east to Aravallis, differs not only from the north-eastern portion but with the entire state, probably because it is adjacent to the Deccan plateau.

Previous contributions

This area did not invite much attention of the floristic workers. Duthie's specimens e.g. *Sida ovata* Forsk. from Baran, 4562 (deposited in DD *fide* Maheshwari & Singh, 1976) were not included in his flora (1903-1929). Jain & Kotwal's (1960), publication of an account of vegetation of Shahabad is the first report from this area. Gupta (1965a) added some plants to Rajasthan flora from Kota; and published an account of vegetation of Kota and environs (1965 b) and of hydrophytic vegetation of Kota (1966). Majumdar, who in 1969 mentioned some plants from this area in his "notes on Rajasthan flora" and published "Synoptic flora of Kota division" (1971, 1976); additions to which were made by Maheshwari and Singh (1976). Singh (1970, 1973, 1974, 1975 and 1977) reported additions to flora of Rajasthan from this area Maheshwari and Singh (1974) published an account of aquatic flora from

Bundi. Shringi's (1981) account of the grasses from Jhalawar district is probably the latest contribution on this area.

Analysis of Flora

Survey of literature and study of herbarium specimens housed in various herbaria (BLAT, BSA., BSI., LWG., and RUBL) have revealed 796 species for this area of which 103 (84 dicots and 19 monocots) are endemic to India. Their numerical representation is as follow. :

	Number of species endemic to India	Taxa to which they belong	
		Genera	Families
Dicots	84	75	40
Monocots	19	17	7
Total	103	92	47

Total number of endemic species in India (*fide* Chatterjee, 1962) is approximately 6700, which is 50% of the total Flora of this country. For S.E. Rajasthan, this figure works out to be 13%, which is much less, compared to the percentage for India. Probably this is due to a few himalayan elements represented in this area. Comparison of endemic elements occurring in adjoining areas is as follows :

Indian Elements	Number of species			
	India (Chatterjee, 1962)	Delhi (Maheshwari, 1963)	Mt. Abu (Jain, 1967)	S.E. Rajasthan (present studies)
General Elements	2,545	81	130	97
Himalayan Elements	4,169	8	17	6
TOTAL	6,714	89	147	103
Percentage of Endemic species	50%	16.7%	31%	13%

Forty-three of these endemic species, belonging to 39 genera and 28 families, commonly occur in N.E. Rajasthan (Sharma *et* Tiagi, 1979).

Maximum number of endemic species in SE. Rajasthan belong to Acanthaceae, Fabaceae, (*Sensu Str.*) and Poaceae with 12 species in each. This is followed by Asteraceae having only 9 species, Chatterjee (1962), records 65 families (*fide* Maheshwari *et al.* 1965), whose more than 50% species are confined to India; Sixteen of them also exist in S.E. Rajasthan. These are shown in table below :

Sl. No.	Name of family	Number of endemic species	
		Occurring in S.E. Rajasthan	Occurring in India (Chatterjee, 1962)
1.	Acanthaceae	12	514
2.	Ampelidiaceae	2	69
3.	Anacardiaceae	2	67
4.	Annonaceae	1	129
5.	Apiaceae	1	180
6.	Asclepiadaceae	2	234
7.	Asteraceae	9	697
8.	Boraginaceae	2	145
9.	Brassicaceae	1	178
10.	Euphorbiaceae	2	444
11.	Fabaceae *(S. Str.)*	12	867
12.	Gentianaceae	3	189
13.	Gesneriaceae	1	133
14.	Lamiaceae	3	421
15.	Oleaceae	1	97
16.	Rubiaceae	1	551

The following six families have not been included by Chatterjee in his list of 32 families : Apocynaceae (1), Bixaceae (c.f. Flacourtiaceae, 1), Cleomaceae (1, *c.f.* Capparidaceae), Combretaceae (2), Meliaceae (2), Sapotaceae (1). Moreover, Moraceae (1) and Ulmaceae (1), are included in family Urticaceae, (s. l.), and Nyctanthaceae (1) in family Oleaceae.

The following families also contain endemic species, their number being shown in parenthesis against their names : Burseraceae (1), Caesalpiniaceae (1), Convolvulaceae (1), Cucurbitaceae (1), Lythraceae (1), Mimosaceae (4),

Moringaceae (1), Rutaceae (2), Santalaceae (1), Scrophulariaceae (2), Simaroubaceae (1) and Sterculiaceae (1) Araceae (1), Commelinaceae (2), Cyperaceae (1), Eriocaulaceae (1), Hydrocharitaceae (1), Poaceae (12) and Zingiberaceae (1). However, none of these families figure in Chatterjee's (1962) list of 65 endemic families.

The rare and endangered species of S.E. Rajasthan are enumerated below :

S. No.	Name of Species	Red-data Book categories	Common in N.E Rajasthan
	ANNONACEAE		
1.	*Miliusa tomentosa* (Roxb.) Sinclair	I	—
	BRASSICACEAE		
2.	*Cochlearia cohlearioides* (Roxb.) Miers ex Hk. f. *et* Thom.	I	—
	CLEOMACEAE		
3.	*Cleome simplicifolia* (Camb.) Hk. *et* Thom.	I	—
	BIXACEAE (COCHLOSPERMACEAE)		
4.	*Cochlospermum religiosum* (L.) Alston	I	—
	STERCULIACEAE		
5.	*Sterculia villosa* Roxb.	I	—
	RUTACAE		
6.	*Limonia acidissima* L.	I	+
7.	*Murraya koenigii* (L.) Spreng.	I	+
	SIMAROUBACEAE.		
8.	*Ailanthus excelsa* Roxb.	I	+
	BURSERACEAE		
9.	*Boswellia serrata* Roxb. ex Colebr.	V	+
	MELIACEAE		
10	*Azadirachta indica* L.	I	+
11.	*Soymida febrifuga* Jussieu	R	—
	VITACEAE		
12.	*Ampelocissus latifolia* (Roxb.) Planch.	I	+
13.	*Cissus rependa* Vahl	R	—
	ANACARDIACEAE		
14.	*Buchanania lanzan* Spreng.	I	—
15.	*Rhus mysurensis* Heyne ex Wt. *et* Arn.	R	+
	MORINGACEAE		
16.	*Moringa oleifera* Lam.	I	+
	FABACEAE		
17.	*Alysicarpus hamosus* Edgew.	I	+
18.	*A. tetragonolobus* Edgew.	I	+
19.	*Crotalaria hirsuta* Willd.	I	—

20.	*C. mysorensis* Roth.	R	—
21.	*Dalbergia paniculata* Roxb.	I	—
22.	*D. sericea* D. Don.	E	—
23.	*Erythrina stricta* Roxb.	R	—
24.	*E. suberosa* Roxb.	R	—
25.	*Heylandia latebrosa* DC.	I	+
26.	*Millettia auriculata* Bak.	R	—
27.	*Pueraria tuberosa* (Roxb. ex Willd.) DC.	R	—
28.	*Rhynchosia capitata* DC.	I	+
	CAESALPINIACEAE		
29.	*Bauhinia vahlii* Wt. *et* Arn.	I	—
	MIMOSACEAE		
30.	*Acacia catechu* Willd.	I	+
31.	*A. nilotica* (L.) Del. var *tomentosa* Sharma	V	+
32.	*Mimosa hamata* Willd.	I	+
33.	*M. himalayana* (L. f.) Benth.	I	—
	COMBRETACEAE		
34.	*Terminallia alata* Heyne ex Roth.	I	—
35.	*T. arjuna* (Roxb. ex DC.) Wt. *et* Arn.	I	+
	LYTHRACEAE		
36.	*Rotala serpyllifolia* Roxb.	I	—
	CUCURBITACEAE		
37.	*Luffa umbellata* (Klein) Roem.	E	—
	RUBIACEAE		
38.	*Hedyotes biflora* (L.) Lam.	E	—
	APIACEAE		
39.	*Peucedanum dhana* Buch.—Ham. var. *dalzelii* C.B.Cl.	I	—
	ASTERACEAE		
40.	*Blumea membranacea* DC. var. *jacquemontii* (Hk. f.) Randeria	V	—
41.	*Caesulia axillaria* Roxb.	I	+
42.	*Cyathocline purpurea* (G. Don.) O. Ktze.	I	+
43.	*Erigeron asteroides* Roxb.	R	—
44.	*Glossocardia bosvallea* (L.f.) DC.	I	+
45	*Launea procumbens* (Roxb.) Ramayya *et* Rajgopal	I	+
46.	*Pullicaria angustifolia* DC.	I	+
47.	*Vernonia anthelmintica* Willd.	I	+
48.	*Vicoa vestita* (Wall. ex DC.) Benth. *ex* Hk. f.	R	—
	SAPOTACEAE		
49.	*Manilkara hexandra* (Roxb.) Dub.	I	+
	OLEACEAE		

50.	*Jasminum roxburghianum* Wall. ex DC.	V	—
	APOCYNACEAE		
51.	*Wrightia tomentosa* (Roxb.) Roem. *et* Schult.	I	+
	ASCLEPIADACEAE		
52.	*Ceropegia bulbosa* Roxb.	V	+
53.	*Dregea volubilis* (L. f.) Benth. ex Hk. f.	V	—
	GENTIANACEAE		
54.	*Centaurium centaureoides* (Roxb.) Rao *et* Hemadri	I	—
55.	*Exacum pedunculatum* L.	R	—
56.	*Hoppea dichotoma* Willd.	I	+
	EHRETIACEAE		
57.	*Cordia dichotoma* Forst. f.	I	+
	BORAGINACEAE		
58.	*Trichodesma sedgwickianum* Banerjee	V	—
	CONVOLVULACEAE		
59.	*Argyreia sericea* Dalz. *et* Gibs.	I	—
	SCROPHULARIACEAE		
60.	*Kickxia incana* (Wall.) Pennell	R	—
61.	*Striga densiflora* (Benth.) Benth.	I	—
	GESNERIACEAE		
62.	*Didymocarpus pygmaea* C.B.Cl.	I	—
	ACANTHACEAE		
63.	*Barleria prattensis* Sant.	V	—
64.	*Eranthemum nervosum* (Vahl) R. Br. ex Roem. *et* Schult.	R	—
65.	*E. roseum* (Vahl) R. Br.	R	—
66.	*Gantelbua urens* (Heyne) Bremek.	I	—
67.	*Hemigraphis rupestris* Heyne ex T. Anders.	R	—
68.	*Hypoestis lanata* Dalz.	R	—
69.	*Lepidagathis hamiltoniana* Wall.	I	—
70.	*L. trinervia* Wall. ex Nees	I	+
71.	*Petalidium barlerioides* Nees	I	—
72.	*Physichilus serphyllum* Nees	I	—
73.	*Justicia neesii* Ramam.	V	—
74.	*Rostellularia quinqueangularia* Nees	I	+
	NYCTANTHACEAE		
75.	*Nyctanthes arbor-tristis* L.	V	+
	LAMIACEAE		
76.	*Lavandula bipinnata* (Roth) Ktze. var *rothiana* Ktze.	V	+
77.	*Leucas biflora* (Vahl) R. Br.	I	—
78.	*Pogostemon benghalense* (Burm. f.) Ktze.	V	—
	SANTALACEAE		
79.	*Santalum album* L.	V	+

	EUPHORBIACEAE		
80.	*Acalypha lanceolata* Willd.	I	+
81.	*A. malabarica* Muell.-Arg.	I	+
	MORACEAE		
82.	*Ficus religiosa* L.	I	+
83.	*F. benghalensis* L.	I	+
	ULMACEAE		
84.	*Trema politoria* Bl.	R	+
	HYDROCHARITACEAE		
85.	*Nechamandra alternifolia* (Roxb.) Thw.	I	+
	ZINGIBERACEAE		
86.	*Curcuma amada* Roxb.	V	+
	COMMELINACEAE		
87.	*Amischophacelus cucullata* (Roth) Rao *et* Kamathy	V	+
88.	*Commelina hasskarlaei* C.B.Cl.	I	—
	ARACEAE		
89.	*Sauromatum pedatum* (Willd.) Schot	R	—
	ERIOCAULACEAE		
90.	*Eriocaulon sollyanum* Royle	R	—
	CYPERACEAE		
91.	*Eriophorum comosum* Wall. ex Nees	I	+
	POACEAE		
92.	*Arthraxon meeboldii* Stapf	R	—
93.	*Dichanthium aristatum* (Poir.) C.E. Hubb.	E	—
94.	*Hemarthria protensa* Steud.	R	—
95.	*Hygroryza aristata* (Retz.) Nees ex Wt. *et* Arn.	I	—
96.	*Ischaemum pilosum* (Klein ex Willd.) Wt.	I	—
97.	*Iseilema anthephoroides* Hack.	I	+
98.	*I. prostratum* (L.) Anders.	I	+
99.	*Oropetium villosulum* Stapf	I	—
100.	*Sehima sulcatum* (Hack.) A. Camus	I	—
101.	*Themeda quadrivalvis* (L.) O. Ktze.	I	+
102.	*Tripogon purpurascens* Duthie	I	—
103.	*Vetiveria lowsonii* Hk. f.	V	+

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14

Observations on Some Rare or Endangered Endemics of Southeastern Kutch

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Introduction

The present area of investigation is the southeastern part of Kutch district, Gujarat state. The district of Kutch lies at the western extremity of India. The district stretches roughly from 22°-44'-11" (approx.) to 24°-41'-25" (approx.) N and 68°-09'-46" (approx.) and 71°-54'-47" (approx.) East longitudes. It is bounded on the north by Great Rann to Kutch, North-west by Sind (Pakistan), west and south-west by the Arabian sea, south by the Gulf of Kutch, on the south-east by the Surendranagar district and little Rann of Kutch, on the east by the districts of Banaskantha and Mehsana and on the north-east by the south-East Rajasthan.

Botanically the area is underexplored. In view of the obvious damage done to this sensitive desert ecosystem, the authors felt the urgent necessity of preparing a modern and up-do-date flora of this region. A few trips in 1973 and numerous excurisons during the period 1976-1980 have resulted in the preparation of a modern flora for the S.E. region of Kutch.

Analysis of the floristic data revealed that phytogeographically, the area is more akin to Sind (Pakistan) and N.W. Rajasthan than with any other part of Gujarat state. The flora shows dominance of western elements over eastern or Indo-Malayan. Endemic element is very low (2.4%) and few of the endemic plants are restricted only to Kutch and Saurashtra regions while other endemics are comparatively widely distributed over the entire northern semiarid zone.

Rare plants represent a small but important part of the flora of southeastern Kutch. They are very suceptible to the effects of environmental change, because they occur in small populations or at scattered localities and are often confined to unique and localized habitats. The causes of such environmental change are biotic activities such as land clearing, cutting, lopping, overgrazing, the

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development of man-made forests (monocultures) and industrial pollution. The result of all such activities will be the dwindling of plant taxa.

Comparison of the vegetational and floristic account of Thakar (1926) with field observations made under the present floristic work clearly points to the process of deterioration which has set in due to various biotic influences. Further changes in the physical conditions of the Kutch area are envisaged in the light of extension of irrigational facilities to be provided under the Narmada project. This will also lead to loss of many habitats. It is, therefore, urgently necessary to make an inventory of all such rare, threatened and endangered plant species and to initiate measures to conserve the specific habitats. In addition to the biological interest, some of these rare endemics are also important from the chemical and economic points of view. Preliminary phytochemical analysis of these plants have revealed few of them to be rich sources of pharmacologically and economically important alkaloids and saponins. The purpose of this list is to provide relevant information on such plants of southeastern Kutch. Voucher herbarium specimens prepared for all these rare, threatened wild plants have been deposited in the Herbarium of Plant Taxonomy Laboratory, Department of Botany, Faculty of Science, The M. S. University, Baroda.

Earlier Protection Efforts

In Kutch district, the importance of protection of the forest areas was realised much earlier by the then Maharaja of Kutch who, demarcated certain areas as reserved and protected forests. Chaduva and Nadi Baug Rakhals are such forests where biotic activities like, grazing, cutting and felling of trees were strictly prohibited. This resulted in the good development of some of the spiny and nonspiny trees in these forests.

But inspite of all this some of the common species are becoming rare mainly because of two reasons. Firstly, many wild habitats other than inland, protected forest areas such as Mangroves, aquatic bodies and grasslands were not brought under the purview of rules for protected areas which resulted in the gradual deterioration of these habitats.

Secondly, over the last 15-20 years, the forest department has developed many man-made forests (mostly monocultures) in the area for different purposes like providing shelter belts, green belts and for fire wood. This also has resulted in the loss of few wild habitats and the diversity of their floral constituents.

All the rare endemics and threatened plants that are enumerated in this paper have been classified into four categories. Plants that are strictly endemic to Kutch and Saurashtra regions have been placed under the first category. The second category includes those species which though widely distributed over the entire northern semiarid zone including the adjoining Sind province (Pakistan) are restricted to it. The third category consists of those plants which

are commonly found in some of the Tropical African countries like Sudan, Arabia and Egypt. These plants have probably extended their distribution range into the Kutch district and are thus new entrants to the flora of the Indian subcontinent. Finally, those plants which have become rare or threatened due to overexploitation for medicinal purposes have been placed under the fourth category.

Enumeration of rare, threatened or endangered plant species of southeastern Kutch

I. Plants that are endemic to Kutch and Saurashtra regions.

Helichrysum cutchicum (Clarke) Rao et Deshpande (Asteraceae)

Habit : An erect or a procumbent annual, thinly covered with grey, cottony hairs.
Habitat : Slopes of the rocky hillocks.
Range : Kutch (Dahisara, Ningal, Bhuj), Saurashtra (Barda mountains).
Status : Rare and endemic to Kutch and Saurashtra regions of Gujarat State.
Chemistry : Saponins—whole plant.

Indigofera coerulea Roxb. var. *monosperma* Sant. (Fabaceae).

Habit : An erect undershrub, more or less greyish with minute, appressed hairs.
Habitat : Hard, sandy soils.
Range : Kutch (Bhadreshwar) and Saurashtra.
Status : Rare and endemic to Saurashtra and Kutch regions.
Chemistry : Alkaloids—Leaves and root bark.
Saponins—Stem, leaves and root bark.

II. Plants that are restricted to northern semiarid zone of the Indian subcontinent.

Campylanthus ramosissimus Wight (Scrophulariaceae)

Habit : An erect, much-branched shrub.
Habitat : Restricted to certain sand-stone formations.
Range : In India, the plant is found only in Kutch (Chaduva Rakhal and Bhuj).
Pakistan (Sind—limestone hills at Hyderabad and Baluchistan).
Status : Rare.
Chemistry : Alkaloids—stem and root.

Convolvulus stocksii Boiss. (Convolvulaceae)

Habit : An erect, annual herb.
Habitat : Among grasses on gravelly soils.

Range : India (Gujarat--Kutch (Bhuj), Chhotaudepur and Broach; Rajasthan).
Pakistan (Sind, Baluchistan).
Status : Rare and threatened in the area due to over-grazing of grasslands.

Heliotropium bacciferum Forsk. var. *suberosum* (Clarke) Bhandari (Boraginaceae)
Habit : A much-branched undershrub.
Habitat : Saline sandy soils.
Range : In India, the plant is restricted to Kutch (Mandvi) and N.W. Rajasthan.
Pakistan (Sind).
Status : very rare.

Limonium stocksii (Boiss.) O. Ktze. (Plumbaginaceae)
Habit : A low-branched perennial with a woody stem.
Habitat : Coastal, saline soils.
Range : India—Gujarat--Kutch (Bhadreshwar), Saurashtra (Verawal)
Pakistan (Sind, Baluchistan).
Status : Rare.

Pavonia ceratocarpa Mast. (Malvaceae)
Habit : An erect undershrub.
Habitat : Hillocks, and hard, gravelly soils.
Range : India (Gujarat--Kutch, Saurashtra).
Pakistan (Sind).
Status : The plant is rare and is very much restricted in its distribution.

Schweinfurthia papilionacea (L.) Merrill (Scrophulariaceae)
Habit : A dwarf, robust, glaucous herb.
Habitat : Rocky and gravelly soils.
Range : India (Gujarat--Kutch, Saurashtra; N. W. Rajasthan).
Pakistan (Sind, Baluchistan), Afghanistan.
Status : Rare.
Chemistry : Alkaloids– All the plant parts ;
Saponins--Stem, root and fruits.

III Plants of Perso-Arabian floristic element which have extended their distribution range into the Kutch district.

Ipomoea kotschyana Hochst. ex Choisy (Convolvulaceae)
Habit : A herbaceous, prostrate annual.
Habitat : Sandy and hard, gravelly soils.
Range : All over southeastern Kutch, Mauritania, Mali, Dahomey, Niger, Techad, Ethiopia and Sudan.

Status : Though the plant is common in the area, it is not so far reported from any other locality in India.

Premna resinosa Schau. (Verbenaceae)
Habit : A straggling shrub.
Habitat : Hillocks.
Range : In India, the plant is restricted to Kutch district only. Tropical Africa, Arabia.
Status : Rare.

Schweinfurthia pterosperma A. Braun (Scrophulariaceae)
Habit : An erect annual herb.
Habitat : Saline soils.
Range : In India, the plant is restricted to Kutch district only. Bhuj, Gandhidham, Khavada, Sudan, Arabia.
Status : Rare.
Chemistry : Alkaloids—stem, leaves and fruits.
Saponin—stem, leaves and fruits.

IV Plants that are rare or threatened due to over-exploitation for medicinal purposes.

Cassia senna L. (Caesalpiniaceae)
Habit : A perennial shrub.
Habitat : Hard, gravelly soils.
Range : India (Gujarat—Kutch (Anjar, Adipur and Gandhidham). The plant is under large scale cultivation in Tinnevelly district of Tamil Nadu, Maharashtra and A.P.
Tropical Africa and Arabia.
Status : The plant is seen growing wild in Kutch district. Threatened in the area due to exploitation of the plant for medicinal purposes.
Chemistry : The leaves and pods of this plant contain Sennosides which are used as laxatives.

Commiphora wightii (Arnott) Bhandari (Burseraceae)
Habit : A much-branched, generally leafless, hardy, resinuous shrub.
Habitat : Rocky hillocks and hard, gravelly soils.
Range : India (Gujarat—North Gujarat, Central Gujarat (Vasad), Kutch and Saurashtra; Rajasthan; Khandesh; Berar; Mysore and Bellary. Pakistan (Sind, Baluchistan), Arabia.
Status : Presently common, but threatened in the area due to illegal exploitation of the plant by pharmaceutical and perfumery Industries.
Chemistry : Saponins : Stem and root.

Concluding remarks

The rate at which the process of deterioration of this desert biota is proceeding, it is urgently necessary that steps are taken to halt the process and thereby conserve the diversity of species so characteristic of these inhospitable saline and sandy deserts. Although a few areas have been partially protected, many others are left to their destiny.

Strict laws conserving the peculiar habitats are the need of the hour. An inventory of all the threatened plants should be compiled and public be educated to ascertain their survival. Strict penalties should be imposed on any deliberate defaultor. The Biology of the threatened and endangered species should be critically studied so as to assess their ecological amplitude. Efforts should be made to rear these plants in Botanical gardens and transplant them as and when their peculiar ecological niches are available.

This further brings us to a more relevant discussion on the desirability of merely reprinting old provincial floras in order to meet the needs of the scientific community. The authors are of the opinion that reprinting of old flora has its own importance but it in no way solves the problem of conservation of threatened plants. It is urgently necessary to revise these floristic works on the most modern lines backed up by intensive and extensive field work. It is this process of modernization of a regional flora which is essential for a proper and accurate assessment of the nation's floral wealth. Such efforts on the part of all the taxonomists will put the entire problem of plant species conservation vis-a-vis their habitat conservation in the proper perspective.

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15

Some Rare Plants of Madhya Pradesh

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To determine the status of the plant species dealt in the present paper, a thorough checking of literature and herbarium was done. It is revealed that *Eragrostiella leioptera* endemic to India. *Sporobolus tetragonus* is endangered species and *Indigofera nummulariifolia* and *Aristida cumingiana* are threatend/rare species of the area. The field observations as well as consultation of herbaria at BSA, CAL, LWG supported the view that *E. leioptera, S. tetragonus* are endangered species. The details of these species are discussed.

INDIGOFERA NUMMULARIFOLIA (L.) Livera ex Alston in Trim. Handb. Fl. Ceylon 6: 72. 1931.

Dalzell and Gibson (1861) cited in "Bombay Flora" that it is very common species in that area. Cooke (1901-1908) stated it to be a rare species of the area. This species has been reported from South India, W. Trop. Africa and Ceylon. It is quite possible that this species would have been common around 1861. However, the author has observed this as a threatened species which is subjected to extensive grazing.

Ecological Note : Grows on red-yellow soils along the forest roadside. *Specimen examined* : Damoh (Tendukhera) 17.6.1979. *Shukla* 29436

ROTALA MEXICANA Cham. & Schlect in Linnaea 5 : 567. 1830.

This species is represented by a solitary sheet at CAL. It is observed to be a rare plant in Madhya Pradesh. A Single collection has been made so far by author from Damoh district, where it was seen growing in dense patches.

Ecological Note : Marshy habitat along the bank of Nala.
Specimen examined : Damoh (Jhalon) 28.9.1979. *Shukla* 29607.

SPOROBOLUS TETRAGONUS Bor in Kew Bull. 1949. 251. 1949.

Clarke (1883) collected this species from Chota Nagpur and since then no subsequent collection is available except Nair's collection from Balaghat (1973). Bor (1960) also reported the restricted distribution of this species from Burma and Thailand.

Ecological note : Restricted in dense forests on moist places.
Specimens examined : Balaghat (Jalagaon) 28.9.1973, *Nair* 18468.
ERAGROSTIELLA LEIOPTERA (Stapf) Bor in Indian For. 66 : 270. 1940.

Bor (1940) reported this species at about 1700-2000 m. in Khasi and Garo hills. Recently this species has been collected by Sengupta from Ambikapur in M.P. [specimen deposited at BSA]. There are no other collections of this anywhere from India.

Ecological note : It occurs in hilly regions on slopy rocky red-yellow soils.
Specimens examined : Ambikapur (Pingla Nala) 19, 11. 1972 *Sengupta* 15552.

ARISTIDA CUMINGIANA Trin. et Rupr. Sp. Stip. 141. 1842.

It is another rare grass species. The only collections of this are those of Clarke (1803) from Ranchi (CAL) and Haines (1925) from M.P. Recently Sengupta (1972) has collected this species from Raigarh. It is evident that this species is very rare.

Ecological note : In damp soils of open meadows.
Specimen examined : Raigarh (Sonna-Khudia Range) 21.11.1971 *Sengupta* 16496.

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16
Rare and Endemic Flowering Plants of Orissa

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Introduction

The wide range of topography and other physical features of Orissa provided by the hills ranging from almost sea level to about 1500 m altitude, the coastal plains, the Chilka lake, the deltoic swamps of Mahanadi and Brahmani river have influenced the vegetation to give rise to a rich and varied flora. The forests cover 43 percent of the total land area of the state and are broadly classified into the Dry Deciduous, the Moist Deciduous and the Semi-evergreen types, besides various other subsidiary types and seral types to a limited extent such as the tidal forests and the coastal sal forests.

The total number of species of flowering plants and Pteridophytes comprising the flora of the State is estimated to be around 2,500. From the informations gathered from field observations and published literature (Banerjee, 1972; Chatterjee, 1940; Gamble, 1915-36; Haines, 1921-24; Hooker, 1872-97; Kapoor, 1964; Mooney 1950; Panigrahi et al., 1964; Pattnaik, 1956; Paul, 1975; Paul, Balapure and Rizvi, 1980; Raizada, 1948; Raju, 1964, 1970; Rao and Banerjee, 1967; Rao and Mukherjee, 1969; Sanyal, 1957; Saxena, 1973, 1974, 1976, 1977; Saxena and Brahmam, 1978a, 1978b, Srinivasan and Rao, 1961). 101 species of flowering plants in the flora of the state are found to belong to rare plants. These have been classified into the status categories as defined by the International Union for Conservation of Nature and Natural Resources (Melville, 1970-71, Maheshwari, 1977) with notes on their occurrence, distribution and degree of threat and causes of rarity in some cases. Eight species *(Acacia donaldii, Aglaia haslettiana, Aspidopteris hutchinsonii, Homonoia intermedia, Mucuna minima, Oryza jeyporensis, Tragia gagei and Uvaria eucincta)* are found to be endemic to Orissa besides four others which though not endemic in strict sense, extend to some parts of the neighbouring states only. These are, *Dimeria mooneyi, Hypericum gaitii, Dasianthus truncatus* and *Maytenus bailadillana.*

Various natural and biotic factors seem to be responsible for the rarity of the species. The requirement of specialised habitats or depletion due to excessive exploitation are the main factors responsible for their rare distributions.

ENUMERATION

ENDANGERED

Balanophora polyandra Griff. (Balanophoraceae)

Mahendragiri, Bhatodih, 1000m., Keonjhar.

Distribution : Sikkim, Khasi hills, Orissa.

Cassipourea ceylanica (Gardn.) Alston (Rhizophoraceae)

Rocky margins of Chilka lake.

The population of the species in the area has been reduced to countable number because the mangrove forests once plentiful in the islands of Chilka and along its margins have all been cleared by man.

Distribution : Orissa, Karnataka, Kerala, Tirunelvelli; Sri Lanka.

Stemona tuberosa Lour. (Roxburghiaceae)

Mahendragiri, 1200 m.

Distribution : Northern Circars southwards upto Nellore, 900-1200 m, Bengal, Assam; Silhet, Chittagong, China.

VULNERABLE

Alphonsea madraspatana Bedd. (Annonaceae)

Bhitarkanika, Khandagiri, Bhubaneswar.

Distribution : Eastern Ghats, Karnataka, Tamilnadu.

Cycas circinalis L. (Cycadaeeae)

Puri, Ganjam.

Poor regeneration of the species, coupled with the collection of seeds and roots for edible purpose poise threat to the species.

Distribution : Malabar coast, south India; Sri Lanka, Madagaskar, Sumatra, Java, East Tropical Africa.

Gloriosa superba L. (Liliaceae)

Throughout the State, scattered.

With the increasing demand of the seeds for isolation of colchicin and exploitation of the species both for seeds and the roots (as planting material), the species is showing tendency of depletion.

Distribution : Throughout tropical India and ascending to 1500 m. in the Western Himalaya; tropical Asia and Africa.

Gnetum ula Brong. (Gnetaceae)

Similipahar, Mayurbhanj; Mahendragiri, 1200 m.

Distribution : Eastern tropical Himalaya; Western Ghats and some parts of the Eastern coast also in Chindwala district of Madhya Pradesh, Andamans; Singapore, Malaysia.

Phoenix paludosa Roxb. (Arecaceae)

Delta areas of Mahanadi and Brahmani rivers: Bhitarkanika Paradeep, Dangmal, Kujang etc.

The trees are subjected to heavy destruction as almost all parts of the plant are used by the local people in some way or the other. The state Forest Department has since taken some measures to check cutting of the trees.

Distribution : Aestuarial shores from Bengal to Burma and Andaman islands; Thailand, Cochin China.

Rauwolfia serpentina (L.) Benth. ex Kurz (Apocynaceae)

Scattered: Ganjam, Puri, Keonjhar, Mayurbhanj.

The species has been badly depleted in the past, due to over-exploitation for roots. In Ramgiri (Ganjam) and other Agency areas where the plant still occurs in good frequency, the exploitation is still going on to a considerable extent.

Distribution : Sub-Himalayan tract from Sirhind estwards to Assam, Sikkim and North and Central Bengal and from Bombay and Central India to Sri Lanka, Eastern and Western Ghats, Andaman Islands; Burma, Java.

RARE

Alchornea mallis Muell.—Arg. (Euphorbiaceae)

Rebna forest, Keonjhar.

Distribution : Central and Eastern Himalayas, Assam, Sikkim, Circars; Nepal.

Amoora cucullata Roxb. (Meliaceae)

Dangmal (Cuttack) in forest, along tidal stream.

Distribution : Lower Bengal, Andamans; Nepal.

Ascocentrum micranthum (Lindl.) Holttum (Orchidaceae)

Pauri hills, 500 m, Bamra.

Distribution : Sikkim, Dehra Dun, Naga and Khasi hills; Burma.

Atylosia cajanifolia Haines (Fabaceae)

Mahendragiri, Ganjam; Puri.

Distribution : Forests of Southern range of Bihar and Orissa.

Bulbophyllum careyanum Spreng. (Orchidaceae)

Kapilas, Dhenkanal.

Distribution : Tropical Himalaya from Nepal eastwards, Khasi hills; Burma.

Capparis olacifolia Hook. f. & Th. (Capparaceae)

Mahendragiri, 1300 m, Ganjam.

Distribution : Tropical Himalayan Valleys from Nepal to Assam.

Capparis roxburghii DC. (Capparaceae)

Barkuda, Chilka.

Distribution : Western Ghats and Carnatic.

Carissa gangetica Stapf ex Gamble (Apocynaceae)

Mahendragiri, Ganjam.

Distribution : Tamilnadu

Ceropegia hirsuta Wight & Arn.
Khurda, Puri.
Distribution : Deccan Peninsula from Concan to Travancore.
Chirita hamosa R. Br. (Gesneriaceae)
Serango and Mahendragiri (Ganjam).
Distribution : Central India, Bihar, Western Deccan Peninsula, Khasi hills.
Chukrasia tabularis A. Juss. (Meliaceae)
Sukinda, Cuttack.
Distribution : Western Ghats, Deccan; Malacca, Sri Lanka.
Dipcadi montanum (Dalz.) Baker (Liliaceae)
Gunpur, Koraput.
Distribution : Rohilkhand, Concan and Western Deccan.
Drypetes assamica (Hook. f.) Pax & Hoffm. (Euphorbiaceae)
Mahendragiri hills, Ganjam.
Distribution : Visakhapatnam, Assam, Sikkim, Khasi Hills.
Eleiotis sororia DC. (Fabaceae)
Cuttack.
Distribution : Plains of Bundelkhand, Western Peninsula, Deccan, Carnatic, Nilgiris and Pulney hills; Sri Lanka.
Eria bambusifolia Lindl. (Orchidaceae)
Mahendragiri, 1500 m, Ganjam.
Distribution : Tropical Sikkim Himalaya, Khasi hills.
Garcinia cowa Roxb. ex DC. (Clusiaceae)
Mals of Puri; Mayurbhanj; Athmalik.
Distribution : Bihar, Orissa, Bengal, Assam, Khasi hills, Andaman, Bangladesh, Burma, Thailand.
Homalium nepalense (Wall.) Benth. (Samydaceae)
Mahendragiri, Ganjam.
Distribution : Rambpa hills in Godavari; Nepal.
Hypericum gaitii Haines (Hypericaceae)
Similipahar, Mayurbhanj.
Distribution :Bihar and Orissa.
Indigofera aspalathoides Vahl ex DC. (Fabaceae)
Hukitola island, Cuttack.
Distribution : Carnatic; Sri Lanka.
Indigofera wightii Grah. (Fabaceae)
Kalahandi.
Distribution : Plains of western India; Visakhapatnam, hills of Deccan, Western Ghats; Sri Lanka.
Justicia nilgherrensis Wall. ex T. And. (Acanthaceae)
Similipahar, Mayurbanj.
Distribution : Western Ghats, Karnataka, S. Arcot, Nilgiris.
Knoxia linearis Gamble (Rubiaceae)
Mahendragiri, Ganjam.

Distribution : Western Ghats, Tamil Nadu, Tirunelveli.

Leucas clarkei Hook. f. (Lamiaceae)

Gangpur; Surisunuli, Ganjam.

Distrubition : Bihar and Orissa.

Lobelia terminalis C. B. Cl. (Campanulaceae)

Talcher; Sambalpur.

Distribution : Bihar and Orissa, Northern Bengal.

Malaxis mackinnonii (Duthie) Ames. (Orchidaceae)

R. Udaigiri, Ganjam.

Distribution : Mussoorie, Dehra Dun (U.P.), Amarkantak and Bastar (M.P.), Bengal, Bihar, Orissa, Gujarat; North Thailand.

Maytenus bailadillana (Narayan & Mooney) Raju & Babu (Celastraceae)

Kalahandi.

Distribution : Orissa and Madhya Pradesh.

Maytenus rothiana (Walp) Loureau Callen. (Celastraceae)

Mahendragiri.

Distribution : Western Peninsula, the Concan and Kanara.

Melasma thomsonii (Hook. f.) Wettst. (Scrophulariaceae)

Kalahandi.

Distribution : Bihar and Orissa, Madhya Pradesh, South India.

Mollugo disticha Ser. (Aizoaceae)

Kalahandi.

Distribution : South Deccan Peninsula, East cost of Tamil Nadu; Sri Lanka.

Natsiatum herpeticum Buch.—Ham. (Icacinaceae)

Mahendragiri; Mals of Puri; Angul.

Distribution : East Bengal and Himalaya from Nepal to Sikkim, Khasi hills; Silhet, Chittagong and Pegu.

Neanotis quadrilocularis (Th.) Lewis. (Rubiaceae)

Mahendragiri, Ganjam.

Distribution : Karnataka, Kerala; Sri Lanka.

Neocinnamomum caudatum (Nees) Mer. (Lauraceae)

Mahendragiri; Similipahar.

Distribution : Central and Eastern Himalaya, Northern Circars, Sikkim; Nepal, Burma.

Nervilia crispeta (Bl.) Schltr. (Orchidaceae)

Koraput.

Distribution : Andhra Pradesh, Orissa, Karnataka, Sikkim, Manipur; Java, New Guinea.

Nilgirianthus circarensis (Gamble) Bremek. (Acanthaceae)

Karlapat, Kalahandi.

Distribution : Northern circars.

Nilgirianthus lupulinus (Wall.) Bremek. (Acanthaceae)

Kalahandi.

Distribution : Western Deccan Peninsula, Concan, Kerala, Tirunelveli.

Nothopegia heyneana Gamble (Anacardiaceae)

Mahendragiri; Mals of Puri; Malaygiri; Baula hills near Anandapur, Keonjhar.

Distribution : Peninsular India, Western Ghats, Tirunelveli.

Olax acuminata Wall. ex Benth. (Olacaceae)

Kalinga.

Distribution : Assam, Khasi hills; Bhutan, Silhet.

Ophiorrhiza trichocarpos Bl. (Rubiaceae)

Mahendragiri, Ganjam.

Distribution : Andaman; Chittagong, Burma, Java.

Oropetium villosum Stapf ex Bor (Poaceae)

Sonabera, Samsalpur.

Distribution : Orissa, Central India, Bombay, Poona.

Osbeckia rostrata D. Don var. *sexangulata* Haines (Melastomataceae)

Kalahandi, 800 m.

Distribution : Bihar and Orissa.

Parabaena sagittata Miers (Menispermaceae)

Kasipur, Kalahandi.

Distribution : Assam, Khasi hills; Nepal, Chittagong, Ava.

Paramignya griffithii Hook. f. (Rutaceae)

Sukinda, Cuttack; Mals of Puri.

Distribution : Assam; Silhet, Burma, Malaysia.

Pavetta brevifolia DC. (Rubiaceae)

Mahendragiri, Ganjam.

Distribution : Nilgiri hills.

Peperomia dindigulensis Miq. (Piperaceae)

Mahendragiri, Ganjam.

Distribution : N. Circars, Carnatic, Western Ghats.

Persea macrantha (Nees) Kostermans (Lauraceae)

Kalahandi.

Distribution : Deccan Peninsula from Concan Southwards; Sri Lanka.

Peucedanum dhana Buch-Ham. ex C. B. Cl. (Apiaceae)

Ganjam.

Distribution : N. W. India, Kumaon, North Bengal.

Phlebophyllum jeyporensis (Bedd.) Bremek. (Acanthaceae)

Jeypore; Mahendragiri.

Distribution : S. Deccan Peninsula.

Pittosporum nepaulense (DC.) Rehd. & Wilson (Pittosporaceae)

Mahendragiri, Ganjam; Similipahar, Mayurbhanj.

Distribution : Subtropical Himalaya from Sikkim to Garhwal; Khasi hills and Mishmi; Western Peninsula, Cancan to Nilgiri.

Pimpinella bracteata Haines (Apiaceae)

Rebna hills, Keonjhar; Pal Lahara.

Distribution : Bihar and Orissa.

Podostemon wallichii R. Br. (Podostemaceae)

Similipahar, Mauyrbhanj.

Distribution : Khasi hills, Ava.

Polyalthia Korint; (Dunal) Thw. (Annonaceae)

Bahakund, Hetamundia and Bitorkanika tidal forests, Cuttack.

Distribution : Western Peninsula from Visakhapatnam southwards; Sri Lanka.

Polystachya flavescens (Bl.) J. J. Sm. (Orchidaceae)

Mahendragiri, Ganjam.

Distribution : Western Ghats; Burma, Malaysia.

Prunus gygeoides Koehne (Rosaceae)

Mahendragiri, Ganjam.

Distribution : Bihar, Bengal.

Psoralia corylifolia DC. (Fabaceae)

Khurda, Puri.

Distribution : Plains of India, Sri Lanka.

Psychotria adenophylla Wall. (Rubiaceae)

Puri; Similipahar, Mayurbhanj.

Distribution : Assam, Sikkim, Chittagong, Burma.

Psychotria fulva Buch.—Ham. ex Hook. f. (Rubiaceae)

Mahendragiri, Ganjam.

Distribution : Assam, Khasi hills, Cachar, Mahipur, Eastern Ghats; Pegu.

Rhaphidophora hookeri Schott. (Araceae)

Koraput; Kalahandi.

Distribution : Assam, Manipur, Sikkim, Silhet.

Salicornia brachiata Roxb. (Chenopodiaceae)

Chilka.

Distribution : East coast of India, Coasts of Nellore, Chinglaput, Tarjore and Tirunelveli; Sri Lanka.

Schefflera roxburghiana Gamble (Araliaceae)

Ganjam.

Distribution : Northern Circars, Eastern Ghats.

Sophora glauca Lesch. (Fabaceae)

Mahendragiri, Ganjam.

Distribution : N Circars, Western Ghats, Travancore, Salem.

Sophora wightii Baker (Fabaceae)

Mahendragiri, Ganjam; Ganda-Mardhan

Distribution : Hills of Western Peninsula, Karnataka.

Traverniera cuneifolia Arn. ex Wight. (Fabaceae)

Mahanadi mouth at Hetamundia block, Cuttack.

Distribution : Plains of Sindh and Punjab, Andhra Pradesh, Karnataka; Afghanistan, Orient.

Tephrosia roxburghiana J. R. Drum. (Fabaceae)
Mahendragiri, Ganjam.
Distribution : N. Circars, Deccan, Karnataka.
Tinospora sinensis (Lour.) Merr. (Menispermaceae)
Adava, Ganjam.
Distribution : Western Peninsula, Sikkim, Khasi hills; Chittagong.
Trichospermum grandiflorum D. Don (Gesneriaceae)
Rebna forest, Keonjhar; Similipahar, Mayurbhanj.
Distribution : Assam, Khasi hills.
Tripogon roxburghianus (Steud.) Bhide (Poaceae)
Koraput; Kalahandi.
Distribution : South and West India.
Tropidia angulosa Bl. (Orchidaceae)
Kalahandi.
Distribution : Sikkim, Travancore, Malabar; Silhet, Burma.
Tylophora fasciculata Buch-Ham. ex Wight. (Asclepiadaceae)
Kalahandi.
Distribution : Central and S. India; Sri Lanka.
Tylophora rotundifolia Buch.—Ham. ex Wight. (Asclepiadaceae)
Ganjam.
Distribution : Assam, Concan, Travancore; Sri Lanka.
Uvaria hamiltonii Hook. f. & Thoms. (Annonaceae)
Similipahar, Mayurbhanj, Ganjam.
Distribution : Sikkim Terai, Bihar, Assam.
Vibuurnum acuminatum Wall. ex. DC. (Caprifoliaceae)
Mahendragiri, Ganjam.
Distribution : Daccan, N. Circars, Western Ghats.
Xylocarpus gangeticus C. E. Parkinson. (Meliaceae)
Jambu.
Distribution : Bay of Bengal, Andaman; Malaysia.

INDETERMINATE

Acacia donaldii Haines (Mimosaceae)
Sambalpur.
Distribution : Endemic to Orissa.
Aglaia haslettiana Haines (Meliaceae)
Mals of Puri; Angul.
Distribution : Endemic to Orissa.
Aspidopteris hutchinsonii Haines (Malpighiaceae)
Mayurbhanj, 900 m.
Distribution : Endemic to Orissa.
Desmos longiflorus (Roxb.) Safford (Annonaceae)
Mals of Puri.

Distribution : Assam, Khasi hills; Chittagong.

Dimeria mooneyi Raizada ex Mooney (Poaceae)

Sonabera, Sambalpur.

Distribution : Orissa, Madras.

Evodia miliafolia Benth. (Rutaceae)

Bonai.

Distribution : Eastern Himalaya, Assam; Burma.

Garcinia spicata (Wight & Arn.) Hook. f. (Clusiaceae)

Ganjam.

Distribution : Western Peninsula, Circars; Sri Lanka.

Hibiscus platanifolius (Willd.) Sweet (Malvaceae)

Mals of Puri.

Distribution : Eastern India, Bengal, Orissa and South India; Sri Lanka.

Homonoia intermedia Haines (Enphorbiaceae)

Mahanadi river bed.

Distribution : Orissa.

Lasianthus truncatus Bedd. (Rubiaceae)

Mahendragiri, Ganjam.

Distribution : Orissa, Hills of Visakhapatnam.

Licuala peltata Roxb. (Arecaceae)

Karlapat, S. Kalahandi.

Distribution : Sikkim, Assam, Khasi hills, Andaman; Silhet, Burma.

Mucuna minima Haines (Fabaceae)

Sambalpur.

Distribution : Endemic to Orissa.

Oryza jeyporensis Govindaswami & Krishnamurty (Poaceae)

Jeypore.

Distribution : Endemic to Orissa.

Polyalthia semiarum Benth. & Hook. f. (Annonaceae)

Mals of Orissa; Bonai; Muyrbhanj.

Distribution : Assam; Silhet, Burma.

Pterocaulon redolens F. Vill. (Asteraceae)

Sundergarh.

Distribution : Orissa; South Burma, Philippines, New Caledonia, Australia.

Sonneratia griffithii Kurz (Rhizophoraceae)

Tidal forests of Mahanandi.

Distribution : India; Burma.

Terniola zeylanica Tul. (Podostemaceae)

Angul.

Distribution : Western Peninsular India in Ghats; Sri Lanka.

Tragia gageri Haines (Euphorbiaceae)

Mals of Puri.

Distribution : Endemic to Orissa.

Uvaria eucineta Bedd. ex Dunn (Annonaceae)
Sal forests of Bhanjanagar.
Distribution : Endemic to Ganjam district of Orissa.

INSUFFICIENTLY KNOWN

Cedrela brevipetiolulata Haines
Mals of Orissa.
Distribution : Orissa.

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17

Some Threatened Plants of Bengal Plains

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Introduction

The Flora of alluvial plains and mangrove swamps of Sunderbans of West Bengal is modified by various environmental factors. The main factor is the habitat disturbance directly due to the population pressure (Meijer, 1973). The industrialization of West Bengal during the early part of this century, influx of settlers from erstwhile East Bengal caused the habitat disturbance in such magnitude that ecological niches offered in few sheltered belts of Sunderbans disappeared as a result of removal of forest belts for agricultural and fuel purposes while the flora of E. Himalayan hills of West Bengal is affected to a large extent by the extension of commercial plantations like Tea, Cinchona and by monoculture of timber yielding plantations at the expense of the primary forests.

1. Sunderban Area

As new lands are being formed due to alluvial silts carried by the river system of the Himalayas flowing into the Bay of Bengal, advancing of stilted forests (mangrove formations) help in the development of land and conserve the newly formed land bars. The most important casualty that occurred during the last fifty years is the loss of 25% of the tidal forest of 24-Parganas of West Bengal, which acted as a bulwark against sea and also functioned as the primary coloniser of the saline swamps of Hooghly deltas. The loss of mangrove forests in the Sunderbans area either due to the felling of the forests for paddy cultivation or for fuel resulted in the frequent submersion of the area during cyclonic rains and tidal bores. Besides, the large scale removal of *Excoecaria agallocha* in the Sunderbans of Bangladesh for paper industry laid open vast tract of land to the fury of cyclones causing destruction of land and property. Recently the 1970 cyclonic storm caused loss of thousands of humanlife and properties worth crores of rupees in Bangladesh.

The gradual disappearance of species previously collected from an area indicates the state of change in the ecosystem. The local extinction of species within a specified area is usually due to inforced extinction. The main causative factor is anthropogenic action of urbanization and habitat disturbance. Since mangrove genera like *Acanthus, Aegiceras, Bruguiera, Carallia,*

Ceriops, Excoecaria, Heritiera, Kandelia, Lumnitzera, Nipa, Sonneratia, Rhizophora, Xylocarpus are gregarious in growth with low speciation rate, the measure of loss of such species can not be gauged. However, several species establish as a part of the ecosystem in the tidal forests and their presence or absence gives an indication of the magnitude of ecological disturbances.

The most visible casualty is the poor occurrence of Orchids in the mangrove forests. A list of orchids which are considered rare from the collections housed at Central National Herbarium (CAL) is given below :

(1) *Acampe rigida* (Buch.– Ham. ex Smith) P. F. Hunt : Eastern Himalaya and Tenasserim; reported from Sunderbans (Heinig s.n.; Prain, 1903), and no fresh collection available.

(2) *Dendrobium anceps* Swartz : A botanically interesting plant occurring in the gangetic delta, Sikkim & Assam Himalayas. After Heinig's collection (Heinig 13) from Sunderbans, no fresh collections are available.

(3) *Luisia brachystachys* (Lindl.) Bl. : An interesting ornamental species of lower Himalayan range, once reported from Sunderbans (Prain, 1903); no fresh collections are available.

(4) *Oberonia gammiei* King & Prantl. : —A small epiphytic orchid reported from Sunderbans (Prain, 1903), but no collections are available.

(5) *Saccolabium ochraceum* Lindl. : Peninsular India and tropical eastern Himalayan epiphytic orchid, reported from Sunderbans (Prain, 1903), and no fresh collections are available.

(6) *Sarcanthus insectifer* Reichnb. f. : An interesting scandent epiphytic orchid of Bihar, Assam and Cachar, reported from Sunderbans (Prain, 1903), but no fresh collection is available.

(7) *Trias oblonga* Lindl. : An epiphytic Burmese orchid, recorded from Sunderbans but no specimen available in CAL.

II. Plains of Bengal

The Plains of West Bengal support dry deciduous forest in the districts of Purulia, Bankura, Birbhum and Burdwan with preponderence of Sal forests. Because of urbanization and industrialization, supporting one of the highly populated areas in the plains of West Bengal in 24Parganas and adjoining area, the following species have become vulnerable locally :

(1) *Aldrovanda vesiculosa* L. (Droseraceae) : An interesting insectivorous plant collected from Salt Lakes of 24-Parganas (Prain, 1903).

(2) *Drosera burmani* Vahl (Droseraceae) : The species collected from Burdwan and adjoining areas have become vulnerable locally.

(3) *Drosera indica* L. (Droseraceae) : The species reported from Birbhum and adjoining areas of West Bengal and have become rare.

(4) *Olax nana* Wall. ex Benth. (Olacaceae) : Reported from Konnagar in Hooghly District of West Bengal (Biswas, 1971) and its further distribution require study.

Phylogenetically primitive plants like *Helminthostachys zeylanica* (*L.*) Hook. of the family Helminthostachyaceae and *Psilotum nudum* Beauv. of the family Psilotaceae have become scarce due to overcollection and habitat disturbances.

A list of taxa described for the first time from West Bengal which require more collections, is given below. The following taxa are represented only by type specimen. The rarity of such taxa cannot be established unless more data is attained on their distribution : -

(1) *Alysicarpus rugosus* var. *minor* Prain (Leguminosae) : The plant was reported from central Bengal and Chotanagpur by Prain (1930a). No specimen is available in Herbarium (CAL).

(2) *Cardanthera uliginosa* Buch.—Ham. var. *birbhumensis* Guha (Acanthaceae) : Once collected by Guha in 1967 from Nanur, Birbhum and is represented only by the type specimen.

(3) *Hygrophila phlomoides* Nees var. *roxburghii* C. B. Clarke (Acanthaceae) : No fresh collection available from Sunderbans.

(4) *Microula duthiei* Banerjee (Boraginaceae) : Described from Teesta Valley and no further collection available.

(5) *Phyllanthus mukerjeeanus* Mitra et Bennet (Euphorbiaceae) : Besides the type, no further collection is available.

(6) *Polygala crotalarioides* Buch.—Ham. var. *glabrascens* Coll. et Hemsl. (Polygalaceae) : is of restricted distribution in Midnapore and Purulia of West Bengal.

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18

Threatened plants of Meghalaya—A Plea for Conservation

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Introduction

Change is the rule of nature and the vegetation of any place is under constant modification, one type leading to the other. During this gradual process of evolution of flora, it is quite likely that certain species get either eliminated from the area or their domain gets highly shrinkened, whereby they have to struggle for their existence. Such species may be termed as 'Threatened plants'. Plant species can also become threatened due to man's influence or stress on the natural flora mainly due to his tendency to exploit the natural resources for his material comforts.

During the course of our studies on the flora of Meghalaya for past over 6 years, a large number of such threatened plants have been encountered which are either rare, endagered or even endemic. A large majority of these plants however, are threatened due to the disturbance in their natural habitats. A knowledge of threatened plants in our country is very meagre (Jain and Sastry, 1980), and regionwise surveys are highly necessary before we are able to compile a final list of threatened plants of the country. As a prelude to this an account of threatened plants with reference to Meghalaya is discussed.

Area of study

The state of Meghalaya (comprising of the Garo, the Khasi and the Jaintia hill districts, and lying between 25°47′—20°10′ N and 89°45′—92°47′ E) in the north-east India is one of the richest and interesting Botanical regions which has attracted the attention of a number of botanists from time to time. Physiographically the region is remarkable due to the highly dissected and irregular topography, with an elevation ranging from about 100 m to 1990 m. The region experiences a tropical monsoonic climate and receives both north-east and south-west monsoons. The world's rainiest spots with an annual recorded rainfall of 1143 cm around Cherrapunjee and Mawsynram are located in this

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state. All these factors have greatly influenced the rich flora of the state, which can be mainly classified under the tropical and temperate types and each type comprising of numerous subtypes such as evergreen and semievergreen, deciduous, pine forests, grasslands and bamboo forests (Rao, 1974).

Threatened plants of Meghalaya

Threatened species may be endangered (taxa in danger of extinction) or vulnerable (taxa nearing endangered category) or rare, where the world population of a given taxon is very small and at risk. But as these categories are difficult to clearly demarcate in any given situation, all these species are discussed here under the broad group 'Threatened plants'. Most of the threatened plants in Meghalaya are however confined to the so called 'Sacred forests' which are the remnants of past climax vegetation. Many of the species enumerated here have not been mentioned by Jain and Sastry (1980) in their 'Threatened plants of India'. It may however be noted that many more species could be added to the list after further thorough botanical explorations in the state. Also species thought to be threatened may not prove to be so with intensive explorations, particularly to those areas which are normally inaccessible.

Conservation of threatened plants

This is one aspect which could be discussed at any length. The only way of conserving these threatened plants in Meghalayan situation seems to be, to declare certain areas in different parts of the state, where forests are still preserved and comparatively undisturbed as 'Biotype sanctuaries'. It is observed that species such as *Baliospermum micranthus*, *Elaeocarpus acuminatus*, *E. prunifolius*, *Fissistigma rubiginosum*, *Medinella rubicunda*, *Monotropa uniflora*, *Goniothalamus simonsii*, *Hedera helix*, etc. are found only in dense natural forests, which are rather becoming rare in Meghalaya, mainly due to the evil practise of Shifting agriculture. Further, it is evident that most of the so called threatened plants in Meghalaya are today confined to Sacred forests, which are the remanants of past climax vegetation. It is therefore suggested that these sacred forests be given further protection alongwith creation of many more wildlife sanctuaries to preserve the 'Biological diversity' for the future. A modest beginning has already been made in this direction by proposing the forests around Balphakram in Garo hills as a Wildlife Sanctuary.

Besides creation of certain Biotype reserves, ecological studies particularly on specialized ecological niches or habitats of certain species such as *Nepenthes khasiana* are to be carried out so that rapid multiplication of these species is made possible.

Enumeration of threatened plants

In the following enumeration of threatened plants, the species are alphabetically arranged. Brief remark on their habit and distribution is made. The numbers mentioned at the end of each species pertain to collection number of K. Haridasan, if not otherwise specified. All the collections studied are deposited in the herbarium of the department of Botany, North-Eastern Hill University, Shillong (NEHU).

Acer laevigatum Wall. (Aceraceae)

Trees; rare, forming upper storey in temperate forests; regeneration very low; Temperate himalayas from Simla to Khasi hills; in Meghalaya now confined only to Sacred forests at Shillong peak and Mawphlang. 2393.

Afzelia xylocarpa Benth. (Fabaceae)

Twiners: Nepal and Khasi hills. We have recorded this only from Laitkor and Shillong peak forests. Earlier record of this is also from Laitkor (Kanjilal et al, 1934-40). Extremely rare and needs urgent protection. 2395.

Apodites benthamiana Wt. (Olacinaceae)

Trees forming upper storey. Hooker (1872-97) reports this from western ghats, Nilgiris and Meghalaya. Kanjilal has collected this from Shangpung in 1916 and subsequent to this there are no collections in ASSAM herbarium. Our collection from Mawlai (Khasi hills) makes it interesting and indicates its extreme rarity. 2395.

Artocarpus lacoocha Roxb. (Moraceae)

Deciduous trees, throughout north-east India, tropical Himalaya and Burma (Hooker, 1872-97). The population of this species in Meghalaya has considerably reduced due to felling for timber and also due to its poor regeneration. The only collection of this from Meghalaya in ASSAM herbarium is that of Kanjilal made in the year 1915 from Garo hills. We have noted only a couple of trees in Baghmara and Damra of Garo hills. 4620.

Baliospermum micranthus Muell-Arg. (Euphorbiaceae)

Small trees; Hooker (1872-97) reports this from Khasi and Jaintia hills; presently this species is confined to Sacred forests of Mawsmai and Mawphlang. Extremely rare and needs protection. 1298.

Berchemia floribunda Wall. ex Brandis (Rhamnaceae)

Shrubs; Tropical Himalayas, Bangladesh and Khasi hills (Hooker, 1872-97). We have noted this only from Mawlai in Shillong; extremely rare. 5272.

Campanumoea javanica Bl. (Campanulaceae)

Twiners; Sikkim and eastwards to Burma and Java. After Kanjilal's collection (no 5958) in 1915 from Nongstoin the only collection in ASSAM herbarium is of Balakrishnan from Jowai. Our collection is also from Jaintia hills, where it is extremely rare. 3391.

Chirita hamosa R. Br. (Gesneriaceae)

Herbs; Hooker (1872-97) reports this from Khasi hills, Burma and Malaya. There are no collections in ASSAM herbarium. Even in CAL there is a solitary, poorly annotated sheet. Our report therefore forms a second collection after a lapse of about 100 years (Haridasan et al. 1981). Confined to lime stone forests of Balphakram sanctuary in Meghalaya. 10067.

Clerodendrum hastatum Lindl. (Verbenaceae)

Shrubs; Khasi hills and Bangladesh (Hooker, 1872-97). We have recorded this species only from Umsemlem (Khasi hills). The population of this species is fast disappearing due to forest clearings. 4568.

Delhousea bracteata Grah. (Fabaceae)

Scandent shrubs; eastern Himalaya, Assam and Sylhet. We have collected this only from Umtesor in Khasi hills, where a solitary plant was noticed. 4684.

Dipsacus asper Wall. ex DC. (Dipsacaceae)

Herbs; reported from Khasi hills (Hooker, 1872-97); but our collection is only from Jaintia hills, where it is extremely rare. 3392.

Elaeocarpus acuminatus Wall. ex Mast. (Elaeocarpaceae)

Trees; Bangladesh, Assam and Khasi hills. Our only collection of this species in the entire state is from Mawsmai sacred forest in Khasi hills, where only one tree is growing. 4297.

Elaeocarpus prunifolius Wall. ex Mast. (Elaeocarpaceae)

Trees; this has been reported from Sylhet and Khasi hills. Our collection is only from Jarain (Jaintia hills) where it is extremely rare and confined to Sacred forests. We may soon loose this species from the state if conservation measures are not taken. 2055.

Endospermum chinensis Benth. (Euphorbiaceae)

Trees; Khasi and Jaintia hills, Kanjilal et al., (1934-40) report that this is very common throughout the province; but now it is very rare and met with along the banks of rivers near Lailad in Khasi hills. 5296.

Engelhardtia wallichiana Lindl. (Juglandaceae)

Trees; Khasi and Jaintia hills in Meghalaya. Now only a few trees are noticed in Lailad of Khasi hills. Urgent protection is needed for this species. 3396.

Epipogium roseum Lindl. (Orchidaceae)

Saprophytic orchids; tropical Himalayas, Nepal, Sikkim and Khasi hills (Hooker, 1872-97). We have collected this only once from Nongpoh area in Meghalaya and never again. 5281.

Erycibe paniculata Roxb. (Convolvulaceae)

Large climbers; throughout India, Malaya and Australia. But in Meghalaya extremely rare and only a few plants are noticed.

Euonymus bullatus Wall. ex Lindl. (Celastraceae)

Small trees reported from Khasi and Jaintia hills (Hooker, 1872-97) Presently confined to the Sacred forests at Mawsmai only; all collections in ASSAM herbarium are from this area only. 4664.

Fraxinus floribundus Wall. (Oleaceae)

Trees; temperate and sub-alpine Himalayas (Hooker, 1872-97). In the entire Meghalaya we have noticed only a couple of trees near Malki in Shillong. The previous collection of this species in ASSAM herbarium is in 1957 by G. K. Deka near Jowai. 4548.

Fissistigma verrucosum (Hook. f. & Th.) Merr. (Annonaceae)

Kanjilal et al (1934-40) believe that this is common throughout the evergreen forests of Assam. But there are only 3 collections in the ASSAM herbarium, the latest being 1915 (by U. N. Kanjilal). Balakrishnan (1981) reports this from Jaintia hills based on Kanjilal's collection. Our collection from Raliang, Jaintia hills therefore makes it interesting and indicates its extreme rarity; another species that needs urgent protection. 9851.

Gastrodia exilis Hook. f. (Orchidaceae)

Saprophytic orchids; Hooker (1872-97) reports this from Khasi hills. There are no collections in ASSAM herbarium. Our collection after about 100 years perhaps forms the second report. 3387.

Goniothalamus simonsii Hook. f. & Th. (Annonaceae)

Small trees; Hooker (1872-97) reports this from Khasi hills. Presently this species is restricted only to Lailad area of Nongkyllem reserve forest. Another extremely rare species in the state. 10288.

Hedera helix L. (Araliaceae)

Climbers; Khasi hills, and Bhutan. All the collections of this in ASSAM herbarium are from Shillong peak and Mawphlang, where at present only a few plants exist, as forests are being cleared off at a very fast rate.2400.

Hymenodyction excelsum Wall. (Rubiaceae)

Trees; Western Himalaya, Nepal and Bangladesh. In Meghalaya it is very rare and collected only from Tura peak. 4621.

Ilex khasiana Purkayastha (Aquifoliaceae)

Trees endemic to Khasi hills. All collections in ASSAM herbarium are from

Shillong peak. We have noticed only a few trees near streams in Upper Shillong. Regeneration of this species is very poor; another highly threatened species in the state Rao & Haridarsan (1982). 4799.

Ilex venulosa Hook. f. (Aquifoliaceae)

Another species reported from Khasi hills (Hooker, 1872-97). Most of the collections in ASSAM herbarium are from Sohrarim and Laitlyngkot area (Khasi hills): but most forests in that area have been cleared off only last year and the plants are difficult to locate in that area now. 3393.

Leptodermis griffithii Hook. f. (Rubiaceae)

Shrubs reported from Khasi hills (Hooker, 1872-97). Most of the collections of this species in ASSAM herbarium are from Upper Shillong and Mawphlang. Now it is extremely rare being confined to forest margins. 2397.

Litsaea elongata Wall. (Lauraceae)

Trees; Assam, Khasi and Jaintia hills. This species is now confined to certain sacred forests in Khasi hills. Very rare. 2394.

Medinella rubicunda Bl. (Melastomaceae)

Epiphytic shrubs; Sub Himalayan ranges, Sikkim eastwards to Khasi hills. We have noticed this species only in sacred grooves of Meghalaya, where it is extremely rare. 4300.

Meliosma wallichii Planch. (Sabiaceae)

Trees; Tropical Himalayas, Nepal, Sikkim and Khasi hills (Hooker, 1872-97). Balakrishnan (1981) reports this from Jaintia hills, where hardly a few trees are left now. 4278.

Michelia punduana Hook. f. & Th. (Magnoliaceae)

Trees, reported from Khasi hills by Hooker and Thomson (Fl. Brit. India 1:43). Balakrishnan (1981) reports this species from Jaintia hills but based on a collection of Kanjilal. We have noted this in Jowai where only a few trees are left. 2834.

Monotropa uniflora L. (Monotropaceae)

Saprophytic herbs on dense humus covered soil; Temparate Himalayas, Khasi hills and Japan. This species is now confined only to sacred forests and is at risk. 2399.

Munronia pinnata (Wall.) Harms. (Meliaceae)

Herbs with discontinuous distribution in India; Eastern Himalaya, Sikkim, Khasi hills and South India. Due to forest clearings the population of this species in Meghalaya has become extremely thin; needs urgent protection. 2791.

Nepenthes khasiana Hook. f. (Nepenthaceae)

This is the pitcher plant of Meghalaya, struggling for survival in small, isolated pockets. 3398.

Pauthrea arguta Deene (Rosaceae)

Trees reported from Khasi hills. Presently confined only to Shillong peak, where hardly a few trees are left. Urgent protection is needed for this species.

Pentaplerigium rugosum Hook. f. (Vacciniaceae)

Epiphytic shrubs; Bhutan and Khasi hills. This species is now confined only to Sacred forests of Mawphlang and Shillong peak; but the forests at Shillong peak are also highly disturbed and with the result the species is at risk. 4156.

Photinia integrifolia Lindl. (Rosaceae)

Trees; Himalayas, Nepal, Sikkim and Khasi hills. In Meghalaya this species is confined only to Cherrapunjee where only few isolated trees are left. 3394.

Polygala tricholopha Chodat. (Polygalaceae)

Scandent shrubs; Assam, Cachar hills and Khasi hi ls. An extremely rare species not collected at all after 1931. Our collection forms the second collection from this region (Haridasan et al 1983), where only one plant is noticed. 5959.

Picrasma javanica Bl. (Simarubaceae)

Trees; Indo-Malaya to Philippines. The only previous collection of this in ASSAM herbarium is from Dawki in the year 1947. Our collection is from dense evergreen forests of Tura peak, where only few trees are left. 4690.

Porana racemosa Roxb. (Convolvulaceae)

Climbers; Assam, and Andamans. Very rarely collected in Meghalaya. With the clearing of certian forests in Shillong peak last year, one of its habitat has been lost. Urgent protection is needed for this interesting species.

Rauvolfia serpentina Benth. ex Kurz (Apocynaceae)

Herbs; throughout India and Burma and Philippines. Due to over exploitation for medicinal purposes this has become an endangered species in Meghalaya. We have collected this only once from Garo hills. 9811.

Rhododendron formosum Wall. (Ericaceae)

Shrubs extensively collected for ornamental flowers and with the result the population of this has become very thin in Meghalaya. We have collected this only from Jakrem and Elephant falls, where only few plants are growing along water courses. 4148.

Salix tetrasperma Roxb. (Salicaceae)

Trees; Himalayas, Assam and eastwards to Java. In Meghalaya very rare and only a few isolated trees are noticed in Khasi hills. 3395.

Schima khasiana Dyer (Theaceae)

Trees; Khasi hills. This species is now found only in a few pockets like Shillong Peak, Soh-rarim and Jowai. Very similar to *S. wallichii* which is common in the state. Often *S. khasiana* is reduced as a variety under *S. wallichii* but there are distinct differences between the two. 4277.

Schizandra neglecta Sm. (Schizandraceae)

Climbers; Temperate Himalayas, Sikkim and Khasi hills (Hooker, 1872-97). Presently only a few plants are surviving in Upper Shillong. Unless conservation measures are taken we may soon loose this species for ever. 4274.

Sophora acuminata Benth. ex Baker (Fabaceae)

Shrubs; Bangladesh, Eastern Himalayas and Khasi hills. We have recorded this species only from Sacred forests at Mawsmai, where only a few countable number of plants are left. 4663.

Sterculia alata Roxb. (Sterculiaceae)

Trees; Bangladesh, Burma and Malaya. Kanjilal (1934-40) says that this species is very common throughout the province. But in ASSAM herbarium there are only few very old collections from Nagaland and Bangladesh. We have recorded this plant only from Dawki in Khasi hills, where only two trees seen. 9807.

Strophanthus wallichii A. DC. (Apocynaceae)

Climbing shrubs; Khasi hills, Chittagong (Bangladesh) and Burma. One of the very rare species in Meghalaya; collected only once from Lailad (Khasi hills) where a solitary plant was noticed. Urgent protection is needed for this species. 5289.

Tupidanthus calyptratus Hook. f. & Th. (Araliaceae)

Shrubs; Khasi hills. We have not been able to collect this anywhere from Khasi hills. Our only collection of this is from Balphakram in Garo hills. Extremely rare. 2738.

Trachelospermum auritum Sch. (Apocynaceae)

Lianas; Khasi hills and Manipur. The only collection of this species from Meghalaya in ASSAM herbarium is of Bor in 1936. Extremely rare and we have collected this only once from Tura peak. 4226.

Uvaria hamiltonii Hook. f. & Th. (Annonaceae)

Climbers; Sikkim, Bihar, Orissa and Assam. (Hooker, 1872-97). Another interesting species with a considerably reduced population. Now confined only to evergreen forests of Balphakram and Rangrengiri in Meghalaya. 5266.

Ulmus lanceaefolia Roxb. (Ulmaceae)

Trees; subtropical Himalayas, Sikkim, Khasi hills and eastwards to Burma. We have recorded this only from Lailad in Khasi hills, where it is extremely rare and needs protection. 10244.

Wrightia coccinea Sims. (Apocynaceae)

Trees; Bangladesh, Burma and Philippines. There are no collections of this from Meghalaya in ASSAM herbarium. Our collection from Lailad, Khasi hills therefore forms a new distributional record of this species. Extremely rare. 9988.

Xylia dolabriformis Benth. (Mimosaceae)

Trees; South India, Burma and Malaya. Extremely rare in Meghalaya and confined only to Nongkyllem reserve forest in Khasi hills, where only a few trees are noticed. We have not noticed fruit setting in this species. 10209.

Conclusion

Fifty four threatened plants of Meghalaya are reported in this paper, based on field work and herbarium studies (ASSAM). It may however be noted that mere a poor representation of a species in the herbarium may not conclude a given taxon rare or threatened. Certain ephemeral species with a short span of life may not be normally encountered by botanists unless a specific search is made and collected. Therefore, extensive and intensive botanical explorations, particularly to those areas which are normally inaccessible are highly necessary before we are able to comment and compile a final list of threatened plants.

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19

A Census of Endemic Orchids of North-Eastern India

SANDHYAJYOTI DAS AND N. C. DEORI, *Botanical Survey of India, Shillong.*

The north-eastern India with its highly humid tropical climate is very remarkable for diversity of vegetation and flora, and the region attracted the attention of many famous botanists since the early nineteenth century. A large number of new taxa have been described from this region. Orchidaceae constitutes one of the largest families of Angiosperms and there are about 24000 species in the world (Hawkes, 1965). They are widely distributed but the concentration of species is usually high in the humid forests of tropical countries. Orchids form a dominant element in the vegetation of the north-eastern India. Hooker (1854) while exploring this region stated "Orchidaceae are, perhaps, the largest natural order in the Khasia, where fully 250 kinds grow, chiefly on trees and rocks, but many are terrestrial, inhabiting damp woods and grassy slopes. I doubt whether in any other part of globe the species of orchids outnumber those of any other natural order, or form so large a proportion of the flora". In Indian flora there are over 1000 species of orchids of which about 550 occur in north-eastern India.

The word endemic is generally used to mean a species, genera or other group confined to a particular area. During the consultation of herbarium specimens and live collection of Orchidaceae in the National orchidarium, it was felt that some information on endemic orchids of this region will be useful. The north-eastern India is phytogeographically divided into two regions (i) the eastern Himalayas comprising the entire state of Sikkim, Bhutan, northern part of Bengal and Arunachal Pradesh and (ii) Assam comprising the Assam plains, Meghalaya, Mizoram, Manipur, Nagaland and Tripura. The present work on a preliminary census of endemic orchids of north-eastern India includes all the above mentioned areas excluding Bhutan and is based on available literature, herbarium materials and field observations.

Chatterjee (1939) recorded about 61.5 dicotyledonous species as endemic to India of which about 50% occur in the Himalayas. Again, Chatterjee (1960) reported about 1000 monocotyledonous species as endemic to the Himalayas. Thus, the Himalayas are rich in endemic flora.

In the present study it is observed that, although majority of orchid species are common in distribution to India and neighbouring countries about 85 species are confined only to the north-eastern India. Out of these again, 20 species occur only in Sikkim Himalaya, 18 in Meghalaya particularly the Khasi and Jaintia Hills, 6 species in Assam, 4 species in Arunachal Pradesh, and 2 species

in Nagalad. It is also observed that about 50% of these species are represented in Shillong herbarium (ASSAM).

The orchid flora of this region has been depleted in nature mainly due to two reasons, namely (i) over collection of ornamental species, and (ii) disturbance of their habitat. Several endemic and ornamental species eg. *Paphiopedilum fairieanum, P. spicerianum, P. venustum, Anectochilus crispus, A. grandiflorus, Cymbidium cochleare, Eria barbata* etc. have been exploited in large quantities resulting in shrinking of their populations. Some terrestrial orchids eg. *Habenaria khasiana, Spathoglottis pubescens* etc. are depleted in nature due to clearing of land for cultivation. Deforestation causes destruction of many epiphytic orchids. Depletion of species in nature was also observed during field work done in connection with revisionary studies on a few genera. A few species were not recorded after their first collections and were found to be represented by their type specimens only, eg. *Coelogyne treutleri, C. albo-lutea.*

Efforts are being made to collect the rare orchids and to cultivate them in the National orchidarium and in the experimental gardens. During botanical explorations by the Botanical Survey of India, some rare orchids have been collected after long intervals. For example *Bulbophyllum depresum* and *Eria discolor* originally reported from Sikkim have been collected from Kameng and Lohit districts (of Arunachal Pradesh) respectively. *Gastrodia exilis* reported from Khasi Hills by Hooker has been recollected recently. *Eulophia manii* originally reported from Assam and Sikkim has also been collected from Manas Sanctuary in Assam. Out of the endemic and rare orchids mentioned in the following list some species are in cultivation in the National orchidarium and in the Woodlands garden at Shillong.

Acrochaene punctata Lindl. Fol. Orch. 1. 1854.
Distr. : Sikkim Himalaya.
Anectochilus crispus Lindl. in J. Linn. Soc. 1: 180. 1857.
A. grandiflorus Lindl. in J. Linn. Soc. 1: 179. 1857.
Distr. : Sikkim Himalaya, Meghalaya.
A. tetrapterus Hook. f. Fl. Brit. India 6: 96. 1890.
Distr. : Manipur.
Aphyllorchis vaginata Hook. f. Fl. Brit. India 6: 117. 1890.
Distr. : Meghalaya.
Bulbophyllum brachypodum var. *geei* Rao and Balak. in Bull. Bot. Surv. India 10: 350-352. 1968.
Distr. : Arunachal Pradesh.
B. candidum (Lindl.) Hook. f. Fl. Brit. India 5: 770. 1890.
Distr. : Meghalaya, Nagaland, Sikkim, Arunachal Pradesh.
B. cirrhetum Hook. f. Fl. Brit. India 5: 770. 1890.
District. : Sikkim Himalaya.
B. confertum Hook. f. Icon. Pl. 21: 2035. 1890.
Distr. : Meghalaya, Sikkim Himalaya

B. depressum King & Pantl. in J. As. Soc. Beng. 66: 585. 1898.
Distr. : Sikkim, Arunachal Pradesh.
B. leptanthum Hook. f. Ic. Pl. t. 2039A. 1890.
Distr. : Meghalaya, Sikkim.
B. mishmeense Hook. f. Fl. Brit. India 5: 765. 1890.
Distr. : Arunachal Pradesh, Assam.
B. virens Hook. f. Fl. Brit. India 5: 770. 1890.
Distr. : Assam, Arunachal Pradesh.
Calanthe elytroglossa Reichb. f. ex Hook. f. Fl. Brit. India 5: 853. 1890.
Distr. : Sikkim Himalaya.
C. herbaceae Lindl. Fol. Orch. Calanthe 10: 1854.
Distr. : Sikkim, North Bengal, Assam, Arunachal Pradesh.
C. longipes Hook. f. Fl. Brit. India 6: 195. 1890.
Distr. : Sikkim, Himalaya.
C. odora Griff. Notul. 3: 365. 1837.
Distr. : Assam.
C. uncata Lindl. Fol. orch. Calanthe 6: 1854.
Distr. : Sikkim Himalaya.
Chryssoglossum assamicum Hook. f. Fl. Brit. India 5: 784. 1890.
Distr. : Assam.
Coelogyne griffithii Hook. f. Fl. Brit. India 5: 838. 1890.
Distr. : Assam, Manipur, Nagaland, Arunachal Pradesh.
C. hitendrae Das & Jain in Orch. Review 86: 195. 1978.
Distr. : Nagaland.
C. treutleri Hook. f. Fl. Brit. India 5: 837, 1890.
Distr. : Sikkim Himalaya.
Corybus purpureus Joseph & Yog. in Indian For. 93: 815. 1967.
Distr. Meghalaya.
Cymbidium cochleare Lindl. in J. Linn. Soc. 3: 28. 1859.
Distr. : Sikkim Himalaya, Meghalaya, Arunachal Pradesh.
Dendrobium spathaceum Lindl. in J. Linn. Soc. 3: 15. 1859.
Distr. : Sikkim Himalaya.
Eria barbata Reichb. f. in Walp. Ann. 6: 270. 1861.
Distr. : Meghalaya, Sikkim Himalaya.
E. calamifolia Hook. f. Fl. Brit. India 6: 191. 1890.
Distr. : Assam.
E. clavicaulis Lindl. Bot. Reg. Misc. 219. 1840.
Distr. : Meghalaya, Sikkim Himalaya, Arunachal Pradesh.
E. discolor Lindl. in J. Linn. Soc. 3: 51. 1858.
Distr. : Sikkim, Arunachal Pradesh.
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Distr. : Meghalaya.

E. scrabrillinguis Lindl. in J. Linn. Soc. 3: 51. 1859.
Distr. : Sikkim Himalaya.
E. vittata Lindl. in J. Linn. Soc. 3: 51. 1859.
Distr. : Sikkim Himalaya, Manipur.
Eulophia manii Hook. f. Fl. Brit. India. 6: 4. 1890.
Distr. : Assam, Sikkim.
Galeola falconeri Hook. f. Fl. Brit. India 6: 88. 1890.
Distr. Meghalaya, Arunachal Pradesh, Sikkim.
Gastrodia exilis Hook. f. Fl. Brit. India 6: 123. 1890.
Distr. : Meghalaya.
Goodyera prainii Hook. f. Fl. Brit. India 6: 112. 1890.
Distr. : Assam, Nagaland.
G. recurva Lindl. J. Linn. Soc. 1: 183. 1857.
Distr. : Meghalaya.
G. robusta Hook. f. Fl. Brit. India 6: 113. 1890.
Distr. : Meghalaya.
Habenaria concinna Hook. f. Fl. Brit. India 6: 155. 1890.
Distr. : Meghalaya.
H. furfuraceae Hook. f. Fl. Brit. India 6: 147. 1890.
Distr. : Meghalaya.
H. gracillima Hook. f. Fl. Brit. India 6: 163. 1890.
Distr. Meghalaya, Manipur.
H. Khasiana Hook. f. Fl Brit. India 6: 151. 1890.
Distr. : Meghalaya.
H. leptocaulon Hook. f. Fl. Brit. India 6: 154. 1890.
Distr. : Sikkim Himalaya.
H. malleifera Hook. f. Fl. Brit. India. 6: 143. 1890.
Distr. : Sikkim Himalaya, Meghalaya, Mizoram.
H. nemotocaulon Hook. f. Fl. Brit. India 6: 154. 1890.
Distr. : Sikkim Himalaya.
H. oligantha Hook. f. Fl. Brit. India 6: 154. 1890.
Distr. : Sikkim Himalaya.
H. sikkimensis Hook. f. Fl. Brit. India 6: 155. 1890.
Distr. : Sikkim Himalaya.
H. trifurcata Hook. f. Fl. Brit. India 6: 151. 1890.
Distr. : Assam, Meghalaya.
Liparis delicutala Hook. f. Icon. Fl. t. 1889.
Distr. : Meghalaya, Arunachal Pradesh, Assam, Mizoram.
L. gamblei Hook. f. Icon. Pl. 19: t. 1812. 1889.
Distr. : Sikkim Himalaya.
L. perpusilla Hook. f. Icon. Pl. 19: t. 1856. 1889.
Distr. : Sikkim Himalaya.

L. prainii Hook. f. Icon. Pl. t. 1859. 1889.
Distr. : Assam, Nagaland.
L. torta Hook. f. Icon. Pl. 21 : 2013. 1890.
Distr. : Meghalaya.
L. vestita Reichb. f. in Flora 274. 1872.
Distr. : Assam, Meghalaya.
Listera micrantha Lindl. in J. Linn. Soc. 1 : 176. 1857.
Distr. : Sikkim Himalaya.
Luisia inconspicuum (Wall. ex Hook. f.) King & Pantl. in Ann. Roy. Bot. Gard. Calcutta 8: 203. t. 272. 1898.
Distr. : Sikkim, Arunachal Pradesh.
L. volucris Lindl. Fol. Orch. 1.
Distr. : Eastern Bengal, Sikkim, Meghalaya, Mizoram.
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O. treutleri Hook. f. Icon. Pl. 18: t. 1786. 1888.
Distr. : Sikkim Himalaya.
Odontochilus clarkei Hook. f. Fl. Brit. India 6: 100. 1890.
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P. spicerianum (Reichb. f.) Pfitz in Engler's Bot. Jahrb. 19: 41. 1894.
Distr. : Assam.
P. venustum (Wall.) Pfitz. in Engler's Bot. Jahrb. 19: 41. 1894.
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Studies on the Flora of Balphakram Wildlife Sanctuary in Meghalaya : 2. Distributional Remarks on certain Rare and Interesting Plant Species

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Introduction

It is well known that the tropical forests on this earth are under a great stress and are fast disappearing mainly due to the tendency of man to exploit the forests for his better living. North-east India, especially Meghalaya is no exception to this. Added to this the age-long practice of shifting agriculture (*Jhuming*) in this region has removed the natural forest cover throughout the state, except in some preserved pockets in the form of sacred groves. Balphakram forests in Garo Hills are, however, comparatively much less disturbed and therefore, proposed to declare it as a wildlife sanctuary. It is only these protected pockets of vegetation offer shelter to a large number of rare, endemic or threatened species. In the present paper an account of distribution of such rare plant species from Balphakram Wildlife Sanctuary has been given.

Area of Study

The proposed Balphakram Sanctuary lies between 90°60′—91°03′ E and 25°16′—25°38′ N and covers the portions of East Garo Hills and West Khasi Hills in the southern part of the state of Meghalaya. The area covered by this sanctuary is approximately 450 km^2 and the elevation varies from 50 m to an abrupt raise in Kylas Peak or Chutmang Peak with 1026 m above sea level. It is bordered all along the south by the plains of Bangladesh.

The area is almost unaccessible and has, therefore, maintained a rich forest cover amdist which only a few pockets of tribal population live. The forests are quite diverse and rich owing to the diverse ecological conditions prevailing in the area. The forests can be mainly classified under (a) Tropical Evergreen Forests, (b) Tropical Moist Deciduous Forests, (c) Bamboo Forests and other Secondary Formations and (d) Savanna or Grassland mainly in the elevated plateau region.

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Distributional remarks on the flora

Under this, mainly the following categories of species are discussed :—

(1) Those species which are considered to be rare and are collected either after Hooker (1872-1897) or Kanjilal *et. al.*, (1934-1940).

(2) Species which were thought to be endemic to Khasi Hills (in Meghalaya) and are collected from Balphakram Sanctuary,

(3) Species which are collected for the first time from Meghalaya (New distributional records).

All these species have been listed according to alphabetical order and the family names are mentioned in brackets. Brief remarks are made on the habit, earlier report or collection and present collection for each species. The numbers mentioned at the end of each entry pertain to collection number of Y. Kumar, which are deposited in the Herbarium of North-Eastern Hill University, Shillong.

1. ACROCARPUS FRAXINIFOLIUS Wt. (Caesalpiniaceae)

This is a tall deciduous tree reported from Khasi and Garo Hills in Meghalaya (Kanjilal *et, al.*, 1934-40) based on a collection of Kanjilal in 1915; Ghosh *et, al.*, (1978) have reported this from Garo Hills, based on a collection of T. D. Srinivasan 1929-35. There are no subsequent collections of this species anywhere from North-East India. The present collection from Balphakram Sanctuary, therefore, forms a significant report. An extremely rare species being confined only to natural forests and is in real danger of extinction. 5744.

2. ARTABOTRYS CAUDATUS Wall. ex Hook. f. & Th. (Annonaceae)

An extremely rare, woody climber reported from Khasi Hills (Hooker, 1872-97) based on a solitary specimen of Wallich. There are only 3 collections of this species in ASSAM herbarium, collected from Sibsagar and Lakhimpur by Kanjilal in the year 1914. The present collection from evergreen forest of Balphakram in Meghalaya forms a new and interesting record for the State. 5807.

3 BULBOPHYLLUM GRIFFITHI Reichb. f. (Orchidaceae)

A rare epiphytic orchid. Earlier reported from Khasi Hills around 1600 m. (Hooker, 1890). The only collection of this species from Meghalaya is from Khasi and Jaintia Hills. Present collection from Garo Hills shows its further extension southwards. 5813.

4. CARDIOPTERIS LOBATA R. Br. (Olacaceae)

A curious herbaceous climber which is extremely rare in the area. Hooker (1872-97) reports this from Sylhet (Present Bangladesh) and Cachar (Assam) and eastwards in Burma and treats it as a genus of doubtful affinity. There is, however, a solitary collection of this in ASSAM herbarium by Panigrahi in

1960 (No. 22609). The present collection from Balphakram makes it interesting. Efforts should be made to protect this curious species. 5804.

5. CEROPEGIA ANGUSTIFOLIA Wt. (Asclepiadaceae)

Slender twining herb, endemic to Meghalaya (Balakrishnan, 1981). Earlier reported only from Khasi Hills, (Hooker, 1872-97); Kanjilal *et, al.*, 1934-40). Present collection from Garo Hills shows its further southward distribution. 5673.

6. CHEIROSTYLIS PUSILLA Lindl. (Orchidaceae)

Extremely rare terrestrial orchid species reported from Khasi Hills around 1500 m (Hooker, 1872-97); whereas the present collection from Balphakram area at about 30-35 m makes it a curious report. Adequate protection by way of conserving the natural habitat is necessary for further survival of this interesting species. 5700.

7. CHIRITA HAMOSA R. Br. (Gesneriaceae)

This is a curious herb found as undergrowth in dense lime stone forests in Balphakram Sanctuary. After Hooker (1872-97) there appears to be no report of this species from anywhere and hence the present report (after 100 years) re-establishes its occurence in Meghalaya. There are no specimens of this in ASSAM herbarium. 5637.

8. CRATAEVA NURVALA Buch.-Ham. (Capparidaceae)

The present collection from Balphakram forms the first report for Meghalaya. Kanjilal *et. al.*, (1934-40) report this species from Assam and say "somewhat rare, occuring sporadically on low hilly grounds". Very rare in Balphakram. 5801.

9. DIPLOMERIS PULCHELLA Don (Orchidaceae)

Another interesting terrestrial orchid previously reported from Khasi hills around 1500 m (Hooker, 1872-97). We have been able to collect this species from Balphakram (around 25-30 m) on rocks along the Maheshkola river inside the sanctuary. An extremely rare endemic species which is under threat. There is a solitary collection of this from Meghalaya by R. N. De. 17145 (ASSAM). 5680.

10. DOCYNEA HOOKERIANA Decne. (Rosaceae)

A rare tree species, reported from Khasi hills (Hooker, 1872-97; Brandis, 1906), Kanjilal *et. al.*, (1934-40) report this species without mention of any place or locality of collection. There are only few old collections of this species in ASSAM herbarium. The present collection from Balphakram, Garo hills not only re-establises its occurrence in the region but also shows its south-west extension of distribution. 5344.

11. ERIOCAULON ECHINULATUM Mart. (Eriocaulaceae)

This marshy, scapigerous herb is reported from this region as a new record for India (Myrthong *et, al.*, 1973, in press). An extremely rare species in open grassland Commonly associated with other species of *Eriocaulon* and *Utricularia* spp. 5737

12. FISSISTIGMA RUBIGINOSUM (A. DC.) Merr. (Annonaceae)

A rare woody climber. Earlier reported from Assam and Chittagong (Hooker, 1872-97). However, Kanjilal *et. al.*, (1934-40) reported from Sylhet in Bangladesh and Garo hills from Meghalaya based on their collection No. 5337 in the year 1915. Subsequent to this there are no collections from Meghalaya. Present collection made after a long gap, establishes its occurence in Meghalaya. 6740.

13. HOMALIUM SCHLICHII Kurz (Samydaceae)

An extremely rare tree species reported from Chittagong in Bangladesh (Hooker, 1872-97; Brandis, 1906). Kanjilal *et. al.*, 1934-40) report this from Khasi hills and Sylhet based on their collections made in the year 1918; Rao, (1974) has reported this species from Burma, Assam, and Khasi and Jaintia Hills. Balakrishnan (1981) reports this species from Jarain. But there are no recent collections in ASSAM herbarium. 5789.

14. LASIOBAEMA SCANDENS (L.) de Wit var. *horsfieldii* (Wall. ex Prain) de Wit (Caesalpiniaceae)

This large climber has been reported from Assam, and Khasi hills in Meghalaya (Kanjilal *et. al.*, 1934-40). But the only collection of this species in ASSAM herbarium is from Assam (collected by Kanjilal from Nowgong in the year 1914) and from Kamrup (by Shri Ram Serma in the year 1932). Therefore, the present collection of this species from Balphakram sanctuary re-establishes its occurence in Meghalaya. Extremely rare in the area. 5699.

15. LIPARIS ACUMINATA Hook. f. (Orchidaceae)

Terrestrial orchid. Earlier reported as an endemic orchid from Khasi hills (Hooker, 1872-97; Balakrishnan, 1981). Present collection from Balphakram probably shows its southern limit. An extremely rare orchid in the area. 5559.

16. NEPENTHES KHASIANA Hook. f. (Nepenthaceae)

This curious endemic pitcher-plant confined to small prckets in Meghalaya (Hooker, 1872-97; Rao, 1974) is also collected from this sanctuary. 5380,5564.

17. PHANERA KHASIANA (Baker) Thoth. (Caesalpiniaceae)

An extremely rare woody climber, reported earlier from Khasi hills (Hooker, 1872-97; Kanjilal *et. al.*, 1934-40). Our present collection from Balphakram indicates the extreme southern limit of distribution. Balakrishnan (1981) says

that this is an endemic species to Meghalaya. But there are some collections of this species in ASSAM herbarium made from Tirap district of Arunachal Pradesh. 5519.

18. PHYLLANTHUS LONGIFLORUS Heyne ex Hook. f. (Euphorbiaceae)

This is a peninsular Indian species reported as a new record for North-East India from Balphakram (Rao, *et. al.*, 1983). Common on open gravelly soils. 5402.

19. POLYALTHIA SEMIARUM Benth. & Hook. f. (Annonaceae)

A very rare tree species. Present collection of this species forms the first collection from Meghalaya as this has not been collected by the earlier workers from this region (Hooker, 1872-97; Kanjilal *et. al.*, 1934-40; Balakrishnan, (1981). Balakrishanan (1981) however reports this from Jaintia hills based on a collection of Balarm sing. s.n. 5806.

20. STYLIDIUM KUNTHII Wall. ex DC. (Stylidiaceae)

Rather an extremely rare species in the area and has been reported as an interesting collection from North-East India after about 100 years (Haridasan, *et. al.*, 1983) one of the ephemeral species which escapes the notice of botanists. 5456.

21. UNONA DUMOSUS (Roxb.) Saffared (Annonaceae)

A climbing shrub. Earlier reported from Assam (Hooker, 1872; Kanjilal *et. al.*, 1934-40). The present collection of this from Balphakram forms a new distributional record for Meghalaya. Very rare. 5814.

22. UVARIA HAMILTONI Hook. f. & Th. (Annonaceae)

An interesting and rare liana, earlier reported from Sikkim and Assam in this region (Hooker, 1872; Kanjilal *et. al.*, 1934-40). Present collection of this from Balphakram in Meghalaya forms a new distributional record. Confined to evergreen forest of Balphakram. Unless these natural forests are preserved we may loose this species for ever. 5812.

23. UVARIA LURIDA Hook. f. & Th. (Annonaceae)

Like the previous species reported only from Khasi Hills (Rao, 1974). Present collection from Balphakram shows its southern extension. There are no collections of this species after 1945 in ASSAM herbarium. Extremely rare. 5693.

Conclusion

Balphakram sanctuary in Meghalaya is very rich in flora and harbours a number of interesting and rare plants, some of which are reported either after Hooker (1872-97) or after Kanjilal *et. al.*, (1934-40). Most of these species are

endangered and need adequate protection. It is hoped that this new sanctuary offers protection to such wild flora and fauna which are otherwise struggling for survival.

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21

Observations on Extended Distribution of New and Rare Taxa of North-Eastern India with special reference to Arunachal Pradesh

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Introduction

Arunachal Pradesh, situated in North Eastern India (Lat. 26°30′ and 29°28′ N, Long. 91°36′ and 97°25′ E), is floristically one of the richest areas of the world. Phytogeographically it is the meeting ground of the Indo-Malayan (S. E. Asian) and Sino-Japanese, Formosan and Korean (E. Asian) floras. The mingling of species in this region has possibly favoured natural hybridisation and the variability of plants. The lower reaches of Arunachal Pradesh comprising the evergreen rain forests are particularly rich in the number of genera and species. However, inspite of the richness of floras, the area, to this date, remains a terra incognita and without a comprehensive published Flora.

Considering the above facts, the Forest Research Institute recently launched a project for writing up a Forest Flora of Arunachal Pradesh. To date, six collection trips have been made in 4 districts of this Union Territory (out of five, excluding Lohit) resulting in innumerable collections. These collections have revealed a number of endemic, rare and new taxa occurring in the region. Besides, several Chinese and Japanese elements found in the area have also been brought to light.

The information gathered and observations made on extended distribution of new and rare taxa found in Kameng, Subansiri, Siang and Tirap districts of Arunachal Pradesh are presented in this paper. Emphasis has been given on the endemic taxa of the region, some of which have been collected after a lapse of 30 years or more. New taxa here signify those species and varieties which have been described after the publication of Hooker's Flora of British India (1872-97). In most cases, these taxa were known only by their type collections until they have been collected recently from outside their type localities, invariably from Arunachal Pradesh.

NEW AND RARE TAXA OF ARUNACHAL PRADESH

Thirty four (34) new and rare taxa of Arunachal Pradesh, collected recently by the Systematic Botany Branch of the Forest Research Institute and deposited

in the Dehra Dun Herbarium, are discussed below. The species are arranged alphabetically and information such as synonymy, distribution, extent of rarity, specimens examined and relevent references are given.

AGAPATES SIMILIS Airy Shaw in Kew Bull. 12: 472. 1968. (Ericaceae)

It is a beautiful, red-flowered epiphytic shrub, endemic to Subansiri district. Hitherto it is known only by three collections. It was described by Airy Shaw (*l.c.*) on the basis of two fruiting collections viz. Kingdonward in 1938 and Cow & Hutchison in 1965. *Bennet* & *Naithani* 3350, Subanasiri district, 3rd Nov. 1977. In 1978 this rare species was collected from outside its type locality, viz. Kameng district. This second collection represents the extended distribution of *A. similis* from Subansiri district to Kameng district of Arunachal Pradesh.

Specimen examined: Seppa Road, Kameng district 1500 m, 4.11.1978, *Sahi* & *Naithani* ser. II. No. 934.

*ALBIZIA ARUNACHALENSIS Sahni & Naithani in Indian For. 105(4): 274, Pl. 1. f. A—E. 1979. (Mimosaceae).

This species has recently been described from Kameng district of Arunachal Pradesh. It is a beautiful tree with cream-coloured flowers. It should be reared in Botanical Gardens of Eastern Himalaya for its ornamental purpose.

Specimens examined; Near Munna-Dirrang 1577 m, Kameng district, 8.4.1977, *Sahni* & *Naithani* ser. II. No. 416; 28.10.1977, *Bennet* & *Naithani* 3243. Above Jamiri 1300 m, Kameng district, 3.11.1978, *Sahni* & *Naithani* ser. II. No. 911.

ALBIZIA GAMBLEI Prain in Journ. As. Soc. Beng. 66(2): 513. 1897 et in Ann. Bot. Gard. Cal. 9: 31. t. 41. 1901. (Mimosaceae).

This rare tree was earlier known from Kangra in Himachal Pradesh, Sikkim, Nagaland and Yunnan in China. In Dehra Dun Herbarium, it is represented by only two collections-Bor from Nagaland and Haines from Kalimpong, North Bengal. It has recently been collected from Kameng district of Arunachal Pradesh.

Specimen examined: Kalactawg 1500 m, Kameng district, 14.10.1977, *Bennet* & *Naithani* 2976.

*BEILSCHMIEDIA PSEUDOMICROPORA (Purkayastha) Kosterm. in Journ. Indonesia 1: 150. 1952. (Lauraceae).

It is a handsome, evergreen tree up to 20 m high with spreading crown. So far it is known only by its type collection (*Purkayastha*, 4.9.1936) from Digboi Res., Lakhimpur district in Assam. The present collection from Kameng district of Arunachal Pradesh after a lapse of 41 years is a case of extended distribution.

It should be planted in Gardens for its handsome foliage and also to conserve this species.

Specimens examined: Below Sessa 300 m, Kameng district 23.4.1977, *Sahni* & *Naithani* ser. II. No. 661; 5.11.1978, *Sahni* & *Naithani* ser. II. No. 951.

CROTALARIA BHUTANICA Thothathri in Journ. Bombay nat. Hist. Soc. 66(1): 70. f. 1-5, 1968. (Papilionaceae)

This rare species was earlier known by its type collection in Thimpu, Bhutan. Recently Naithani & Bennet reported its occurrence in Kameng district of Arunachal Pradesh.

Specimen examined: Tawang to Thunglung 200 m, 21.10.1977, *Bennet & Naithani* 3125.

*DALBERGIA CLARKEI Thothathri in Journ. Jap. Bot. 46(5) : 73. 1973. (Papilionaceae)

This rare, extensive, climbing shrub was up till now known by its type collection: *C. B. Clarke* 42875 B, 29.1.1886, Khasi Hills, Meghalaya which is deposited in Leningard Herbarium, U.S.S.R. Recently it has been collected after a lapse of 92 years from Kameng district.

Specimen examined: Above Jamiri 950 m, Kameng district, 3.10.1978, *Sahni* & *Naithani* ser. II. No. 910.

DICENTRA PAUCINERVIA Stearn in Brittonia 13: 45. f. 51-8. 1961; Hara in Fl. East. Himl. 104. 1966. (Fumariaceae)

This beautiful, yellow-flowered species is known from Nepal, Sikkim, Nagaland, Meghalaya, Arunachal Pradesh, Tibet and N. E. Burma. It has recently been collected from Kameng district of Arunachal Pradesh.

Specimens examined: Below Sessa 1200 m, Kameng district, 10.10.1977, *Bennet & Naithani* 2924;Below Peri-Ia 1800 m, Kameng district, 30.10.1978, *Sahni* & *Naithani* ser. II. No. 848.

*DIOSPYROS CACHARENSIS (Das et Kanjilal f.) Naithani in Indian For. 106(8): 583. f. A—E. 1980. *Maba cacharensis* Das et Kanjilal f. in Assam For. Rec. 1: 15 pl. 1934. (Ebenaceae).

This rare tree was described under *Maba* by Das & Kanjilal f. *(l.c.)* from Cachar and Lakhimpur in Assam and Meghalaya. Subsequently it has never been collected from outside the type localities. Recently Naithani *(l.c.)* reported it from Arunachal Pradesh where it is rare; he also transferred it to *Diospyros*. It has been collected after a lapse of more than 40 years.

Specimen examined: Likhabali 800 m, Siang district, 4.5.1977, *Naithani* ser. II. No. 951.

DYSOXYLUM RETICULATUM King in Journ. As. Soc. Beng. 65(2): 114. 1897

This rare tree is known from Sikkim, North Bengal, Cachar, Lakhimpur in Assam and Meghalaya. It has been found to extending its distribution towards Arunachal Pradesh.

Specimen examined: Deomali, Tirap Forest Division 150 m, 30.10.1976, *Vaid* & *Naithani* ser. II. No. 146.

GAULTHERIA SESHAGIRIANA Subbarao & Kumari in Bull. bot. Surv. Ind. 10: 223 f. 1-10. 1968. (Ericaceae)

This species has been known only by its type collection from Takepokong, Siang district of Arunachal Pradesh. The present collection from Bomdi La, Kameng district indicates its extended distribution.

Specimen examined: Bomdi La 2400 m, Kameng district, 16.4.1977, *Sahni* & *Naithani* ser. II. No. 536.

GOMPHOGYNE MACROCARPA Cong. in Engl. Pflanzenr. 66 : 40. 1916. (Cucurbitaceae)

This rare climber was earlier known only by its type collection (*Meebold*, Manipur, 1907, in fruit). Subsequently it was collected by Deb, from Tirap district of Arunachal Pradesh in 1961. According to Deb & Dutta the type specimen of this species, deposited in Herb. Breslau, was perhaps destroyed during the last war. Deb's collection was therefore designated as the neotype. Chakravarty reported *Hemsleya graciliflora* (Harm.) Cong. from Nagaland on the basis of Bor's collection No. 6214, 1935 in flowers, which was checked by Jaffrey who stated that it was *G. macrocarpa*. This is the second representative collection of this species. The present collection from Kameng district is the third representative collection which shows its extended distribution.

Specimen examined: Tawang to Thunglung 2000 m, Kameng district, 21.10.1977, *Bennet & Naithani* 3131 (in fruit).

*GYMNOCLADUS ASSAMICUS Kanjilal ex Kanjilal f. in Assam For. Rec. 1 : 7. Pl. 4. 1934; Kanjilal et al. Fl. Assam 2 : 125. 1938. (CAESALPINIACEAE)

This is a small tree up to 20 m high and is known only from its type locality, Khasi Hills (Meghalaya). It has recently been collected from Kameng district after a lapse of 43 years, The tribals use its fleshy pods for washing hair as a substitute for soap. The species deserves *ex-situ* conservation.

Specimen examined: Near Dirrang 1800 m. Kameng district, 20.10.1978, *Sahni* & *Naithani* ser. II. No. 706.

HYDROCOTYLE HIMALAICA P. K. Mukherjee in Indian For. 95 : 470. f. 1-2. 1969. (APIACEAE)

This species chiefly occurring in Nepal, Sikkim, N. Bengal and Meghalaya, has been collected twice from Lohit district of Arunachal Pradesh by R. S. Rao. The present collection is from Kameng district.

Specimen examined: Lumla 1500 m, Kameng district, 34.10.1977, *Bennet & Naithani* 3192.

*INDOFEVILLEA KHASIANA Chatterjee in Nature 173: 345. 1946 et in Kew Bull. 1947: 1948. (Cucrbitaceae)

Indofevillea, a monotypic genus, was described by Chatterjee *(l.c)*, It was first collected by G. Mann from Khasi Hills (Meghalaya) and Charduar Forest, Dirrang district of Assam. Subsequently it has been collected by Burkill from Abor Hills (Siang district) in 1911-12 and by Bor in 1933 from Aka Hills (Kameng district). Although it was recently recorded from Bhutan (Sen Gupta & Malick) it has not been reported from Arunachal Pradesh in recent times. The present collection of this extensive climber from Kameng, Subansiri and Siang district indicate that this species has been collected after a lapse of more than 40 years and shows extended distribution to Subansiri district.

Specimens examined: Likhabali 800 m, Siang district, *Naithani* ser. II. No. 966; Seujusa 250 m, Kameng district, 6.4.1979, *Gaur & Jain* ser. II. No. 85; Frest Range Banderdewa 200 m, Subansiri district 17.4.1979, *Gaur* & *Jain* ser. II. No. 317.

*LITHOCARPUS KAMENGENSIS Sahni & Naithani in Indian For. 106 (6) 441. A-C. 1980. (sphalm. *kamengii*). (Fagaccae)

This rare, large, evergreen tree was recently described from Kameng district.

Specimen examined: Seppa Road 1800 m, Kameng district, 4.11.1978 *Sahni* & *Naithani* ser. II. No. 935.

*LUCULIA GRANDIFOLIA Ghose in Beng. nat. Hist. Soc. 25 (8): 156. f-d. 1952; Naithani & Bennet in Indian Journ. For. 4 (2): 163. f. A-C. 1981. (Rubiaceae)

This very rare shrub was described from Eastern Bhutan. Recently it has been reported from Arunachal Pradesh, (Naithani & Bennet *l.c.*) where it is extremely rare and is localised at one place in Kameng district. It is a highly

ornamental plant with fine foliage and beautiful flowers. In wild state, this species is known only by two collections; the Arunachal collection has been made after 31 years of the Bhutan collection.

Specimen examined: Between Rupa & Jegoan 1000 m, Kameng district, 13.10.1977, *Bennet & Naithani* 2956 and 29.10.1978. *Sahni & Naithani* ser. II. No. 833.

MITREPHORA HARAE Ohashi in Hara Fl. Himal. 97.f.14.1966 (sphalm. *harai*). (Annonaceae)

This graceful, small tree 3-12 m high is known by its type collection (*Hara*, 6300075, March 1963) from Sikkim, which is deposited in Tokyo University Herbarium. This is the first species of the genus recorded from the Himalaya. The present collection from Kameng district indicates its extended distribution. This ornamental species should be planted in Botanical Gardens situated up to 1000 m, the flowers are white with purple streaks.

Specimen examined: Below Sessa 610 m, Kameng district, 23.4.1977, *Sahni & Naithani* ser. II. No. 657.

PARIS POLYPHYLLA Smith var. APPENDICULATA Hara in Fl. E. Himal. 419 1966 et 2: 167. 1971. (Liliaceae)

This taxon is known only from Sikkim and Bhutan. It has recently been collected from Subansiri district of Arunachal Pradesh.

Specimens examined: Tale Valley 2400 m, Subansiri district, 2.11.1977, *Bennet & Naithani* 3333.

*PHYLLOSTACHYS ASSAMICA Gamble ex Brandis Ind. Trees 667. 1906. (Bambusaceae)

This is a graceful, caespitose bamboo so far known only by two collections viz. Griffith from Mishmi Hills (Lohit district) and Sahni from Subansiri district. The latter collection was made after a lapse of more than 50 years. The present collection from Arunachal Pradesh is only the third in the series. The species is used for making huts and walking sticks.

Specimen examined: Zoram 1800 m, Subansiri district, 29.4.1977, *Naithani* ser. II. No. 901.

*PINUS BHUTANICA Grierson, Long & Page in Notes Roy. Bot. Gard. Edinb. 38 (2): 299. Pl. 1. fig. 1. 1980. (Pinaceae)

This species was described from Bhutan. From Arunachal Pradesh, it is so far known by a single collection viz. *Sahni & Naithani*, 381, 6.4.1977, Tenga

Valley, Kameng district. The present collection is from a place between Munna Camp & Bomdila, about 50 km away from Tenga Valley.

Specimen examined: Tenga Valley 1200 m, Kameng district, 6.4.1977, *Sahni* & *Naithani* ser. II. No. 381; Below Munna Camp and Bomdila 2000 m, Kameng district, 27.10.1978, *Sahni* & *Naithani* ser. II. No. 798.

*Populus gamblei Dode in Extr. Monogr. Ined. Pupulus, 63. 1905; Haines in Journ. Linn. Soc. Bot. 37: 407. 1906; Brandis Ind. Trees 718. 1906; Sahni in Indian For. 95: 335 & 349. 1969.

This species was earlier known from Kalimpong in North Bengal and Bhutan. It was reported after a lapse of 63 years from Arunachal Pradesh by Sahni *(l.c.)* were it is restricted to Subansiri district. The present collection confirms its distribution in the area.

Specimen examined: Yachuli 900 m, Subansiri district, 28.4.1977, *Naithani* ser. II. No. 899; Yachuli 1050 m, Subansiri district, 27.4.1978, *O.H. Kaul s.n.*

Primula bhutanica Fletcher in Grad. Illus. 63: 312. fig. p. 310. 1941 et Trans. & Proc. Bot. Soc. Edinb. 33: 109, 1941. (Primulaceae)

From India, this rare species was first collected by Kingdonward in 1935; afterwards it was collected by R. S. Rao in 1973 from Se La Pass. The present collection from Se La gives an indication of the rarity of this plant in India.

Specimen examined: Se La 3800 m, Kameng district, 10.4.1977. *Sahi* & *Naithani* ser. II. No. 463.

Primula irregularis Craib in Notes Roy. Bot. Gard. Edinb. 6: 233, 268. 1917; V. V. Smith and Fletcher in Trans. Roy. Soc. Edinb. 61: 283. 1944; Hara Fl. E. Himal. 248. 1966.

This species known from Sikkim and S. Tibet (Hara *l.c.*). It has recently been collected from Arunachal Pradesh indicating extension of its range.

Specimen examined: Se La 3500 m, Kameng district 10.4.1977, *Sahni* & *Naithani* ser. II. No. 465.

Primula scapigera (Hook. f.) Criab in Notes Roy. Bot. Gard. Edinb. 6: 254. 1917.

This taxon is known from Sikkim, Bhutan and Assam. The present collection indicates its occurrence in Arunachal Pradesh.

Specimen examined: Pari La 2400 m, Kameng district, 14.4.1964, *Sahni* 5154.

*RADERMACHERA SINICA (Hance) Hemsl. in Hook. Ic. Pl. sub. t. 2428. 1902; van Steenis in Blumea 13 (1): 130. 1976; Naithani & Bennet in Indian Journ. For. 4 (2): 163. 1981. *Stereospermum sinicum* Hance in Journ. Bot. 20: 16. 1862. (Bignoniaceae)

Fischer described *R. borii* (collected by Bor in 1935) from Nagaland where it is locally called *thaprii*. Recently van Steenis *(l.c.)* stated that *R. borii* was synonymus with *R. sinica*, a native of China and Taiwan. After Bor's collection it was never collected again from any part of India until the present gathering was made after 42 years from Arunachal Pradesh.

Specimen examined: Munna Camp 2100 m, Kameng district, 28.10.1977, *Bennet & Naithani* 3242.

*RHODODENDRON DALHOUSIAE Hook. f. var. RHABDOTUM (Balf. f. & Cooper) Cullen in Notes Roy. Bot. Gard. Edinb. 36 (1): 107. 1978; Sahni & Naithani in Indian For. 105 (1): 77. Pl. 1. 1979; Cullen in Notes Roy. Bot. Gard. Edinb. 39 (1): 37. 1980; Dam & Dam in Bull. bot. Surv. Ind. 21 (1-4): 175. Pl. 1. f. 1-5. 1979 (1981). *R. rhabdotum* Balf. f. & Cooper in Notes Roy. Bot. Gard. Edinb. 10: 141. 1917. (Ericaceae)

This rare, spectacular, epiphytic shrub or small tree, having cream colour flowers with purple bends, was first collected by Cooper in 1915, from Bhutan. After this it has been collected 2 or 3 times more. Recently it was reported by Sahni & Naithani *(l.c.)* and Dam & Dam *(l.c.)* from Kameng district of Arunachal Pradesh. The present collection, from outside its type locality, has been made after a lapse of ca 30 years. In 1980 Cullen *(l.c.)* reported it from China.

It is such a beautiful plant that it has been awarded Merit as well as First Class Certificates by the Royal Horticultural Society. It is now facing hazards of extinction owing to the massive road building and developmental activities in Arunachal Pradesh. Although it has been reared at Shillong, its culture in Botanical Gardens at other places in Eastern Himalaya should be encouraged. An altitude of ca 2000 m is ideal for its successful establishment.

Specimen examined: Near Bampu 1982 m, Kameng district, 4.5.1977, *Sahni & Naithani* ser. II. No. 320 & 321.

*RHODODENDRON TAWANGENSIS Sahni & Naithani in Indian For. 105 (9): 685. Pl. 1. f. A-D. 1979.

This beautiful, red-flowered shrub, up to 8 m high, with papery pale-brown bark was recently described from Kameng district. It is rare and should be reared in Botanical Gardens in the Eastern Himalaya for sake of its ornamental flowers.

Specimen examined: Near Tawang 2900 m, Kameng district, 11.4.1977, *Sahni & Naithani* ser. II. No. 478; Tawang 3000 m, 22.10.1978, *Sahni & Naithani* ser. II. No. 751.

RHYNCHOGLOSSUM LAZULINUM A. S. Rao & Joseph in Bull. bot. Surv. Ind. 9 (1-4): 280. f. 1-6. 1967. (Gesneriaceae)

This species was first collected by Bor from Aka Hills (Kameng district) in 1936. Later it was collected by Deka from Balipara F. T. in 1951 and by Joseph & Sastry from Kameng & Subansiri districts in 1964. Recently it has again been collected from Kameng district.

The species, to date, is known only by a few collections and is rare.

Specimen examined: Below Sessa 1200 m, Kameng district, 10.10.1977, *Bennet & Naithan* 2925.

*SALACIA KHASIANA Purkayastha in Indian For. 64: 277. Pl. 23. 1938. (HIPPOCRATEACEAE)

This large, woody climber which is conspicuous on account of its orange, warty, big fruits was first collected by Sri Ram Sharma from Khasi Hills (Meghalaya) in 1935-36. After this it has not been reported. Recently it was collected after a lapse of 41 years from Arunachal Pradesh. This indicates its extended distribution.

Specimen examined: Nakfun Range 200 m, Tirap Forest Division, 3.11.1976, *Vaid & Na'thani* ser. II. No. 175.

*SALIX BHUTANENSIS Floderus Bot. Notiser 227. 1940. (Salicaceae)

This 3 m high willow was collected by Ludlow & Sheriff in 1937 from Central Bhutan. After this there has been no report of its occurrence. The present collection from Tawang in Kameng district, made after a lapse of 40 years, indicate its occurrence in Arunachal Pradesh.

Specimen examined: Tawang 3000 m, Kameng district, 13.4.1977, *Sahni & Naithani* ser. II. No. 485 and 486; Below tawang 2800 m, 15.4.1977, *Sahni & Naithani* ser. II. No. 510 & 513.

*SENECIO BORII Raizada in Journ. Ind. bot. Soc. 27 (4): 206. 1948; Naithani & Bennet in Indian Journ. For. 4 (1): 74. 1981. (Asteraceae)

This rare, beautiful, yellow-flowered climbing shrub was collected by Bor in 1942 & 1945 from Nagaland. Recently, Naithani & Bennet *(l.c.)* reported it from Kameng district where it is common around Peri La at 1900 m. The present collection made after a lapse of 32 years indicate its common occurrence in Arunachal Pradesh. It should be reared in Botanical Gardens for ornamental purposes.

Specimen examined: Between Tenga & Peri La 1900 m, 15.10.1977, *Bennet & Naithani* 3042; Below Peri La 1900 m, 20.10.1978, *Sahi & Naithani* ser. II. No .829.

SPERMACOCE LATIFOLIA Aubl. Hist. Pl. Guiane Fr. 55. t. 194. 1775; Deb & Dutta in Bull. bot. Surv. Ind. 18: 217. 1976. *Borreria* latifolia (Aubl.) K. Schum. in Mart. Fl. Bras. 6(6): 61. 1881; Hara Fl. E. Himal. 307. 1966. B. *articularis* Mukherjee in Rec. bot. Surv. Ind. 20(2): 116. 1973 (*non* K. Schum.). B. *eradii* Ravi in Journ. Bombay nat. Hist. Soc. 66(3): 539. 1970; Naithani & Raizada in Indian For. 102: 682. 1976; Sivarajan & Joseph in Journ. Bombay nat. Hist. Soc. 77. 368. 1980. (Rubiaceae)

Ravi *(l.c.)* described *Borreria eradii as* endemic to Kerala. Subsequently, it was reported by Naithani & Raizada *(l.c.)* from Bengal, Tripura & Burma and by Sivarajan & Joseph *(l.c.)* from Meghalaya & Mizoram. Deb and Dutta *(l.c.)* critically checking the specimens, found that *Borreria eradii* Ravi is synonymus with *Spermacoce latifolia* Abul, a native of America. So far, it has not been reported from Arunachal Pradesh.

Specimen examined: Deomali 150 m, Tirap Forest Division, 30.10.1976, *Vaid* & *Naithani* ser. II. No. 640.

*SYMPLOCOS GLAUCA (Thumb.) Koidz. Bot. Mag. Tokoyo 39: 313. 1925. (Symplocaceae)

Symplocos pealii King ex Das was published in the year 1934 on the basis of a few collections from Lakhimpur, Sibsagar and Cachar districts of Assam. Recently, merged under the synonymy of *S. glauca* (Thunb.) Koidz., a native of China and Japan. The distribution of this species now extends from Assam to Arunachal Pradesh as evidenced by the present collection made after a lapse of more than 40 years from India.

Its timber is used for making roof of huts; fibre from bark for making ropes; fatty oil and starch extracted from seeds.

Specimen examined: Deomali 150 m, Tirap Forest Division, 31.10.1976, *Vaid* & *Naithani* ser. II. No. 148.

*SYZYGIUM ASSAMICUM (Biswas & Purkayastha) Raizada in Indian For. 4: 336. 1948. *Eugenia assamica* Biswas & Purkayastha in Kew Bull. 1938: 262. f. 1-8. 1939. (Myrtaceae)

This is a rare, handsome, evergreen tree (up to 25 × 2 m) with beautiful white flowers. It is known from Pasighat, Siang district of Arunachal Pradesh and Jorhat in Assam. It has recently been collected from a different locality in Arunachal Pradesh (Likhabali, Siang district) after a lapse of 30 years.

It should be introduced in the Botanical Gardens of Assam and Arunachal Pradesh (Itanagar).

Specimen examined: Likhabali 800 m, Siang district, 4.5.1977, *Naithani* ser. II No. 949.

Conclusion

From a perusal of the above account of the interesting taxa from Arunachal Pradesh it is explicit that they can be classified under 2 groups each comprising $\pm 50\%$ of the total number of species/varieties discussed in the paper—(1) those which were at one time restricted in distribution and were mostly known from their type locality, sometimes only by the type collection but have now been shown to have extended their distribution, and (2) those which are indeed rare and have been collected after a lapse of 30 years or more either from the type locality or outside. This latter category also includes a few new species which have been described after 1977 from Arunachal Pradesh.

Taxa of the first category should not be considered vulnerable from the point of view of extinction as perhaps these are young elements now showing signs of extending their range of distribution. On the other hand, taxa of the second category are those which are definitely threatened with extinction and call for serious attention. These endangered taxa have been marked in the text with an asterisk (*).

While the former group of plants would help the conservation activities indirectly by way of eliminating them from such a consideration, it is suggested that concentrated efforts should be made for *in situ* as well as *ex situ* conservation of the taxa belonging to the latter group, lest we might lose them from the midst of our flora.

22

Notes on the little known taxa of Rhodiola L. from Sikkim and Assam

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The botanically well known Sikkim Himalaya has attracted a number of botanists and naturalists from time to time. The first impressive collection from this area was made by J. D. Hooker during 1848-49. In the same centuary explorations were undertaken by G. King, C. B. Clarke, J. S. Gamble, D. Prain, G. Watt & Dungboo.

At the beginning of the present centuary sizable collections were gathered from Sikkim by, Smith and Cave (1911), Smith (1913). Subsequently further studies were carried out and published by Margound (1929), Pradhan (1962), Rao (1963), Anon (1913 & 1963), Biswas (1966), Hara (1966, 71, 75) and Ghosh (1970).

In recent years the major exploration of Eastern Himalaya (Nepal-Bhutan) was carried out by Hara and a group of Japanese botanists during 1960-1972 following which valuable contributions in the form of enlisted floras were brought out by H. Hara, et al (1979). However, excepting *Rhodiola cretinii* included in this account, no other collections of these species of this genus have been mentioned by Hara et al *(l.c.)* from Sikkim.

The five species of *Rhodiola* L. dealt with here are distributed from Nepal to Bhutan and two of them are also reported from Assam (now Arunachal Pradesh). But from Herbarium records the frequency of their occurrence is found to be very poor and the collection from Sikkim is represented only by the type collections.

Except *R. cretinii* remaining four species are very small 2-5 cm having a short life cycle and are reported to occur between 3500-5500 m. Moreover, due to their small size and alpine distribution there is every possibility of missing them in the remote valleys like Zemu & Llonakh in Sikkim from where they were originally collected.

With the inclusion of Sikkim as a new State under Indian territory in 1975 rapid developmental works are progressing at a fast rate. Specially construction of roads, bridges, clearing of vegetation in the interior areas are changing the faces of the valleys and mountains and disturbing the habitats for such fragile herbs alongwith their associates. Keeping in view the taxonomic and botanical interest of such rarities, it is necessary to recollect and conserve these poorly represented taxa through intensive and extensive explorations and grow them under suitable condition for preservation.

These species of *Rhodiola* have not been included in the recently published lists of rare and endangered species by Sahni & Rau (1974), Jain (1976), Jain & Sastri (1980) and Raizada (1980).

The following five species are briefly described with proper taxonomic treatment and indicating the reasons in support of their rarity.

1. RHODIOLA SMITHII (R. Hamet) Fu in Act. Phy. Sin. Addit. 1: 122. 1965. *Sedum smithii* R. Hamet in Engl. Bot Jahrb. 50 : Beibl. 112, 8. 1913.

A small herb 3-5 cm long. Rhizome densely covered with scaly leaves. Stems 1-3 in number, annual, suberect, glabrous, without indurated stems. Leaves alternate, linear to ovate. Inflorescence terminal, corymbose. Flowers hermaphrodite, reddish.

Flowering & fruiting: July-Sept.

Distribution: India: Sikkim; Nepal, Tibet.

This species was described by R. Hamet in 1913 on the basis of collection done by Smith & Cave (1909) from Llonakh 15000', Sikkim Himalaya and represented only by the type collection (CAL) from India, two collections from Nepal (BM) and three from Tibet. The occurrence of this species is not only rare in India but also in adjoining countries as evidenced by literature and herbarium record.

The species occurs on moraines, exposed rocks and is generally confused with *Rhodiola humilis* as both are found in more or less same altitude and habitat but easily distinguishable from the latter by having unisexual flowers.

2. RHODIOLA CRETINII (R.-Hamet) Ohba in Journ. Jap. Bot. 51: 386. 1976; Ohba in Hara et al, Ann. Enum. Fl. Pl. Nepal 2: 161. 1979. *Sedium cretinii* R. Hamet in Journ. Bot. 54: Suppl. 1.16.1916.

Perennial herbs 8-12 cm long, erect. Rhizome slender, armed with scaly leaves. Stems 1-4 in number, annual without older stem remains. Leaves alternate, sessile, linear to elliptic. Inflorescences terminal, bracteate, forming small corymbs. Flowers 4-5 merous, dioicious, yellowish or reddish.

Flowering & Fruiting: Late June-August.

Distribution: India: Sikkim; Bhutan, Nepal, S. Tibet.

This species was also collected by Smith & Cave in 1909 from Sikkim (Zemu, Llonakh 12-14500') and described by R. Hamet in 1916 as new species on the basis of those collections. The distribution of the species ranges from Nepal to Bhutan and is recorded only by the type collection until second gathering was done by Hara et al from Sikkim (Jongri-Olothang 4200 m.) in 1963.

The species is reported to occur in between 3800-4500 m on scree slopes, ridges, under effect of high velocity wind, where glacial activities are largely preventing its easy propagation. Though the species is reported to be widely distributed in Central and Eastern Himalayas, its representation in the herbaria is very poor.

3. RHODIOLA PRAINII (R.-Hamet) Ohba in Journ. Jap. Bot. 51: 386. 1976; Ohba in Hara et al. An Enum. Fl. Pl. Nepal 2: 162. 1979. *Sedum prainii* R.-Hamet in Bull. Soc. Bot. France 56: 566. 1909; Frod. in Act. Hort. Gothob. 5: append. 26.1930; Berger in Engl. et Prantl. Nat. Pfl.-fam. 2 Aufl. 180: 443. 1930.

Small herbs 3 cm long. Rhizome stout, thick, covered with scaly leaves. Stems solitary, annual, without indurated branches. Leaves subverticillate, alternate upwards, long petiolate, oblong to ovate, entire. Inflorescences terminal, corymbose. Flowers hermaphrodite, pentamerous, pinkish.
Flowering & Fruiting: July-Sept.
Distribution: India: Assam, Sikkim, Nepal, S. Tibet.
This species was described by R. Hamet in 1909 on the basis of Prain's collection (1903) from Kambajong-Sikkim Himalaya, and only known from the type collection until second collection was gathered by P. Kingdonward in 1935 from South of Gyalam, Assam Himalaya and studied by H. Ohba (1977) at BM.

Rhodiola prainii clesely resembles *Sedum filipes* as both are having long petiolate leaves but easily distinguishable from the latter by having scaly leaves on the rhizomes.

4. RHODIOLA STAPFII (R. Hamet) Fu in Act. Phytotax. Sin. Append. 1: 122. 1965. *Sedium stapfii* R. Hamet in Kew Bull. 1913: 156. 1913: Frod. in Act. Hort. Gothob. 5: append. 26. 1930; Berger in Engl. et Prantl, Nat. Pfl.-fam. 2 Aufl. 18a: 450. 1930.

A small herb 2.5 cm. long. Rhizome covered with scaly leaves. Stems annual, erect, solitary. Leaves 5-6 verticillate, patiolate, ovate. Inflorescences terminal, one flowered. Flowers unisexual, pentamerous, reddish.
Flowering & Fruiting: August.
Distribution: India: Assam; Bhutan, Tibet.

The species was first collected by King in 1877 from Tibet and described as *Sedum stapfii* by Hamet in 1913. A study of the latest deposition of the specimens at Kew, BM and CAL indicates its distribution in Tibet, Bhutan and Assam. Those are represented only by four collections and F. Kindonward's discovery from Tron, Lorchu 14000', Arunachal Pradesh is reported here as a new record for India.

5. RHODIOLA HUMILIS (Hook. f. et Th.) Fu in Act. Phytotax. Sin. Addit. 1: 119. 1965; Ohba in Hara et al An Enum. Fl. Pl. Nepal 2: 161. 1979.
Sedum humile Hook. f. et Th. in Journ. Linn. Soc. Bot. 2: 99. 1858; Clarke in Hook. f., Fl. Brit. India 2: 419. 1878. *S. levii* R. Hamet in Bull. Soc. Bot. France 56: 568. 1909. *S. barnesianum* Praeger in Not. Bot. Gard. Edinb. 13: 72. 1921.

A very small tufted herb 2-3 cm long. Rhizome thick, covered with scaly leaves. Stems annual, 2-5 in number, erect or slightly outcurved. Leaves radical and cauline; radical leaves long petiolate, oblanceolate, entire; cauline

leaves alternate, sessile, linear-elliptic. Flowers white, pentamerous, hermaphrodite in corymbs.
Flowering & Fruiting: Aug.—Sept.
Distribution: India: Sikkim; Nepal, S. Tibet.

Originally this species was collected by J. D. Hooker from Yeumtong & Tunkara Pass 15000′ in Sikkim in 1849 and was described by Hook. f. et Th. as *Sedum humile* in 1858. This is the first and last gathering from India and is known from the type collection only. The report of distribution of this species from adjacent countries like Nepal are represented only by three collections (BM) but there are more gatherings from Tibet but noted as not common. This species has apparent similarity with *R. quadrifida* as Hooker placed specimens of both on the same sheet, but hermaphrodite flowers and radical leaves easily separate it from the latter.

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23

Some noteworthy Monocotyledonous species of Meghalaya which are Rare, Endangered or Endemic

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Introduction

The alarming changes that are taking place in recent years in the ecology and landscape have brought about a number of changes in the native flora. One such obvious change is the marked scarcity or total elimination of certain indigenous species which were otherwise quite common at one time. The state of Meghalaya (25°47' -26°10' N and 89°45' -92°47' E in N. E. India) which is considered to be one of the richest botanical regions in India, has especially witnessed a heavy biological depletion mainly due to the large scale practice of shifting agriculture, which involves clearing up of vegetation. With the result, during the course of our studies on the flora of Meghalaya we have recorded a number of extremely rare species which are struggling for survival. Many of these species are very poorly represented in the Herbarium of the Botanical Survey of India at Shillong (ASSAM), with either only one or two old collections or without any collections at all. The present study deals with 32 monocotyledonous species which are rare, endangered or even endemic. The information is partly based on our field observations and partly from herbarium and literature surveys.

In the following enumeration, the species are alphabetically arranged. The family names are given in brackets. Brief remakrs on habit, habitat and on rarity are made. This is followed by the citation of voucher specimens which are deposited in the Herbarium of the North-Eastern Hill University, Shillong (NEHU)* except otherwise specified.

Alisma plantago-aquatica L. (Alismataceae)

Scapigerous herbs, occuring in stagnant, permanent ponds. An extremely rare and endangered plant which deserves our attention for protection. There

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*The abbvoviation 'NEHU' for the Herbarium of the North-Eastern Hill University, Shillong, is yet to find a place in the '*Index Herbariorum*'.

are no specimens of this in ASSAM, collected from Meghalaya. Our collection from Wahkwang, West Khasi Hills probably forms the first report of this from Meghalaya. 1803.

Anthoxanthum clarkei (Hook. f.) Ohwi (Poaceae)

Tufted grasses, frequent in grasslands; panicles shining; spikelets secund, brownish-green. An endangered species collected only once from Nongkrem. There are no specimens of this in ASSAM. 3285.

Bulbophyllum moniliforme Part. et Reichb. f. (Orchidaceae)

Epiphytic orchid; rhizome slender, creeping; pseudobulbs orbicular, closely arranged, forming an unilateral chain; scapes sheathing at base, 1-flowered; bracts amplexicual, membranous; flowers orange-yellow.

The species so far has not been collected by us. The only record of this is from Jaintia Hills collected by Deori, 51737 (ASSAM) and reported as a new record (Deori, 1977). Evidently a very rare species.

Carex inclinis Boot (Cyperaceae)

Terrestrial sedge with sessile spikes, which are alternate and distant at the axils of bracts.

There are no specimens of this in the ASSAM. We have collected this from Upper Shillong where it is extremely rare. Urgent protection is needed for this species. 1210.

Carex rara Boott (Cyperaceae)

Erect marshy sedges; leaves reduced; scapes capillary; spikes terminal, solitary, brownish-yellow, pointed; anthers with a tuft of capillary hairs at the apex.

Another extremely rare and endangered sedge collected only once in marshes in pine forests at Shillong. Again there are no specimens of this species in herbarium of Eastern Circle of Botanical Survey of India (ASSAM). Verma (1968) has included this based on a very old collection of Griffith (No. 6096, 6102). Hence our collection is of much significance. 1499.

Carex remota L. (Cyperaceae)

Terrestrials; spikes distant, sessile, at the axile of bracts. This is also a rare species confined to pine forests of high elevations.

There are no specimens in the herbarium of the Eastern Circle of Botanical Survey of India (ASSAM); present collection therefore is of much significance; unless measures are taken to conserve we may loose this species for ever. 3257.

Ceratostylis teres Reichb. f. (Orchidaceae)

Epiphytic orchids; stems tufted, terete or cylindric, tapering to an acute apex; leaves reduced to sheaths at the base of stems; flowers lateral, 2 cm below the apex of the stem, yellow within and greenish without.

Extremely rare, on tree trunks and on moss covered rocks in forests. There are no specimens of this from Meghalaya in the Herbarium of Eastern Circle of Botanical Survey of India (ASSAM). Hence present collection is of much interest. 2976.

Cleisostoma paniculata (Ker -Gawl.) Garay (Orchidaceae)

Basionym. *Arides paniculata* Ker.-Gawl.

Rare, epiphytic orchids; Deori & Malhotra (1973) have reported this from Khasi Hills as a new record for India. Our present collection from Garo Hills forms the second report of the occurrence of this species in Meghalaya. 2819.

Diplocrum caricinum (Benth.) R. Br. Basionym. *Scleria caricina* Benth. (Cyperaceae)

Terrestrial, short, spreading sedges; leaves and bracts similar, ovate-acute; inflorescence axillary, sessile or stalked; nuts seeous.

This species resembles *Scleria* in all respects excepting for its size. There are no collections in herbarium of the Eastern Circle of Botanical Survey of India (ASSAM). Verma (1968) includes this based on a collection of Griffith (No. 1351) deposited in CAL. This is supposed to have been collected from previous Assam but without any precise locality. Hence our present collection re-establishes its occurrence in the area. Extremely rare which needs our urgent attention for conservation. 3162.

Diplomeris pulchella D. Don (Orchidaceae)

A terrestrial orchid, growing along old road cuttings. Flower solitary, terminal, with a long spur.

Another orchid species threatened with extinction. There is only one collection of this in the herbarium of the Eastern Circle of Botanical Survey of India (ASSAM) collected by R. N. De from Mawsmai (Khasi Hills) No. 17145. Our intensive search for this species in the area was invain. Recently we are able to locate this from altogether a different place, namely Balphakram sanctuary (Garo Hills). Thus the present collection not only re-establishes its occurrence in the state but also indicates its extreme rarity. Hooker reports this from around 4000-5000 ft. whereas the present collection is from around 300 ft. Kumar, 5680 (NEHU).

Eleocharis dulcis (Burm. f.) Trin. ex Hens. Syn. *E. plantaginea* (Retz.) R. & S. (Cyperaceae).

Marshy sedges; culms terete, distinctly septate when dry, striate; lowest glume as if a continuation of the culm, wholly or partly surrounding the culm, sterile.

Extremely rare and collected only once at Baghmara from a shallow water pond. There are no specimens of this species in ASSAM. Our collection therefore, forms a new report from this region. Another endangered plant, soon may be exterminated from the area if conservation measures are not taken. 1975.

Epipogum roseum (D. Don) Lindl. Syn. *E. nutans* Reichb. f. (Orchidaceae)

Saprophytic, leafless orchids, rots tuberous, fleshy; scapes pale brown with few sheaths; lip entire; spur clavate, shorter than ovary.

Very rare, in bamboo forests of lower elevations. There are no specimens of this collected from Meghalaya in the herbarium of the Eastern Circle of Botanical Survey of India (ASSAM) but there is a solitary collection of this in the Herbarium of the North-Eastern Hill University, (NEHU) collected by Shri Haridasan (No. 5281) from Nongpoh (Khasi Hills).

Eriocaulon echinulatum Mart. (Eriocaulaceae)

This is a marshy herb quite distinct from other species of the genus in having long, stellately aristate, glistening bracts, giving the heads a spiny appearance.

An extremely rare species now confined to marshy, open grasslands of Balphakram sanctuary in Meghalaya. *Kumar*, 5737 (NEHU).

Eriocaulon setaceum L. (Eriocaulaceae)

This is a submerged, flexuous herb; stems branched, spirally clothed with capillary leaves; scapes numerous, radiating from the top of the stem.

Very rare, collected only once from Barapani, in stagnant water. There is a solitary specimen of this in the Eastern Circle Herbarium of the Botanical Survey of India (ASSAM), also recorded from the same locality. Unless this habitat is protected we may loose this species for ever. 1091.

Galeola falconeri Hook. (Orchidaceae)

Large saprophytic orchids; scapes branched above; flowers numerous, yellow.

Extremely rare, in dense forests. This is also a species which is almost at the verge of extinction. There are only 2 sheets in the Eastern Circle Herbarium of the Botanical Survey of India (ASSAM) collected in the year 1917 from Khasi Hills, but without precise locality. We have collected this plant only once from Pariong, where we could notice only one plant. Immediate protection is needed for this interesting orchid. 1841.

Hedychium dekianum Rao & Verma (Zingiberaceae)

This species has been recently described as a new species by Rao and Verma (1971). Balakrishnan (1981), says that this is endemic to Jaintia hills. We have not been able to collect this from anywhere in Jaintia hills, nor in other parts of Meghalaya.

Hedychium gracillimum Rao & Verma (Zingiberaceae)

This is another rare species of Zingiberaceae described by Rao and Verma (1971) as a new species. We have noticed this under cultivation in Woodlands Garden.

Hedychium greenii Sm. (Zingiberaceae)

Based on previous collections deposited in ASSAM Herbarium Rao and

Verma (1971) have reported this species; but we feel that this species has already become a victim of deforestation and no longer occurs in the state.

Hedychium hookeri Cl. ex Baker (Zingiberaceae)

Rao and Verma (1971) reported this based on a previous collection deposited in ASSAM herbarium. Now no longer occurs in the state.

Hydychium marginatum Cl. (Zingiberaceae)

Rao and Verma (1972) reported the occurrence of this species from the region based on old collection of Bor (No. 15626) (ASSAM). We are unable to spot this species anywhere in the state. Perhaps no longer occurs in the area.

Hedychium rubrum Rao & Verma (Zingiberaceae)

This species also has been described as a new species by Rao and Verma (1971). We are unable to locate this anywhere in the state except under cultivation in 'Woodlands' Garden of the Botanical Survey of India. *Verma* 34599 (ASSAM).

Hemiorchis rhodorrhachis Schum. (Zingiberaceae)

This interesting species probably has been exterminated from the area. The only collection of this plant in the Eastern Circle herbarium of the Botanical Survey of India (ASSAM) is by G. K. Deka (No. 16436) from Tharia (Khasi Hills) made in the year 1938. We have not been able to spot this plant anywhere in Meghalaya during our study on the Monocot Flora (1977-1981) nor there is any subsequent collection in the Eastern Circle herbarium of the Botanical Survey of India (ASSAM). It is worthwhile to locate this plant and conserve for the future.

Juncus leptospermus Buch. (Juncaceae)

Marshy herbs; scapes slightly, laterally compressed, septate; leaves scape-like, sheathing at base; inflorescence axillary or terminal in the upper nodes; anthers penicellate.

Extremely rare in Meghalaya around 1800 m. in pine forests, associated with ferns. Reference to ASSAM herbarium reveals a solitary collection of this by G. Mann (No. 197) without date and locality. 1530.

Ophiopogon reptans Hook. f. (Haemodoraceae)

Terrestrial herbs; stems prostrate, rooting at nodes with tufts of leaves at each node; scapes concealed in between the tuft of leaves, clothed with membranous scales.

This is considered to be an endemic species to this region (Hooker, 1896). There are no collections in the Eastern Circle herbarium of the Botanical Survey of India (ASSAM). We have noticed this in 2 or 3 different localities. 3110, 2944.

Pantlingia serrata Deori (Orchidaceae)

The only record of this plant from Meghalaya is by Deori (1978) who has described this as a new species. We have not been able to collect this anywhere from Meghalaya.

Paspalidium punctatum (Burm. f.) A. Camus (Poaceae)

Aquatic grass; stems spongy, spikes cylindric, with sparse spikelets; spikes longer than the internodes; collected only once from Baghmara in Garo hills. There are no specimens of this in ASSAM. 1981.

Podochilus cultratus Lindl. (Orchidaceae)

Epiphytic orchids; leaves distichous, on flat leafy stem.

Another rare species in the State. We have noticed this only once during the course of a study on Monocot flora of Meghalaya (Myrthong, 1981). 2973.

Smilacina fusca Wall. (Liliaceae)

Terrestrial, rhizomatous herbs; attached to rocks on banks of rivulets in dense forests. This is an extremely rare species which has been only once collected by Deka in 1942 at Mawphlang Sacred forests. The present collection from Shillong makes it interesting. With the loss of forests this species is also becoming very scarce. 1665.

Stemona tuberosa Lour. (Stemonaceae)

The earliest collection of this in Eastern Circle herbarium of the Botanical Survey of India (ASSAM) is of Panigrahi from Nongpoh in 1956, (No. 4515). With the clearance of forests around Nongpoh this species is no longer available in that area. We are able to collect this from Tura foothill (Garo hills) where we could hardly notice a solitary specimen. Hence this indicates its extreme rarity and needs urgent protection. 3121.

Tenagocharis latifolia D. Don (Butomaceae)

A marshy herb with milky latex. This species is common only at Nongpoh in Meghalaya and has not been so far noticed in other parts of the state. 3076.

Tropidia angulosa Bl. (Orchidaceae)

Terrestrial orchids; stems clothed with brown, membranous, ochreate sheaths; leaves distinctly nerved, crowded at the apex.

This species has been recorded from a dense evergreen forest at Tura peak and with diminishing natural forests in the state this orchid species is also becoming very scarce. There are no collections of this species from Meghalaya in the Eastern Circle herbarium of the Botanical Survey of India (ASSAM). 3223.

Conclusion

31 monocotyledonous species considered to be rare, endangered or endemic are discussed here mainly based on informations from herbaria (ASSAM and

NEHU) and Field observations. However, it should also be noted that one cannot just conclude a plant as threatened only because it is represented by only 1 or 2 old collections in an established Herbarium. It could also be possible that a particular species might be an ephemeral one and might have escaped the attention of plant explorers. Poor representation of a species in a herbarium may also be attributed to under exploration. Under these circumstances it is highly necessary to rise specialists in different groups/families to carry out intensive countrywide surveys and gather first hand field data. It is only then we are able to comment on the correct status of a species or a genus.

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24

Endemism in the Grass Flora of North-Eastern India

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North-Eastern India as defined here comprises of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. The area more or less coincides with the area covered under the 'Flora of Assam' by Kanjilal *et al* (1934-1940) excluding some parts of Sylhet plains and Surma valley which are now in Bangla Desh.

Bor (1960) has reported about 220 genera and 1163 taxa from the present boundary of India. This includes about 370 taxa (32·7%) endemic to this continent. The subfamily Panicoideae is represented by 97 genera and 565 taxa, of which 210 taxa (22·28%) are endemic. Tribe-wise position of this sub family is shown below :

Name of the tribe	Total number of genera	species	Endemic taxa	Percentage
Andropogoneae	60	367	210	57·22
Maydeae	9	16	1	6·25
Paniceae	28	182	13	7·19

The subfamily Pooideae represented by 121 genera and 598 species belonging to 33 tribes shows 26·75% endemism, i.e. 160 taxa are endemic. Tribe-wise position of this subfamily is shown in the following table :

Name of the tribes	Total number of genera	species	Endemic taxa	Percentage
Aeluropodeae	1	1	0	0·0
Agrostideae	8	61	32	52·4
Aristideae	1	17	4	23·5
Arundineae	3	6	1	16·6
Arundinelleae	2	22	13	59·0
Aveneae	14	44	14	31·8
Brachypodieae	1	3	0	0·0
Bromeae	1	17	0	0·0
Centotheceae	2	2	0	0·0

Contd.

Chlorideae	12	30	4	13·3
Danthonieae	6	10	3	30·0
Ehrharteae	1	5	0	0·0
Eragrosteae	17	85	20	23·5
Festuceae	16	101	32	31·7
Garnotieae	2	14	5	35·7
Glycerieae	1	2	0	0·0
Hubbardieae	1	1	1	100·0
Isachneae	4	30	17	56·6
Meliceae	1	9	0	0·0
Milieaea	1	1	0	0·0
Monermeae	1	1	0	0·0
Oryzeae	3	15	2	13·3
Pappophoreae	1	4	0	0·0
Perotideae	1	2	0	0·0
Phaenospermeae	1	1	0	0·0
Phalarideae	1	6	1	16·6
Pommereulleae	1	1	0	0·0
Sporoboleae	2	18	0	0·0
Stipeae	3	32	7	21·8
Streptogyneae	1	1	0	0·0
Thysanolaeneae	1	1	0	0·0
Triticeae	6	48	4	8·3
Zoysieae	5	7	0	0·0

In northeastern India the grasses are represented by 144 genera and 426 taxa. This includes about 35 taxa reported endemic from this region. Tribewise position of the sub family panicoideae is shown in the following table :

Name of the sub family/ tribes	Total no. of genera	Species	Endemic taxa	Percentage
PANICOIDEAE	66	225	19	8·8
Andropogoneae	39	118	13	11·0
Maydeae	4	8	0	0·0
Paniceae	23	100	6	6·0

Endemic taxa of Panicoideae are presented below tribewise. Name of the state or area for which it is reported endemic is mentioned in parenthisis. *Cymbopogon jwarancusa* var. *assamensis* (Assam); *C. khasianus* var *nagensis* (Nagaland); *Dichanthium nagense* (Nagaland); *D. planipedicellatum* (Manipur); *D. pteropechys* (Nagaland); *Eulalia speciosa* var. *velutina* (Meghalaya); *Hyparrhenia griffithii* (Meghalaya)- this grass once covered several hundred acres in Nartiang and due to annual fires, now it is a rare grass in the area. Recently it is said to have been collected from near Jowai; *Ischaemum hirtum* (Meghalaya);

I. hubbardii (Meghalaya); *Miscanthus wardii* (Arunachal Pradesh); *Pogonatherum rufo-barbatum* (Meghalaya)—this grass has been reported by Deb (1961) from Manipur and one of the specimen quoted by him after examination was found to be poor and not well separable; *Rottboellia goalparensis* (Assam) and *Themeda huttonsis* (Nagaland). *Andropogon munroi* and *Sclerostachya milroyi* were also reported endemic to Nagaland and Assam respectively. Since mergence of *A. tristis* and *Cymbopogon tibeticus* as synonym under *A. munroi* this species now has a much wider distribution. It is proposed to reduce *S. milroyi* as synonym under *S. fusca*. Maydeae: No endemism. Paniceae: *Digitaria jubata* (Meghalaya); *Hymenachne assamica* (N. E. India); *Panicum humidorum* (N. E. India); *P. incisum* (Nagaland); *P. khasianum* (E. Himalaya, Meghalaya, Nagaland); *Paspalum longifolium* var. *lorrirhachis* (Assam); perhaps this variety is found elsewhere also.

Tribe-wise position of the sub family Pooideae is tabulated below :

Name of the tribes	No. of genera	No. of species	Taxa endemic in N.E. India	Percentage of endemism
POOIDEAE	61	141	14	12·1
Agrostideae	8	25	7	24·0
Arundineae	2	3	0	0·0
Arundinelleae	2	10	2	20·0
Aveneae	7	12	1	8·3
Brachypodieae	1	2	0	0·0
Bromeae	1	2	0	0·0
Chlorideae	3	5	0	0·0
Centotheceae	2	2	0	0·0
Danthonieae	1	2	0	0·0
Garnotieae	1	0	0	0·0
Glycerieae	1	2	0	0·0
Eragrosteae	9	23	1	4·3
Festuceae	6	16	3	18·7
Isachneae	3	10	2	20·0
Oryzeae	4	8	0	0·0
Phalarideae	1	3	0	0·0
Phaenospermeae	1	1	0	0·0
Sporoboleae	1	3	0	0·0
Stipeae	2	2	0	0·0
Thysanolaeneae	1	1	0	0·0
Triticeae	4	5	0	0·0

Agrostideae: *Agrostis griffithiana* (Meghalaya)—it extends upto Arunachal Pradesh; *A. nagensis* (Nagaland); *A. wardii* (Manipur); *Deyeuxia elatior* (Meghalaya)—it extends to Arunachal Pradesh, *D. nagarum* (Nagaland). Arundinelleae:

Arundinella intricata (Arunachal Pradesh, Meghalaya); *A. khaseana* (Meghalaya and Nagaland). Aveneae: *Hierochloe khasiana* (Meghalaya). Eragrosteae: *Eragrostiella leioptera* (Meghalaya). Festuceae: *Festuca rubra* var. *clarkei* (Meghalaya); *Poa khasiana* (Meghalaya, Nagaland); *P. wardiana* (Assam) and Isachneae: *Isachne clarkei* (Nagaland) now it extends to Meghalaya also and *I. scabrosa* (Meghalaya). Remaining 13 tribes do not show any endemism.

Following taxa seem to be rare as no second collection after type materials of some of these are available. *Cymbopogon jwarancusa* var. *assamensis*; *c. khsianus var. nagensis*; *Dichanthium nagense*; *D. planipedicellatum*; *D. pteropechys*; *Ischaemum hubbardii*; *Miscanthus wardii*; *Rottboellia goalparensis*; *Themeda huttonensis*; *Digitaria jubata*; *Agrostis nagensis*; *A. wardii*; *Deyeuxia nagarum*; *Festuca rubra* var. *clarkei* and *Poa wardiana*.

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25

Dwindling Taxa of Meghalaya

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The flora of Meghalaya is the richest in India both in extent and diversity of species. Phytogeographical studies have revealed that N. E. region harbours about 50% of the total flora of India (about 10,000 species). Besides, a good number of primitive angiosperms not reported from any other part of country, hail from this region. An enormous number of timber plants, medicinal plants, and other economically important plants lie in this region. The vegetation of this part is very interesting where there is an admixture of Asiatic and Peninsular Indian elements. This great diversity and richness of flora is mainly due to its physical geography coupled with varied nature of rainfall, temperature and altitude.

Recently, it has been noted that increasing biotic influences, neluding socio-economic development, unrestrained commercial exploitation of forest wealth have threatened the survival of the genetic resources, amounting to a great loss of national heritage.

Mention is made here of a few instances of taxa having restricted distribution in Meghalaya which are likely to be affected by the biotic interference. The present observations are mainly based on basic aspects; the dynamic aspects have to be taken up at a future date.

ENUMERATIONS:

1. *Clematis apiculata* Hook. f. & Th. (Ranunculaceae)

A slender woody climber, flower in axillary panicles. Griffith and Hook. f. (1837, 1850) reported this plant from Nonghlaw and Cherrapunji respectively. Subsequently P. C. Kanjilal 9370 (1931) collected it from Mawloo forests. After that it could not be collected.

2. *Michelia lanuginosa* Wall. (Magnoliaceae).

A fast growing deciduous tree upto 30 M in height and 2·5 M in girth. Kanjilal, U. N. 5889 (1915) collected from Kynsi. It is a very good timber yielding plant and may be depleting due to its high quality of timber. The author could collect this plant from Pariong forest recently.

Distrib.: Nepal, Bhutan & Meghalaya.

3. *Cyathocalyx martabanicus* Hook. f. & Th. (Annonaceae).

A tall and graceful evergreen tree about 50 M in height and 2·5 M in girth. Kanjilal, U. N. 6966 (1915) collected it from Sanitarium, Garo Hills. After that it could not be collected so far.

Distrib.: Tenasserim, Martaban and Meghalaya.

4. *Haematocarpus thompsoni* Miers. (Menispermaceae).

A very large woody climber spreading over tall trees in forest. This plant has recently been collected after a lapse of about 60 years from the primary forests of Sonapahar. *Deka* 37765.

Distrib.: Khasi Hills and Sikkim Himalayas.

5. *Nymphaea pygmaea* Aiton, (Nymphaeaceae).

A very small herb, rootstock with soft, black hairs. Flowers minute, white A critical study of literature and ASSAM Herbarium reveals that this plant was collected from Nogkreim, Khasi Hills. After that it could not be collected even after continuous search. This indicates that the species might have been exterminated from the area.

Distrib.: Khasi Hills, Siberia and N. China.

7. *Alsodeia racemosa* Hook. f. & Th. (Violaceae).

A handsome glabrous shrub with rigid branches. Kanjilal, U. N. 7200 (1917) collected this plant from the Khasi Hills. Griffith & Hook. f. (1839, 1850) also reported this species from this region

Endemic to Meghalaya.

8. *Luvunga scandens* Ham. (Rutaceae).

A powerful scandent evergreen shrub, with slightly recurved spines. It was collected by G. K. Deka 18593 (1945) from Mawsmai forests. It could not be collected subsequently. It is an important medicinal plant.

Distrib. : N. E. India, Burma and Malacca.

9. *Picrasma javanica* Bl. (Simaraubaceae).

A middle sized tree. The bark is very bitter and used as a febrifuge by Miris, Abors and also by Nepalees. Kanjilal, U. N. 4029 (1914) collected it from Umling. Recently we could collect this plant from West Khasi Hills as well as Garo Hills in Meghalaya

Distrib.: N. E. India, Malacca and Java.

10. *Brucea mollis* Wall. (Simaraubaceae).

Small shrubs, branches speckled with closely-set lenticels, collected by S. R. Sharma 16073 (1937). Subsequently, it was collected by Deka 23258, G. Panigrahi 9302, Balakrishnan 47179 and recently from the Garo Hills. But all collectors have mentioned its rarity.

Distrib.; Sikkim, Bhutan and N. E. India.

11. *Aglaia edulis* A. Grey. (Meliaceae).

A fairly large tree, upto 26 m in height and 2 m. in grith with flutted stem. The only collection of this species is of R. N. De 20451 (1941 collected from Garo Hills (ASSAM).

Distrib.: East Bengal, N. E. India, Borneo and Fiji Islands.

12. *Miquelia kleinii* Meissn. (Icacinaceae).

A fairly large climber with corky bark. The flexible shoots are used for binding purposes. Very rare.

Distrib.: N. E. India.

13. *Sageretia hamosa* Brongn. (Rhamnaceae).

A woody straggling or bushy shrub with short straight or hooked spines. It was collected by Kanjilal, U.N. 6004 (1915) from Kynshi and on way to Nongkrein, after that it could not be re-collected.

Distrib.: Nepal, Western Peninsula and Formosa.

14. *Sageretia oppositifolia* Brongn. (Rhamnaceae).

A shrub with creeping branches. Collected by Subba Rao 28055 (1962). Subsequently it could not be collected due to the destruction of the habitat.

Distrib.: India and Java.

15. *Sapindus rarak* DC. (Sapindaceae).

A middle sized or small tree upto 17 m in height. Flowers small, creamy Collected by Kanjilal, U. N. 5606 (1915) from Mynso, Jaintia Hills. Subsequently Deka 18338 (1959) collected this from Shillong.

Distrib.: N. E. India, Java and China.

16. *Lepisanthes burmanica* Kurz (Sapindaceae).

An evergreen tree upto 10 m in height with a straight palm like trunk. Flowers orange yellow with green calyx. The only collection of this in ASSAM is of G. Panigrahi 14823 (1958) from Khasi Hills.

Distrib.: N. E. India and Burma.

17. *Sabia parviflora* Wall. (Sabiaceae).

A woody climbing shrub. Fruits red when ripe. Gustav Mann 8770 (1930) collected it from Barapani. Recently Subba Rao has collected is from Kynsi, 28248.

Distrib.: Kumaon to Sikkim and Khasi Hills.

18. *Meliosma henryi* Diels ssp. *mannii* (Lace) Beusekom (Sabiaceae).

A small tree. Collected by Kanjilal, U. N. (1917) from Sona Krung, Khasi hills. Later on it was collected by S. R. Sharma 10882 and G. K. Deka 18678 from Barapani in 1934 and 1939 respectively.

Distrib.: Khasi Hills, Upper Burma and China.

19. *Semecarpus prainii* King (Anacardiaceae).

A large tree with rough brown bark and glabrous branchlets. Collected by Kanjilal, U. N. (1915) from Patharia forest, subsequently it was collected by R. N. De 18768 (1938). Kanjilal (1935) mentioned that this plant is very rare in this region.

Distrib.: N. E. Region, Java and Sumatra.

The main causes for rarity of most of the species seems to be the loss of their habitat, and over collection of some species. Often a rare taxon of a particular area may be common in some other areas. But from the view point of plant distribution their preservation is extremely useful. Thus, there are some taxa viz. *Nymphaea pygmaea* Aiton, *Luvunga scandens* Ham., *Aglaia edulis* A. Gray, *Sapindus rarak* DC., *Meliosma henryi* Diels ssp. *mannii* (Lace) Beusekom and *Semecarpus prainii* King. etc. that are rooted in the southeast Asia with extension in our area. Such plants are phytogeographical links. The present study is the

first step towards the ultimate assessment of the taxa, that are really endangered in the area, so that proper steps may be taken to preserve these rare species.

In situ conservation of these rare and threatened plants by declaring Biosphere Reserves, where several such endemic/rare species are growing or declaration of gene sanctuaries where pure populations of such plants are growing, are the best methods of conservation in their natural ecosystems. In case of certain species *ex situ* conservation has to be taken up by raising these in Botanic Gardens.

All the Universities, Colleges and other Research Organizations should also develop a sector in their Botanical Garden to conserve such rare and curious plants which often are threatened in their native habitats.

Acknowledgements

It gives me great pleasure to record my deep sense of gratitude to Dr. S. K. Jain, Director, Botanical Survey of India for suggestions and encouragement and to Dr. J.Joseph, Deputy Director for facilities. Grateful thanks are also due to Dr. R. R. Rao, Dept. of Botany, NEHU, Shillong for his help in the preparation of this paper.

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26

Some Rare Plants in Khasi and Jaintia Hills of Meghalaya

S. K. KATAKI, *POSSCEF, Botanical Survey of India, Eastern Circle, Shillong.*

The Khasi and Jaintia Hills of Meghalaya are situated within 25°6″—26°10″ North Latitude and 90°45″—92°47″ East Longitude covering an area of about 15,762 Sq. Km. They show a wide range of altitudes from 216 m to 1986 m with an average annual rainfall of about 7196 mm. Cherrapunji (12319 mm) and Mawsynrain (14672 mm) are the rainiest places. There are several streamlets, streams and rivers and they become prominent during the rainy season. All these conditions coupled with the geographical position make these areas the richest store house of botanical wealth.

Since Hooker's time there has been a significant change of the vegetation on these hills. Hooker came to Cherrapunji, which was the headquarters of this region. He botanised this area by foot, on horse back and on elephant back. There were hardly any vehicular roads. The intervening period has changed the picture entirely by having a net work of vehicular roads with Shillong being the capital. The small township, and villages have now become larger with an increase in population. There was hardly any industry excepting for local mining of coal in Cherrapunji area. Now, there is a cement factory at Mawmloo near Cherrapunji, a plywood factory at Burnihat and hydro-electrical projects at Barapani and Garampani. All these together have had their inevitable influence on the depletion of the original vegetation. For example, the Barapani lake for the hydro-electrical project covers a vast area under water, resulting in depletion of many interesting species like *Cycas pectinata, Dipteris wallichii,* which were reported by Hooker (1854). The dense forest at Sohrarim, near Cherrapunji is damaged to such an extent that species of *Magnolia* have disappeared, which were recrded earlier. Hooker noted: "It may be of use to the future botanist in this country to mention a small wood on the right of this road, near the village Sururem, as an excellent botanical station".

More recent collectors have been the men of the Forest Department: U. N. Kanjilal, P. C. Kanjilal, N. L. Bor, S. R. Sharma, G. K. Deka and many others who helped to enrich our knowledge of this flora. Since 1956, several botanical exploration tours were undertaken in different parts of this region by the Botanical Survey of India with the headquarters at Shillong. It is observed that many interesting species are poorly represented in their original localities either due to the disturbances of their habitats or overcollec-

tion. Even Hooker himself collected the Blue *Vanda* and recorded: "We collected seven men's loads of this superb plant for the Royal Gardens at Kew; .A gentleman who sent his gardener with us to be shown the locality, was more successful:. .An active collector, with the facilities I possessed, might easily clear from 2000l to 3000l. in one season, by the sale of Khasia orchids". Now, there is not a single plant of this orchid in that locality near Jowai. Similarly, the lady's slipper orchids *(Paphiopedilum hirsutissimum, P. insigne, P. venustum)*, a few species of *Dendrobium* and *Cymbidium* are becoming rare due to the exploitation. There are also some species which are becoming rare in their original localities not because of indiscriminate collections but because of disturbances of their natural habitats. If the current practices of human activities continue, even the unrecorded species of immense value will disappear. Because, 'a disappearing species can take with it 10 to 30 dependent species, such as insects, higher animals and even other plants'.

The present work is undertaken at Shillong under a 'Project on Study, Survey and Conservation of Endangered Species of Flora' (POSSCEF). It is based on the study of collections available in the herbarium of Eastern Circle, Botanical Survey of India (ASSAM) and its library. A few field trips were undertaken also to ascertain the present condition of the forest areas in Khasi and Jaintia Hills. The live collections collected so far are grown in the 'Woodlands' compound of Eastern Circle, B.S.I., Shillong.

The following species are found to be rare/endangered in their original localities in Khasi and Jaintia Hills of Meghalaya.

A. *ORCHIDS*

Orchids form a dominant element in the forests of Khasi and Jaintia Hills, as Hooker recorded: "Orchideae are, perhaps, the largest natural order in the Khasia". Now, they are becoming rare in their original localities.

1. *Arachnanthe cathcartii* Benth.
   Epiphytes. Ornamental flowers. Popularly known as 'Spider orchid'. Rare occurrence.
2. *Arundina graminifolia* (D. Don) Hochr.
   Terrestrials. Hooker noted: "Arundina, a beautiful purple grassy leaf orchid, was abudantly in flower on the hill tops". Known as 'Bamboo orchid'. Once common, but now becoming rare due to the clearance of the forest floor.
3. *Coelogyne cristata* Lindl.
   Epiphytes. Large white flowers. Rare occurrence. First discovered by Wallich in 1824 in the lower Himalayas.
4. *Cymbidium eburneum* Lindl.
   Epiphyte. Flowers large, white, fragrant. This species, 'formerly so rare, is now one of the most generally cultivated species in the genus.' It was discovered by Griffith at Myrang in Khasi Hills in 1837.
5. *Cymbidium giganteum* Lindl.
   Epiphytes. Profuse growth occurs on decayed tree trunks. Mainly confined

to higher elevation. In Khasi Hills, it was first collected by Gibson in 1837.

6. *Cymbidium grandiflorum* Griff.

Epipytes. Flowers large and long lasting. Rare due to over-collection.

7. *Dendrobium densiflorum* Wall.

Epiphytes. Popularly known as 'Pineapple orchid'. It was first collected in Khasi Hills by Gibson in 1836.

8. *Dendrobium devonianum* Paxt.

Epiphytes. This is one of the finest Gibson's discovery in Khasi Hills in 1837.

9. *Dendrobium falconeri* Hook.

Epiphytes. Though it was collected by Simons in Khasi Hills, we do not have any record from here so far. Ornamental flowers.

10. *Dendrobium nobile* Lindl.

Epiphytes. This is one of the finest *Dendrobiums*. In Khasi hills it was collected by Gibson in 1837.

11. *Dendrobium wardianum* Warn.

This superb *Dendrob* was first collected in Khasi Hills by Simons in 1856.

12. *Paphiopedilum hirsutissimum* (Lindl.) Pfitz.

Terrestrial. All species of *Paphiopedilum* are known as "Lady's slipper orchids" and their flowers are large, ornamental and long lasting. This species was collected first in 1868-69 by Captain Williamson from Assam side of the Khasi Hills. Recently collected From Jowai area.

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

It was first recorded by Wallich in Sylhet in 1819-20. Later Griffith collected from Khasi Hills. During 1963-65, it was collected in Cherrapunji area. Now, this could not be collected again.

14. *Paphiopedilum venustum* (Wall.) Pfitz.

It was first discovered by Wallich in Sylhet in 1819. Later it was recorded from Sikkim and Khasi Hills.

15. *Pleione tagenaria* Lindl.

Epiphytes. First discovered by Thomas Lobb in Khasi Hills in 1849 and noted as "Where it is said to be restricted to one or two localities of very limited extent." So far, no collection in Khasi Hills.

16. *Pleione maculata* (Smith) D. Don

Epiphytes. Flowers white, ornamental. First discovered by Wallich in Khasi Hills. Later recorded by Hooker and Lobb.

17. *Pleione praecox* (Smith) D. Don

Epiphytes. Flowers pink, large, in Khasi Hills it was recorded first by Gibson in 1837.

18. *Phaius tankervilliae* (Ait.) Bl.

A widely distributed ground orchid which is becoming rare in its original place. First discovered by Wallich in 1837 in Khasi Hills.

19. *Vanda coerulea* Griff.

Epiphytes. Kknown as 'Blue *Vanda*'. It was first collected by Griffith in Khasi Hills. Rare due to overcollection.

Besides, many epiphytic orchids which are becoming rare due to the felling of host trees, the ground orchids like *Anoectochilus sikkimensis*, *Epipogium roseum*, *Galeola falconeri* are also becoming rare due to the disturbance in their natural habitats.

B. *OTHER PLANTS*

Besides orchids, there are many interesting plants in these hills, which are becoming rare in their original localities. They are:

20. *Berchemia floribunda* Wall. (Rhamnaceae)
Not common. Recently recorded from Arunachal Pradesh.

21. *Brainea insignis* (Hook.) J. Sm. (Blechnaceae)
Restricted in distribution. Growing on hill slopes in clusters.

22. *Capparis pumilo* Champ. (Capparidaceae)
Records from Khasi hills and Mikir hills. Rare occurrence.

23. *Clematis acutangula* Hook. f. & Thoms. (Ranunculaceae)
Recorded from Khasi and Mishmi Hills. Not common due to restricted distribution.

24. *Clematis puberula* Hook. f. & Thoms. (Ranunculaceae)
Recorded only from Khasi Hills. very restricted distribution.

25. *Cycas pectinata* Griff. (Cycadaceae)
Restricted in distribution. A very slow growing plant having botanical curiosity.

26. *Dipteris wallichii* (R. Br.) Moore (Dipteridaceae)
A splendid fern. Rare due the disturbance of its habitat.

27. *Loropetalum chinense* Cl. (Hamamelidaceae)
Rare occurrence. Recorded from Khasi Hills.

28. *Lycesteria formosa* Wall. (Caprifoliaceae)
Earlier recorded from Khasi Hills. Later recorded from other places.

29. *Magnolia pterocarpa* Roxb. (Magnoliaceae)
Restricted distribution.

30. *Magnolia punduana* Hook. f. & Thoms. (Magnoliaceae)
Confined to Khasi Hills only.

31. *Meliosma arnottiana* Walp. (Sabiaceae)
Restricted distribution.

32. *Meliosma mannii* Lace. (Sabiaceae)
Rare occurrence and restricted distribution.

33. *Nepenthes khasiana* Hook. f. (Nepenthaceae)
This large insectivorous plant is endemic to Meghalaya. Its natural habitat is now well protected by the local Govt.

34. *Rhododendron formosum* Wall. (Ericaceae)
Once abundant in Khasi Hills. Now, confined only to certain localities

35. *Rhus khasiana* Hook. f. (Anacardiaceae)
Earlier recorded from Barapani. Rare occurrence.

36. *Rubia sikkimensis* Kurz (Rubiaceae)
Very handsome species reported from Mikir Hills and Khasi Hills. Rare occurrence.
37. *Schizandra axillaris* Hook. f. & Thoms. (Magnoliaceae)
Very restricted distribution.
38. *Segeretia hamosa* Borgn. (Rhamnaceae)
Rare. Only record from Khasi Hills.
39. *Sycopsis griffithiana* Oliv. (Hamamelidaceae)
Rare occurrence.

It is also observed that many common plants of botanical interest are becoming rare in their original localities due to disturbance of their habitats by constant clearence of forests, either for fire wood or for construction purposes. They are *Balanophora dioica*, *Drosera peltata*, *Gnetum scandens*, *Podocarpus nerifolia*, *Podostemon* sp., *Hedychium* sp. and many others.

At present, conservation is a world wide problem. In this region, an effort is being made to assist the sister departments to protect the rare and endangered plants in their natural habitats. Some of these plants are collected and kept under cultivation in 'Woodlands' experimental garden for display. It is also proposed to prepare a State-of-Art report with regard to these plants and to locate the areas, where these threatened taxa grow. If we can conserve some of the species, it is sure that our future generation will be thankful for our present effort.

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27

Rare and Endemic species Re-Collected after Fifty Years or more from South India

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Introduction

During the floristic studies in Palghat District, Kerala from 1965 onwards, the authors could come across many rare and endemic species. The vegetation of this area is very rich and varied due to the altitudinal variations and climatic conditions coupled with heavy rainfall. In recent time, there is an awareness for the endangered and threatened taxa, and for the conservation of the same. Hence every attempt has been made to re-locate such rare, endemic and threatened taxa. Henry *et al* (1979) have given a catalogue of about 224 species of flowering plants presumably in danger of extinction in South India. So, special efforts are being made to re-locate and collect such threatened taxa during the exploration works. The following are the outcome of such special endeavour. Eleven rare and endemic species of different families, re-located and collected in Silent Valley R. F. and in the other forest areas of Palghat District, Kerala are dealt with. Their existence is being threatened due to the proposed dam construction across the Kunthiupuzha river in the Silent Valley R. F. However, attempts should be made to protect such rare, endangered and endemic species which once lost, cannot be re-established due to various conditions.

The species dealt are arranged alphabetically with short notes, past and present status and the cause of depletion etc. The present study is based on the authors collections as well as old collections available in MH.

1. ANTISTROPHE SERRATIFOLIA (Bedd.) Hook. f. in Benth. & Hook. f. Gen. Pl. 2: 647. 1876; *Ardisia serratifolia* Bedd. Ic. Pl. Ind. Or. t. 113. 1869 (MYRSINACEAE).

An erect shrub with rusty—villous branchlet towards end. Leaves alternate, lanceolate, long acuminate with prominent tooth-like serratures and many pairs of prominent parallel nerves. Flowers white in axillary umbels. Fruits globose, reddish when ripe.

It is an endemic species reported from Anamalai Hills in Coimbatore Dt., Tamil Nadu. After the type collection, this rare species was not collected. The authors could collect this taxon from Silent Valley R. F. Palghat Dt., Kerala during the year 1969 after a lapse of over 90 years.

Distribution: South India (Anamalai Hills and Palghat Hills).

Specimens examined: TAMIL NADU: Coimbatore Dt. Anamalai Hills, *R. H.*

Beddome s. n. Acc. No. 29588. KERALA: Palghat Dt. Silent Valley R. F. *E. Vajravelu* 33215, Dec. 1969; *N. C. Nair* 56651, Apr. 1978.

2. ARTOCARPUS GOMEZIANUS Wall. ex Trec. ssp. ZEYLANICUS Jarrett in J. Arn. Arb. 41: 90. 1960. *A. lakoocha* auct. non Roxb. 1832. (MORACEAE).

Lofty tree with milky latex. This subspecies described by Jarrett *l.c.* from Western Ghats and Ceylon has not previously been distinguished from *A. lakoocha* which appears to be restricted tree to the north and east of India.

"This new entity is differentiated by the smaller globose heads, and the longer peduncles of the male inflorescence, by the smooth surface of the female head at anthesis and the shorter exsertion of the styles and apparently by the smaller size and smoother surface of the mature syncarp. In addition, the collections seen from India have rather distinctive ovate-lanceolate leaves which are densely greyish pubescent beneath" (Jarrett 1960).

Distribution : South India and Ceylon.

The Holotype *Wight* 2717 (K) was collected from Mangalore in March 1852. After this collection, it was not traced in South India. In 1977, this variety has been re-located and collected by the authors. There is only one lofty tree found in Panthanthode, way to Silent Valley R. F. Palghat Dt., Kerala. Any attempt to broaden the existing road to Damsite (if Dam is constructed) the tree may be cut as it stands on the edge of the road in a slope.

Specimens examined: KERALA: Palghat Dt. Panthanthode R. F. *E. Vajravelu* 49772, April, 1977; *N. C. Nair* 56851 April, 1978.

3. CYNOMETRA TRAVANCORICA Bedd. Fl. Syl. t. 316. 1873. (CAESALPINIACEAE).

A lofty tree, leaflets one pair, creamy pink in colour when young, lanceolate, falcate, acuminate, very unequal sided. Racemes solitary, copious. Pod flat, smoother, firm, semicircular, rugose, sessile, orange when dry.

Gamble reported this rare and endemic species from Tambracherry ghats, Wynnad based on the collection of R. H. Beddome (1880) and C. A. Barber (1903). Beddome also collected this species from Travancore (Tinnavally) hills (1873). During the exploration trips to various parts of southern region, this could not be traced out, but the authors could re-locate a few trees in Siruvani Western slopes, Palghat Dt. in 1979 (after about 70 years). Due to the expansion of the water spread area of the Siruvani Drinking Water Scheme, road work towards Kerala from the dam site is in progress. If the road is widened in future these trees may be removed, thereby this species will be lost.

Distribution: South India (S. Travancore—Tirunelveli, Wynaad, Kerala).

Specimens examined: KERALA. Tambracherry ghat—Wynaad, *R. H. Beddome s. n.* Acc. 18530, 1880; *C. A. Barber* 5668, 21st. Jan. 1903; Travancore, *R. H. Beddome s. n.* Acc. No. 18528, 1873; Palghat Dt. Vattapara—Inchikuzhi, Siruvani slopes, *E. Vajravelu* 62880, May 1979.

4. DIDYPLOSANDRA LURIDA (Wight) Bremek. var. BOURNEA (Gamble) Ellis in Biol. Mem. 2: 106. 1977. *Strobilanthes luridus* Wight var. *bournea* Gamble in Kew Bull. 1923: 374. 1923. (ACANTHACEAE).

A large shrub, leaves ovate, caudate-acuminate, crenate with about 8 pairs of main nerves. Flowers from the old branches, near the ground; bracts, bracteoles and calyx very glandular hairy, nerves very prominent; fruits with persistent bracts.

Gamble described this variety based on the collection from Periya shola, Madura Dt., Tamil Nadu by Bourne in 1897. There are other old collections by R. H. Beddome in 1877 from Pulney hills, Madura Dt.; by M. A. Lawson in 1884 from Sispara ghat in Nilgiri (MH). The authors could collect this rare endemic species during 1977, after a lapse of about 80 years or more. These plants are found on the slopes near the road. Any attempt to widen the road in future, may destroy the plants in large number. This could not be traced out in other forests of Palghat Dt. including Silent Valley R. F.

Distribution: South India (Pulney hills, Nilgiri hills, Memmara hills).

Specimens examined: TAMIL NADU. Madura Dt. Pulney hills, *R. H. Beddome s. n.* Acc. No. 85652, 1877; Periyashola, *Bourne* 678, 5th July, 1897 (Type Material); Nilgiri Dt. Sispara, *Wight s. n.* Acc. No. 37869; *M. A. Lawson s. n.* Acc. No. 37867, 1884. KERALA. Palghat Dt. Minnampara, Nelliyampathy ghat, *E. Vajravelu* 49729, April 1977.

5. EUONYMUS ANGULATUS Wight, Ic. t. 1053. 1846. (CELASTRACEAE).

A small tree or large shrub with slender branches, young stems acutely 4 angled or winged; leaves thick, ovate-lanceolate, acute, thickened on the margins, entire. Flowers pale purple in cymes with slender peduncles and pedicels.

This endemic taxon was reported by Gamble from Coorg, Nilgiri, Bolampatty hills in Coimbatore, based on the collections by R. H. Beddome in 1869.

After a lapse of about 100 years, this rare taxon was collected in Silent Valley R. F.

Distribution: South India (Coorg, Nilgiri, Coimbatore, Palghat).

Specimens examined: TAMIL NADU. Coimbatore Dt. Bolampatty hills, *R. H. Beddome s. n.* Acc. No. 9892, 1869 (Type material); Nilgiri Dt. Sispara ghat, *R. H. Beddome s. n.* Acc. No. 9894 and 9895. KARNATAKA: Coorg, *R. H. Beddome s. n.* Acc. No. 9893.

6. GYMNEMA MONTANA Hook. f. var. BEDDOMEI Hook. f. Fl. Brit. India 4: 32. 1883 (ASCLEPIADACEAE).

A climber, leaves oblong or oblong-lanceolate, petioled. Flowers large, in few flowered cymes, glabrous.

This variety is endemic to South India. Hooker described this variety based on the collection of R. H. Beddome in Anamalai hills, Coimbatore Dt., Tamil

Nadu but Gamble in his Flora Presidency of Madras has not recognised this variety. But the authors could collect this rare variety from Silent Valley R. F. in 1966 and the identity was confirmed at CNH and represented in MH by the above collection only.

Distribution: South India (Anamalai hills and Palghat hills).

Specimens examined: KERALA: Palghat Dt. Mukkali forest, *E. Vajravelu* 27778, June 1966; Silent Valley R. F. *Vajravelu* 33276, Dec. 1969.

7. LASIANTHUS JACKIANUS Wight in Calcutta J. Nat. Hist. 6: 502. 1846. (RUBIACEAE).

An evergreen shrub with conspicuous leafy bracts, covered with bulbous based strigose hairs; leaves subsessile, oblong-lanceolate, abruptly and sharply caudate acuminate at apex. Flowers white, small in sessile cymes.

Though this rare and endemic species is reported from Nilgiris, Wynaad, Attapady valley in Malabar and Bolampatty valley in Coimbatore, based on the collections by Beddome, Lawson and Wight, this species could not be re-located until 1965. During the year 1965 this taxon could be re-located in Chandanathode, Cannanore District as well as in Silent Valley R. F. Palghat Dt., Kerala. Subsequently the collection of this species has been repeated from Silent Valley R. F. only.

Distribution: South India.

Specimens examined: TAMIL NADU: Nilgiri Dt. Sispara Ghat, *R. H. Beddome s. n.* Acc. No. 26384. KERALA: Cannanore Dt. Manantoddy, *M. A. Lawson s. n.* Acc. No. 26383, Jan. 1884; *R. Wight s. n.* Acc. No. 26382; Chandanathode, *J. L. Lills* 25 238, June 1965; Silent Valley R. F., *E. Vajravelu* 26080, Oct. 1965; 27548, June 1966, 32114, July 1969.

8. MACKENZIEA CAUDATA (T. And.) Ramam. in Fl. Hassan District, Karnataka 553. 1976. *Strobilanthes caudatus* T. And. in Thw. Enum. 228. 1860. (ACANTHACEAE).

An erect shrub, twings and petioles hairy; leaves lanceolate, long acuminate, tawny pubescent beneath; Flowers white in peduncled heads with small involucral bracts; bracts linear-oblong, spathulate, densely glandular hairy.

Gamble reported this rare taxon from South Canara, Coorg, Wynaad and Travancore in evergreen forests of Western Ghats. Hook. f also reported this species from the above localities based on Beddome's collections (1867). This species could be re-collected in 1973 only by the authors after such a long gap.

Distribution : South India.

Specimens examined : KERALA: Wynaad, Brammagherry, *R. H. Beddome s. n.* Acc. No. 37809, 37811, 37813, Jan. 1867; Palghat Dt. Mukkali Forest, *E. Vajravelu* 44830, Nov. 1973. KARNATAKA: South Canara, *R. H. Beddome s. n.* Acc. No. 37810.

9. SAPROSMA FRAGRANS (Bedd.) Bedd. For. Man. 134/11. 1872. (RUBIACEAE).

A large shrub, leaves elliptic or obovate, abruptly acuminate, narrowed at base. Flowers white, fragrant in small axillary and terminal cymes.

It was reported from West Nilgiris, Malabar and Tirunelveli hills of Western ghats by Gamble probably based on the collections of Beddome. It is very poorly represented in MH. This endemic species could be re-collected during the year 1969 after a long gap of about 70 or 80 years.

Distribution: South India.

Specimens examined: KERALA: Walaghat (Malabar), *R. H. Beddome s. n.* Acc. No. 26462; Palghat Dt. Silent Valley R. F. *E. Vajravelu* 32119, July 1969, 46271, March 1975.

10. TARENNA NILAGIRICA (Bedd.) Bremek. Fedde Report. 37(7); 200. 1934 *Pavetta nilagirica* Bedd. For. Man. 134/8. 1872. (RUBIACEAE).

A shrub, leaves oblanceolate, caudate acuminate, olive green when dry. Flowers in axillary cymes, with long slender corolla tube.

This rare endemic taxon was reported from West Nilgiris to Travancore and Attapadi hills of Malabar in Western Ghats based on the collections of Beddome, C. A. Barber (1900) etc. The authors could collect this species only in Silent Valley R. F.

Distribution: South India.

Specimens examined: TAMIL NADU: Nilgiri Dt. Devalayam, *C. A. Barber* 2025, 2026, May, 1900. KERALA: Travancore, Vellava mallay, *M. A. Lawson s. n.* Acc. No. 26320. May 1889; Palghat Dt. Silent Valley R. F., *E. Vajravelu* 26139, Oct. 1965, 49795, April 1977; *N. C. Nair* 56632, April, 1978.

11. TOXOCARPUS PALGHATENSIS Gamble in Kew Bull. 1922: 119. 1922. (ASCLEPIADACEAE).

A slender twining climber with milky latex, younger parts with black ferruginous tomentum; leaves opposite, elliptic, obovate, abruptly acuminate, glabrous; flowers, pale yellow, in axillary dichotomous cymes, peduncles rusty pubescent.

This endemic species was described by Gamble based on Beddome's collections from Palghat hills and Anamalai hills. Excepting the above collections, there are no other collection of this rare taxon from any locality. The authors could re-locate this species from the type locality in the dense evergreen forest after a lapse of over 80 to 90 years.

Distribution: South India (Palghat hills of Malabar, Anamalai hills of Coimbatore District).

Specimens examined: TAMIL NADU: Coimbatore Dt. Anamalai hills, *R. H. Beddome s. n.* Acc. No. 32233. KERALA: Palghat Dt. Palghat hills, *R. H. Beddome s. n.* 32232. (Type material); Silent Valley R. F. *E. Vajravelu* 33255, Dec. 1969.

The above mentioned species collected in Silent Valley R. F. will be destroyed if the dam across the Kunthipuzha river in the above area is constructed. Nature directly and indirectly helps the human race in several ways. Hence, it is our duty to protect the nature for the numerous benefits which we are enjoying from the same.

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Some Rare Plants of the Tamilnadu Carnatic

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1. Introduction

The data presented below have been collected from The Carnatic Flora Project (Matthew, 1978 b, 1981).
Location : 10°.50′ to 12°.51′ N. and 77°.28′ to 79°.50′ E.
Area : 27,794 sq Km;
Duration of field work: 1975-1981;
Distance covered within the tract: 72,000 Km.;
Number of Field days: 564;
Collection numbers: 28,404.

The conclusions are based on a survey of:

Flowering Plants	:	2260 species from 983 genera belonging to 173 (152 sensu Gamble & Fischer 1915-36) Families;
Pteridophytes	:	111 species from 59 genera belonging to 33 Families;
Gymnosperms	:	11 species from 9 genera belonging to 53 Families.

A comprehensive enumeration of 31,393 specimens from within the area since mid-19th century and deposited in RHT, MH, FRC, PCM and HIFP forms the bulk of Matthew (1981) Within each Family, genera and species are arranged alphabetically, and the species cited in districtwise (Tiruchi, Salem, Dharmapuri, South Arcot) order. The citation itself indicates the relative abundance/scarcity of the various species.

The significance of this work (Matthew 1981: 8) is that it is the first flora of the peninsula to cover the dry deciduous vegetation excluding the evergreen (covered in Gamble & Fischer, 1915-36) that can bring into sharp relief the composition of the former type of vegetation; one striking finding is that over one half of the indigenous genera (531/1051) are monotypic.

2. Preliminary Remarks

1. At present the frame of reference for the delimitation of taxa are the national Flora (Hooker, J. D. *et al*, 1872-97) and the various provincial Floras, whereas good monographs whould have provided far more accurate parameters. Matthew (1978 c) has stressed that stringent monography is

the first priority in Indian systematic botany. For instance, only careful monography can decide if 915. *Vernonia shevaroyensis* Gamble is really distinct from 914. *V. monosis* C. B. Clarke, or 889. *Notonia shevaroyensis* Fyson is different from 888. *N. grandiflora* DC. As a matter of fact, the early explorers of the south Indian hills (Fyson, 1932) as elsewhere, deeply impressed by certain variations, 'optimistically' (E. D. Merrill) proposed too many new taxa! Over 100 new taxa of mosses were described from the Palni hills alone (Foreau, 1930, 1961, 1964). Good monographs are not likely to retain many of these.

2. This remark has special bearing on the term 'endemic', rather over-exploited since the days of Willis and Merrill.
3. Searching field work is more than ever before required (Matthew, 1978 a). Over 100 species included in Gamble & Fischer (1915-36) have not been collected since their description, several of which are listed in Henry *et al.* (1979). True, primary forests have shrunk fast over the years but to conclude that any species has disappeared would be unwarranted before such habitats have been carefully searched. Three kinds of inaccessibility may be noted :a) size of trees; (b) distance from roads; (c) seasonality of certain species, either of the entire plants, or their fertile stages, rendering from easily susceptible to be missed during general collections.
4. The days of general collecting are largely over. Specialized collecting in view of monographs is urgent. Some experience will show that genera like *Impatiens*, *Caralluma*, *Ceropegia*, *Theriophonum*, among many others, need fresh collection for any meaningful monography to be done.
5. The fact that species like *Aerides ringens* C. Fischer, *Lilium neilgherrence* Wight, *Satyrium nepalense* D. Don etc, though still available on the Western ghats, have nearly been exterminated on the Servarayans (Shevaroys), is indicative of what can happen unless effective conservation measures are taken (Matthew 1981 : 104-106).
6. Within the Carnatic, apart from destruction of primary forests, water pollution is the only significant agent for destruction of vegetation, except at Mettur where chemical effluents have altogether wiped out the vegetation in their course.
7. Aliens and cultivated species are excluded from the present consideration, though some aliens like *Lantana*, *Dodonea*, *Ageratum*, *Bidens* and *Parthenium* have transformed the vegetation!
8. Provisionally the nomenclature of Gamble & Fischer (1915-36) is followed. All the species listed are preceded by the enumeration number (in Matthew 1981) for easy reference.

3. Presentation of Data

Data are organized under two main headings: Shrinking distribution, and Extended Distribution.

A : SHRINKING DISTRIBUTION

(a) From destruction of primary habitats (Matthew 1981: 104-106). Many species, by themselves, are not rare, but owing to the obligate association with the habitat, these disappear along with the habitats. It should be noted that all the species listed below are from the Servarayans!

(i) epiphytism, moisture, total shade :
2265. *Psilotum nudum* (L). Grisheb. 2257. *Lycopodium macrostachys* Hook.
(ii) bogs, shaded ravines :
2270. *Osmunda regalis* L. 210. *Impatiens acaulis* Arn.
27. *Mahonia leschenaultii* Takeda
(iii) grassy downs :
1069. *Swertia corymbosa* Wight 2271. *Anemia schimperiana* C. Presl
194. *Linum mysorense* Heyne

(b) over-exploitation
(i) Ornamentals: 1854. *Lilium neilgherrense* Wight 1804. *Satyrium nepalense* D. Don
1739. *Aerides ringens* C. Fischer

(ii) Pharmacology: 623. *Drosera peltata* Smith
(iii) Timber : 491. *Pterocarpus santalinus* L.f. 264. *Sonneratia apetala* Buch.-Ham.
261. *Xylocarpus obovatus* Adr. Juss.
(the last two in the mangroves).

(c) Restricted Distribution (and rarity):
44. *Cadaba trifoliata* Wight & Arn. (only 2 localities) 1572. *Agrostistachys maingayi* Hook.f.
1255. *Seasmum laciniatum* Klein

(d) Endemism :

532. *Zornia zeylonesis* Pers. 1032. *Hemidesmus indicus* R. Br. ex Schultes
1029. *Decalepis hamiltonii* Wight & Arn.

The mangroves are a special case of endemism, and two species have been mentioned under b. iii.

On the Kalrayan jaghirs is what may be termed an endemic pocket with a notable assemblage of such species.

(e) Suspected extinction :

315. *Aphania bifoliolata* Radlk. (? identify)
630. *Kandelia rheedii* Wight & Arn.
1066. *Exacum perrotetii* Griseb.
1212. *Pedicularis zeylanica* Benth.
1851. *Dipcadi madrasica* C. Fischer & & Barnes.

(f) Collected after 50 years :

161. *Sterculia populnifolia* Roxb.
281. *Hippocratea grahami* Wight
626. *Bruguiera conjugata* Merr.
1843. *Stemona tuberosa* Lour.

B : EXTENDED DISTRIBUTION (Appendix)

Preliminary observations :

(1) 2366. *Gnetum ula* Brongn., 94. *Elatine ambigua* Wight, etc., are not rare, once the habitat is recognized.
(2) The known distribution of 101. *Shorea talura* Roxb. and 565. *Hardwickia binata* Roxb. has been much extended southwards during the Project.
(3) An important contribution is that a large number of species found only in evergreen forests have been collected within the Carnatic; this long list is appended hoping that one species or the other might provoke interest or queries.

4. *Alphonsea sclerocarpa* Thwaites
12. *Mitreogira heyneana* Thwaites
78. *Polygala telephioides* Willd.
94. *Elatine ambigua* Wight
97. *Garcinia cambogia* Desr.
147. *Buettneria herbacea* Roxb.
216. *Atalantia missionis* Oliver
408. *Dalbergia rubiginosa* Roxb.
248. *Amoora canarana* Hiern
257. *Soymida febrifuga* Adr. Juss.
260. *Walsura piscida* Roxb.
267. *Apodytes beddomei* Masters
268. *Pyrenacantha volubilis* Hook.
566. *Mezoneurum cucullatum* Wight & Arn.
626. *Bruguiera conjugata* Merr.
663. *Osbeckia chinensis* L.
783. *Lasianthus truncatus* Beddome
822. *Stylocoryne monosperma* Wight & & Arn.
945. *Chrysophyllum roxburghii* G. Don
1007. *Vallaris solanacea* Kuntze
1205. *Limnophylla roxburghii* G. Don
1337. *Strobilanthes walkeri* Arn. ex Nees
1360. *Lippia unica* Ramark
1572. *Agrostistachys maingayi* Hook. f.
1612. *Euphorbia tortilis* Rottler ex Wight
1615. *Excoecaria robusta* Hook. f.
1663. *Symphyllia mallotiformis* Muell.—Arg.
1811. *Vanilla walkeriae* Wight
1927. *Alisma reniforme* D. Don.
1931. *Potamogeton crispus* L.

4. Conclusions

There is a healthy awareness in the world and in India about the urgency of nature conservation (Henry *et al.*, 1979; Jain 1970; Matthew *et al.*, 1975). During the past decade alone a number of important journals exclusively dedicated to the subject have been appearing: *Environmental Conservation* (Switzerland), *Tiger Papaer* (Malayasia), and *Environmental Awareness* and *Hornbill* inside India itself. The World Wildlife Fund itself is indicative of this global awareness.

Despite all these, the note of alarm raised in Matthew (1981: 104-106) should be taken at its face value.

Need for Careful field work is pressing. The tendency to compile lists of rare/ threatened plants from literature or from the thinner herbarium folders is to be discouraged.

As for the Tamilnadu Carnatic, a *comprehensive census* is under preparation, which can however be finalized only after all the 3 volumes of the Flora are published (early 1983).

The table of monotypic genera given below indicates significant distributional patterns characteristic of the peninsula (evergreens excluded).

Table showing the number of taxa for the Tamilnadu Carnatic.

Groups	Families	Genera	Species	Monotypic Genera	
				Indigenous	Alien
Angiosperms	173 (152)	983	2260	488	85
Pteridophytes	33	59	111	41	–
Gymnosperms	5	9	11	2	5

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29

Extended Distribution of Endemic Plant species on Tirupati Hills

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Endemic plants can be defined as a population or species with narrow physiological or other restrictions which limit them to special habitats or very restricted geographic range or both. The present study is concerned with the endemic plants of Seshachelam hill ranges of Andhra Pradesh which were left unexplored until recent times. The following endemic plants namely *Pterocarpus santalinus* L.f., *Terminalia pallida* Brandis, *Syzygium alternifolium* Walp., *Shorea tumbaggaia* Roxb., *Pimpinella tirupatiensis* Bal. & Subra., *Cycas beddomei* Dyer, *Boswellia ovalifolia* Bal. & Henry, *Phoenix farinifera* Roxb., have been studied with reference to the areas of their distribution at different ecoclimatic conditions on the hills.

Cycas beddomei Dyer, grows on the leeward side of Narayanadri as loose patches with 20-30 plants in each patch in a 10-15 m^2 and about 5-10 such patches occur in a 100 m^2. On the inclined plateaux of Gogharbham hills, the pattern of distribution is rather poor having 3-4 such patches in 20-30 m^2 possessing 3-4 stunted plants in each patch, reaching about foot height competing weakly with the other dominant endemic taxon, *Phoenix farinifera* which is at higher plane in the so called evolutionary ladder. The slopes of Papavinasanam area which are rich with an undergrowth of grass mainly of *Cymbopogon coloratus* have been supporting in among half burried boulders, *Cycas beddomei* in a more or less large number of patches with a relatively more number of species in a selected 100 m square. Special adaptations in this particular plant species over *Cycas circinalis*, are the starchy, fire resistant stems with suckers, the hard rachis, and the sclerophyllus, recurved, hard pinnules. The pattern of its distribution in undisturbed areas is relatively more dominant as compared to the other shrubby species other than *Phoenix farinifera*. This species does not occur below 700 m on the hills under natural conditions.

Phoenix farinifera Roxb., has been quite wide spread in its distribution as compared to other endemics and occupy areas upto 300 m on the hills with gregarious distribution on the upper hill slopes. About 120 to 200 plants have been found in a 100 m square in Gogharbam dam area. The undisturbed Narayanadri slopes, Akasaganga, Papavinasanam, Chakra theertham and Seshadhara theertham areas support 20-50 plants among other shrubby native perennials in a 100 m square. The special adaptations and the distribution

patterns of this endemic taxon are with short stems, with closely set leaf bases and thorny leaves with more waxy coating to cut down transpiration, and the spadices with long stalks supporting the fruits which facilitate long distance migration also by bears and Man. The summer fires would least affect the trunks or the seed of this plant.

Pterocarpus santalinus L.f., a ravine loving endemic tree is of considerable importance due to its high market and export value. This species grows abundantly at higher altitudes, above 600 m and mostly confined to leeward sides of the valleys. In undisturbed areas the plants can be numbered from 30-50 in a 100 m square. In open areas it has rather restricted distribution and stunted growth. However, the areas of its occurrence are inclined slopes Papavinasanam, Akasaganga, Narayanadri, Thumburakona and Ramakrishna theertham. It is more dominant in its distribution pattern as compared to the other related species, *Pterocarpus marsupium*. The special advantages that this taxon enjoys are the trifoliately compound thick shining leaves, rapid growth and heavy fruit-set. The thick pericarp and winged nature of the fruit would also make it fire resistant in addition to its dispersal to longer distances and congenial habitats. Thus, it is better suited in its adaptations as compared to the sparcely distributed *P. marsupium*.

Shorea tumbaggaia Roxb., forms a narrow grove loving huge tree which is mostly confined to altitudes above 750 m. This endemic tree requires highly specialised soil and physical conditions for its proper growth and perpetuation. Its distribution is rather sparce as compared to the other related species *S. talura* which is well adapted to the upper hill slopes on the hills. This endemic taxon distribution is rather agreeing more to the definition of the endemics in being very restricted to such specialised habitats of deep ravines with lot of humus and percolation. Its sparce distribution can be correlated with less coriacious leaves, deep valley habitat, small winged fruits and relatively less fruit setting as compared to the widely occuring, *S. talura* on the hills.

Terminalia pallida Brandis, is a medium sized endemic tree which forms dominant populations on hill plateaux over 500 m and is richly distributed in Papavinasanam, Akasaganga, Garudadhri and Vrushabhadri plateaux (30-50 plants in 100 m square) and is well adapted as compared to *T. chebula* a closely related species. Its survival and relative dominance might be due to thick leaves and high fruit setting.

Syzygium alternifolium Walp., also forms a dominant taxon of the upper hill plateaux in addition to its distribution on slopes and valley tops. It is distributed in Akasaganga, Papavinasanam, Narayanadri, Chakra theertham and Kumaradhara theertham plateaux, roughly about 20 to 30 percent of the other medium sized tree species in a selected 100 m square. Its sister species *S. cumini* is very restricted above 400 m and less adapted to the plateaux life. On the other hand *S. alternifolium* has specially evolved in having very thick leaves and hard seeds which might have helped its distribution and establishment against the odds of moisture levels and unfavourable physical conditions.

Pimpinella tirupatiensis Bal. & Subr., is a herbaceous endemic of seasonal occurence with an underground perennial tuberous root, resembling much like that of carrot and with an aerial, dimorphic basal and cauline foliage. It is predominantly distributed on inclined open slopes of Jamali theertham, Kumaradhara theertham, Akasaganga and Sesha theertham. Four to five hundred plants have been recorded at a time with their above ground foliage and flowering in a 100 m square a little after north-east monsoon in Jamali and Sesha theertham areas. No other species of herbaceous umbellifers are adapted to this region. It forms the queen of herbaceous vegetation during favourable season. The survival of this endemic might be due to its adaptations through subterranian tuberous habitat and through the distribution of seeds, producing long, herbaceous aerial stems leaning on other bushes.

Boswellia ovalifolia Bal. & Henry, grows as an endemic in a narrow belt of lower hill slopes ranging in height from 200 m to 350 m where the physical and soil conditions are more critical to the survival of many tree species. Distribution within this belt appear that the seeds germinate and survive better than those distributed in lower and higher elevations. This taxon shows good correlation with the changing climatic conditions and bear green foliage during favourable conditions and remain bare during flowering, especially from February to March and until the start of the south-west monsoon. The green stem is covered with flakes of thin peeling of papery surface bark which might help in the survival of this taxon in semiarid and eroded lower hill slopes. The flowering and fruiting of this endemic species is tremendously large to ensure maximum seed distribution.

From the foregoing account it is rather clear that majority of the endemics have been more specifically adapted as compared to their sister species occuring as wides in this region. It is also clear that these endemics have been well adapted in this semiarid zone and the adaptive features are very significantly correlated with the physical features of the environment. It is therefore, concluded that the following endemics *Pterocarpus santalinus, Cycas beddomei, Terminalia pallida, Syzygium alternifolium, Pimpinella tirupatiensis,* and *Phoenix farinifera* might be of recent origin with specialised adaptations based on their distribution areas survey and dominance, while *Shorea tumbaggaia* and *Boswellia ovalifolia* might appear to be relics of the ancient populations.

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Threatened Plants of Tirupati and its Environs

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The rapidly changing global conditions due to terrestrial and atmospheric variations around this planet and perhaps from extra terrestrial inductions, have resulted in gradual depletion of habitable regions for proper perpetuation and survival of some plant and animal species. Of the several zones of the globe, the tropical regions have been known for their rich floristic wealth in terms of rich population growth and the number of species as compared to any other region on the earth. Tirupati lies between 79°19′ to 79°23′ and 13°37′ to 13°43′ in the district of Chittoor, Andhra Pradesh; about 160 km west of Madras. This region was not surveyed botanically till recently as it was prohibited from survey for several reasons. The recent studies have revealed that this area is floristically very rich due to varied ecological conditions. About 1470 species belonging to vascular plants have been recorded. The population densities and the survival and perpetuation of several plant species have been hampered due to rapid march of acute arid conditions.

The present study is concentrated mostly on such species whose survival and perpetuation has been variously threatened in different ecosystems at different heights on the hills. The following species have been recorded as threatened. Some of the tree species such as: *Diospyras ebenum. Shorea tumbaggaia. Givotia rottleriformis, Carallia integerrima, Mangifera sylvatica, Pterospermum heyneanum, Polyalthia cerasoides, Scolopia crenata, Wrightia tomentosa, Antidesma ghaesembilla, Walsura trifoliata* are restricted due to denudation, summer firing and grazing giving rise to other shrubby species adapted to such changing climate. Of the shrub and herbaceous species of threatened nature *Phyllochlamys spinosa, Polyalthia korinti, Cleistanthus patulus, Drynaria gersifolia, Habenaria furcifera, Colebrookea oppositifolia, Peperomia dindigulensis, Dioscorea belophylla, Dicranopteris linearis, Blechnum orientale, Asplenium falcatum, Schizoloma ensifolia, Hemionitis arifolia* are important. In the plateaux, *Gmelina arborea, Terminalia paniculata, Homalium zeylanicum, Decalepis hamiltonii, Taxillus tomentosus, Vanda spathulata, Ampelocissus tomentosa, Cissampelos pareira, Apluda aristata, Rhynchosia suaveolens, Sageretia parviflora,* have been located. The plants on depleted hill slopes are *Diospyros montana, Sapium insigne, Lepisanthes tetraphylla, Osyris wightiana, Canthium diccocum, Premna tomentosa, Flacourtia ramonchi, Clematis gouriana, Calicopteris floribunda, Celastrus paniculatus, Coleus barbatus, Dicliptera cuneata,* and such others. The hill tops usually rich in *Disophylla mysoroides Polycarpaea aurea. Cyanotis arachnoides*

and *Justicia micrantha* have been reduced of their populations. The down hills which are frequently subjected to overgrazing, cutting and summer firing have shown reduction in the population size of the species such as: *Gyrocarpus americanus, Cochlospermum gossypium, Lagerstroemia parviflora, Pterolobium indicum, Randia candolleana, Pavetta tomentosa, Rivea ornata, Acalypha alnifolia, Cassia absus* and *Vanda spathulata*. Virtually the plains are cleared off in favour of construction of buildings, roads etc. and the natural plant populations have been replaced with most of the exotic plants. Consequently the native species such as *Diospyros chloroxylon, Capparis sepiaria, Phoenix humilis, Sarcostemma acida, Ceropegia inmea, Leptadenia reticulata, Zornia diphylla, Polygala ramaswamiana, P. erioptera, Microstegium ciliatum, Tragus racemosus, Dolichandrone atrovirens, Ophioglossum graminum,* have become very rare.

Some of the other species which are acutely threatened are *Jussieua repens, J. suffruticosa, Spilanthes acmella, Hypericum japonicum, Hygrorhiza aristata, Ardisia solanacea, Xanthoxylum ovalifolium, Oroxylon indicum, Semecarpus anacardium, Homalium zeylanicum, Anamirta cocculus, Entada scandens, Osyris wightiana, Psilotum nudum, Dioscorea belophylla, Rhynchosia albiflora, Piper trichostachyon, Cyclea burmanni, Evolvulus nummularia, Homalium zeylanium, Begonia malabarica, Pittosporum floribundum, Cissampelos pareira, Scolopia crenata, Neolitsea foliosa, Litsea deccanensis, Justicia betonica, Arundinella setosa, Hemionitis arifolia, Streblus taxoides, Pleurostylia wightii* and *Colebrookea oppositifolia*. The populations of these species are gradually decreasing mainly due to changes in the habitats.

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31

Observations on Rare, Imperfectly known and Endemic Plants in the Sacred Groves of Western Maharashtra

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Introduction

The practice of dedicating forest groves to deities is common in India (Kosambi, 1962; Vartak and Gadgil, 1973). A forest preserved on religious grounds is known as a 'Dev-rai' or 'Dev-rahati' and is assumed to be an abode of the Forest God. It is amazing to see these most luxurient climax pockets of forests formed by sacred groves in the midst of a devastated terrain. These sacred groves have been completely immune from human interference due to religious beliefs (Vartak and Gadgil, 1981).

These sanctuaries are afforded protection through the grace of some deity. Thus removal of any plant material (even a piece of dead wood), or killing any animal from the sacred grove is taboo (Gadgil and Vartak, 1975, 76). The villagers seem to respect this taboo sincerely even today. Village folks believe that breaking these laws may result in serious illness or a violent death. Such strict taboos have led to the preservation of forests in virgin condition. The sacred groves are, therefore, relics of the forests that must have once covered a large part of Western Ghats.

The climax type of vegetation in the sacred groves exhibits a diversity in species of trees and other various life forms dependent for their very existence on trees, huge climbers, epiphytes and other shade loving plants. With the felling of the forest all around the sacred grove, these have become the last refuge for many plant species requiring special habitat preference. The sacred forests are also of great silvicultural interest and serve as indicators of the natural productivity of the region. It is, therefore, imperative to survey these sacred forests and properly assess their role in nature conservation (Gadgil and Vartak, 1975).

Climax vegetation in sacred groves is always very rich in their species composition. As such these sacred groves serve the vital function of preservation of plants which have become very rare or extinct elsewhere. The author has been interested in the ethnobotanical studies of the tribal communities from the Western Ghats (Vartak, 1980)—studied number of unmolested forest patches or *Dev-Rais*. He was surprised to observe a treasure trove of plant

species. These observations initiated the author to undertake a critical study of such interesting plants which are rare outside the area but growing naturally and luxuriently in the well protected grove and near about. This article deals briefly with the collection of such rare plant species. Due to indiscriminate forest cutting, natural habits of the various indigenous and endemic species are in danger. Special efforts will, therefore, be made to study the floristics and environs around such plants.

Present article includes enumeration of 38 species of endangered endemic plant species from 12 selected sacred groves along the Western Ghats.

PLAN OF WORK

From 200 sacred groves recorded so far (Gadgil and Vartak, 1981) only 12 areas were visited for recording composition of the flora and vegetation. Most of the groves represent hilly terrain and heavy rainfall during the monsoon. Following places were visited between March 1980 and May 1981 for recording data.

No.	*Location*	*Nearest Village*	*Area (hectares)*	*Deity*
1.	Ransai	Karnala	2·5	Vardani
2.	Kalsubai	Bari	3·0	Kalsubai
3.	Nagfani	Bhimashankar	5·0	Asra
4.	Talai	Sinhagad	8·0	Taleshwari
5.	Ambavada	Bhor	3·0	Nageshwar
6.	Rairashwar	Bhor	8·0	Raireshwar
7.	Dhup-rai	Hirdoshi	5·0	Durgai
8.	Gani	Mahad	11·5	Kalkai
9.	Vaghajai	Rajgad	4·0	Vagheshwari
10.	Hiryana Keshi	Amboli	6·0	Hiranya Keshi
11.	Kanakeshwar	Jirad	3·0	Somaji
12.	Javli	Mahabaleshwar	10·0	Janai

The plants collected during these visits have been carefully examined in the laboratory and their identification confirmed by reference to the corresponding specimen sheets in the Herbarium of Botanical Survey of India (W C) Pune. Special efforts were made to collect imperfectly known plants or peculiar plant species of doubtful identity. The voucher specimens have been deposited in the Herbarium of the Maharashtra Association for the Cultivation of Science, Pune 411 004.

The sequence in the following enumeration follows Bentham and Hooker's system with relevant modifications. Under each species have been given (*a*) Currently accepted Botanical name, (*b*) flowering and fruiting time, (*c*) brief outstanding morphological features, (*d*) field notes, (*e*) specimens cited.

ENUMERATION OF ENDANGERED SPECIES FROM THE SACRED GROVES

Ranunculaceae

CLEMATIS WIGHTIANA Wall. ex DC.

Fl. and Fr. : Dec.—Jan.

A woody climber. Flowers golden yellow, velvety, showy, about 6 cm in diameter.

Notes: A very handsome species often cut by passers. Now a days scarcely seen at Mahabaleshwar. Apparently endemic and restricted to highest ghats.

Specimens cited: Raireshwar grove: HMACS, 1528.

THALICTRUM DALZELLII Hook.

Fl. & Fr. : July.—Sept.

A slender, much branched suberect herb. Flowers white in leafy panicles crowded at the ends of the branches.

Notes: In the literature it is mentioned as one of the rare plants restricted to the mountainous part of the high rainfall region. Recorded from few localities along the crest of the Western Ghats.

Specimens cited: Mt. Kalsubai-grove; Rairashwar-grove: HMACS, 10042.

Menispermaceae

TINOSPORA MALABARICA Miers.

Fl. & Fr. : Apr.—June.

A large climber on lofty trees. Young twigs covered with whitish tomentum. Flowers pale green in pendulous recemes.

Notes : Due to indiscriminate cutting of trees, this majestic liana is now on the verge of extinction. There are still luxurient climbers in the sacred groves of Kanakeshwar.

Specimens cited : Kanakeshwar-grove : HMACS, 840.

Capparidaceae

CAPPARIS MOONI Wight.

Fl. : Oct.—Nov., *Fr.* : Mar.—Aug.

A large climbing shrub armed with stipular hooked spines. Flowers white, large, showy, 8—10 cm across. Fruit amphisarca, 5-7 cm in diameter.

Notes : The plant is hunted for its hard shelled fruit, which believe to possess miraculous medicinal properties. Now a days becoming rare.

Specimens cited : Dhup rahat near Hirdoshi : HMACS, 211.

Balsaminaceae

IMPATIENS ACUALIS Arn.

Fl. & Fr. : Sept.—Nov.

Ephemeral herb, perennating by tubers. Flowers pink, beautiful, 3 cm across.
Notes : Extremely elegant species usually seen along the wet vertical cliffs. Endangered due to the gradual destruction of its natural habitat.
Specimens cited: Rajgad-grove : HMACS, 825.
IMPATIENS PULCHERRIMA Dalz.
Fl. & Fr. : Sept.—Oct.

An erect much branched herb, 30-45 cm high. Flowers violet purple, 4-5 cm across. One of the most beautiful balsams having large and showy flowers.
Notes : Usually seen along the footpaths in dense forests. Rather rare. Endemic in Western Ghats.
Specimens cited : Ambavda-grove : HMACS, 899.

Burseraceae

CANARIUM STRICTUM Roxb.

A large lofty tree. Leaves imparipinnate, large. Flowers small, in short branched, axillary panicles. Endemic in W. Peninsula.
Notes : Typical constituent of evergreen forests. It is now on the verge of extinction due to indiscriminate forest cutting. There are, however, some well grown trees of Ral-dhup in sacred grove of Dhup rai near Hirdoshi.
Specimens cited : Dhup-rai : HMACS, 980.

Fabaceae

CROTALARIA LEPTOSTACHYA Benth.
F. & Fr. : Oct.—Nov.

A stiff erect herb about 2 m tall. Flowers bright yellow in terminal and lateral many flowered racemes.
Notes : Apparently endemic in W. Peninsula.
Specimens cited : Mahar dar, Sinhagad : HMACS, 1521.
DESMODIUM PARVIFLORUM Baker.
Fl. & Fr. : Sept.—Oct.

An erect herb about 15 cm high. Flowers rosy pink in lax terminal racemes.
Notes : An interesting species showing intergeneric features of *Alysicarpus* and *Desmodium*.
Specimens cited : Rajgad : HMACS, 1745.
ATYLOSIA SERICEA Benth.
Fl. & Fr. : Oct.—Dec.

An erect herb, 60-120 cm high. Flowers yellow, axillary, solitary or in pairs.
Notes : Endemic in W. Peninsula.
Specimens cited : Mahar-dara, Sinhad : HMACS, 1465.
FLEMINGIA NILGIRIENSIS Wight
Fl. & Fr. : Oct.—Nov.

Prostrate herb, diffuse, pubescent. Flowers dull purple in terminal heads.

Notes : Apparently endemic. Occasionally seen amongst boulders on hill tops.
Specimens cited : Kalsubai-grove : HMACS, 1805.

Caesalpiniaceae

CASSIA KLEINII Wight & Arn.
Fl. & Fr. : Oct.

Perennial, much branched herb. Flowers yellow, 1-3 together in the leaf axils.
Notes : So far reported from some restricted areas of N. Konkan.
Specimen Cited : Karnala-grove : HMACS, 2538.
WAGATEA SPICATA Dalz.
Fl. & Fr. : Jan.—Feb.

A robust woody climber armed with sharp spines. Flowers scarlet yellow in dense spicate racemes, sometimes 50 cm long.
Notes : Endemic in W. Peninsula.
Specimens cited : Dhup-rai, Hirdoshi; Karnala-grove : HMACS, 2822.

Mimosaceae

ENTADA PURSAETHA DC. (*Entada scandens* Benth.)
Fl. Mar. *Fr.* Apr.—June.

Huge liana with bipinnate leaves & monstrous pods, sometimes exceeding 120 cm long. Flowers pale yellow in pendulous spikes.
Notes : The species is on the verge of extinction due to the elimination of lofty trees.
Specimens cited : Sacred grove near Rajgad recorded on Dec. 1974.

Begoniaceae

BEGONIA CONCANENSIS A. DC.
F. & Fr. : Aug.—Oct.

Succulent herb, about 30 cm. high; roots tuberous. Flowers rosy-pink on elongated dichotomous peduncles.
Notes : Found on moist, shady vertical rocks during monsoon.
Specimens cited : Karnala-grove, HMACS, 3343.

Umbelliferae

PEUCEDANUM GRANDE C. B. Clarke
Fl. & Fr : Aug.—Oct.

Glabrous perennial herb, 1 m high. Flowers yellowish white in compound umbels.
Notes : Apparently endemic in Western Peninsula. Fruits used in local medicine.
Specimens cited : Rairashwar-grove. HMACS, 3416.
HERACLEUM PINDA Dalz. & Gibs.
Fl. & Fr. : July—Aug.

An erect ephemeral herb, perennating by root-stock. Flowers white in terminal umbel, radiant.

Notes : Root stock is edible and more delicious than carrot, invariably picked up by local inhabitants.

Specimens cited : Bhimashankar. HMACS, 3408.

Rubiaceae

GARDENIA GUMMIFERA Linn. f.

Fl. & Fr. : Feb.—June.

A small shrub or small tree; buds resinous. Flowers white changing to yellow, 1-3 together.

Notes : Very common in Kankeshwar-grove & Karnala-grove; elsewhere rare. Cultivated.

Specimens cited : Karnala-grove. HMACS, 3577.

Asteraceae

CENTRATHERUM TENUE C. B. Clarke

Fl. & Fr. : Oct.—Nov.

An erect, dichotomously branched herb. Flowers purple in many flowered terminal or leaf opposed heads.

Notes : Apparently endemic and restricted to highest ghats.

Specimens cited : Karnala-grove. HMACS, 3892.

LAMPRACHENIUM MICROCEPHALUM Benth.

Fl. & Fr. : Oct.—Nov.

An erect herb 50-60 cm high. Leaves clothed beneath with white tomentum. Flowers purple, showy, in numerous loose heads.

Notes : Endemic and restricted to highest ghats.

Specimens cited : Rajgad-grove, HMACS, 4152.

Apocynaceae

BEAUMONTIA JERDONIANA Wight

Fl. & Fr. : Nov.—Dec.

A large climber. Flowers white, 8-10 cm long, infundibuliform, showy, in terminal rusty-pubescent cymes.

Notes : Apparently endemic. It is on the verge of extinction due to the indescriminate forest destruction.

Specimens cited : Recorded in sacred grove near Amboli, Dec. 1974.

Campanulaceae

CAMPANULA ALPHONSII Wall.

Fl. & Fr. : Oct.—Nov.

A decumbent herb; stems many from the base. Flowers violet, campanulate, solitary or in lax terminal cymose panicles.

Notes : Apparently endemic in hilly regions of the Poona District.
Specimens cited : Talai-grove, Sinhagad, HMACS, 4463.

CEPHALOSTIGMA FLEXUOSUM Hook. f. & Thoms.
Fl. & Ft. : Nov.—Dec.

An erect herb, 15-20 cm high. Flowers pale blue in lax racemes.
Notes : Apparently endemic in Western Peninsula. Usually found amongst short grasses in forest undergrowth.
Specimens cited : Talai-grove, Sinhagad. HMACS, 4477.

Asclepiadaceae

HEMIDESMUS INDICUS R. Br.
Fl. & Fr. : Most of the year.

Perennial prostrate or twining shrubs. Flowers greenish purple, crowded in to subsessile cymes.
Notes : Common in Western India but likely to face indescriminate cutting due to its promising medicinal importance.
Specimens cited : Rajgad-grove. HMACS, 4726.

CEROPEGIA LAWII Hook. f.
Fl. & Fr. : Aug.

An erect herb 30-40 cm high, perennating by tubers; tuber 4-6 cm diam. Flowers yellowish green with red streaks in pendulous cymes.
Notes : Ephemeral species seen in sandy much exposed area and amongst the boulders. Tubers are delicious and often picked up by local people.
Specimens cited : Rairsshwar-grove. HMACS, 4774.

CEROPEGIA OCULATA Hook. f.
Fl. & Fr. : Aug.—Sept.

Herbaceous twiner, perennating by tubers. Flowers greenish purple in 4-8 flowered umbellate cymes.
Notes : Endemic in W. Peninsula. Tubers are edible and often hunted by village folks.
Specimens cited : Talai, Sinhagad. HMACS, 5349.

Gentianaceae

EXACUM BICOLOR Roxb.
Fl. & Fr. : Aug.—Nov.

An erect annual, reaching 60 cm high. Flowers bluish white, showy in copious terminal glabrous cymes.
Notes : Extremely elegant species often fall victim to human greed.
Specimens cited : Rajai-grove, Rajgad. HMACS, 4933.

Boraginaceae

PARACARYUM MALABARICUM C. B. Clarke.
Fl. & Fr. : Nov.—Dec.

An erect herb 30-80 cm high. Flowers metel blue in numerous terminal racemes forming a dense corymb.
Notes : Apparently endemic and restricted to the hill tops of the Western Ghats.
Specimens cited : Rajgad-grove. HMACS, 5085.

Convolvulaceae

PORANA MALABARICA C. B. Clarke.
Fl. & Fr. : Oct.—Nov.
An extensive climber. Flower white in lax panicles.
Notes : One of the most beautiful wild species when in full bloom. Often cut by passers. Endemic in W. Penninsula.
Specimens cited. : Kalsubai-grove. HMACS, 9295.
ARGYREIA CUNEATA (Willd.) Ker-Gawl.
Fl. & Fr. : July—Sept.
A shurb usually erect but tending to climb when growing near the support. Flowers bright purple, tubular, infundibuliform.
Notes : Beautiful wild species, reputed for its various medicinal uses.
Specimens cited : Ranjai, Rajgad. HMACS, 5120.

Orobanchaceae

CHRISTISONIA LAWII Wight
Fl. & Fr. : July—Aug.
Herbaceous root parasite. Flowers dull white, showy, minutely pubescent with yellow eye.
Notes : Endemic in W. Peninsula. Total root parasite on *Carvia.*
Specimens cited : Ambavada-grove. HMACS, 5744.

Lentibulariaceae

UTRICULARIA ALBO-COERULEA Dalz.
Erect herb. Flowers large, fragrant, bluish-purple with a white eye and yellow dot.
Notes : Apparently endemic in high rainfall region of the Western ghats.
Specimens cited : Rairashwar-grove, HMACS, 5746.

Acanthaceae

THUNBERGIA MYSORENSIS T. Anders.
Fl. & Fr. : Oct.—Nov.
An extensive glabrous climber. Flowers purplish green in long lax pendant racemes.
Note : One of the ornnamental wild climbers often hunted for its showy flowers.
Specimens cited : Rairashwar-grove; HMACS, 6152.

PLEOCAULUS RITCHIEI (Clarke) Bremek.
Fl. & Fr. : Nov.—Dec.

A small undershrub; stems 30-40 cm long. Flowers purple in strobiliform axillary and terminal pedunculate or subsessile spikes.
Notes : Apparently endemic in W. Peninsula. Restricted to hill tops and gentle slopes. The plant communities of *Pleocaulus* are often burnt and removed in the process of shifting cultivation.
Specimen cited : Rajgad-grove, HMACS, 6104.

BARLERIA LAWII L.
Fl. & Fr. : Nov.—Dec.

An erect shrub. Flowers white, solitary showy 1-8 cm long, axillary.
Notes : Usually seen along the edge of the forests. Apparently endemic.
Specimens cited : Talai, Sinhgad, HMACS, 5853.

BARLERIA GIBSONII Dalz.

Small shrub. Flowers pink, showy, 6-7 cm long, solitary, axillary.
Notes : Apparently endemic in W. Peninsula. One of the beautiful wild species occasionally seen along the footpaths in dense forests.
Specimens cited : Rairashwar-grove, HMACS, 5844.

Euphorbiaceae

MALLOTUS STENANTHUS Muell. -Arg.
Fl. Nov.—Feb. *Fr.* Dec.—May.

Undershrub, 2-2.5 m high, glabrous;branches with yellowish resinous glands. Flowers dioecious, small, yellowish green in, slender axillary and terminal racemes.
Notes : Santapau listed it as a rare plant at Khandala. It is seen occasionally in the undergrowth of the semi evergreen forests. Apparently endemic in W. Peninsula.
Specimens cited : Bhimashankar-grove, HMACS, 3590;
Dhup-rahat, HMACS, 9191.

DIMORPHOCALYX LAWIANUS Hook. f.
Fl. March—Oct. *Fr.*: Oct.—Dec.

A middle sized tree. Flowers dioecious, usually solitary. Fruit with persistent calyx.
Notes : Occasionally seen in evergreen forests. Apparently endemic in W. Peninsula.
Specimens cited : Bhimashanker-grove, HMACS, 7116.

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32

Notes on some Plants Endemic to Western India

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The paper records taxa observed on the Pavagadh Hill in Gujarat State, endemic to Western India.

The current threats to the survival of the species include: browsing and overgrazing, clearing of vegetation for cultivation, exploitation of forests for timber and firewood, laying roads for vehicular traffic, mining and quarrying, fire (intentional!), collecting for botanical specimens, and critically low population with subsequent danger of breeding collapse.

It is desirable to keep an intensive watch for ascertaining their status, and, subsequently, to contribute to the Species Survival Commission Red Data Book of the International Union for Conservation of Nature and Natural Resources (IUCN).

Alysicarpus beddomei Schindler (Papilionaceae)

An erect, slender herb with orbicular leaves. Flowers pinkish; calyx 4 mm long. Pod reticulately veined.

Base of the Pavagadh Hill, in association with grasses.

Flowers—August.

Alysicarpus belgaumensis Wight (Papilionaceae)

Plants erect about 1 m tall. Leaves 1-and 3-foliolate; elliptic or oblong. Flowers red; clayx 10-12 mm long.

Pavagadh, among grasses.

Flowers and Fruits—September to October.

Amorphophallus commutatus (Schott) Engler (Araceae)

Monoecious plant.

Noted in rocky grounds; half way up the Pavagadh Hill, in the undergrowth of the forest.

Flowers—February.

Anotis foetida (Dalz.) Benth. & Hook. (Rubiaceae)

A slender herb. Leaves linear. Flowers pinkish.

On the Pavagadh Hill, rocky grounds.

Flowers and Fruits—Rainy season.

Blumea malcolmii (Clarke) Hook. f. (Compositae)

Plants clothed with white, soft hairs. Leaves thick, obovate. Flowers yellow. Achenes flattened, hairy.

On top of the Pavagadh Hill.

Flowers—January to February.

Capillipedium filicaulme (Hook. f.) Stapf (Gramineae)

A very slender, handsome grass; rooting at the nodes.

Pavagadh Hill at about 769 m.

Flowers and Fruits –November to December.

Carvia callosa (Nees) Brem. (Acanthaceae)

A shrub with bright purple flowers, bracts green with a pink tinge, stems 4-angled, with continuous furrows.

Flowers.—September to November (Rare; not each year).

Clitoria biflora Dalz. (Papilionaceae)

Erect annuals. Leaves imparipinnate; leaflets 5, membranous, elliptic-oblong, lanceolate. Flowers geminate; blue in colour. Pod 34-45 mm. long.

Pavagadh forest on hill proper.

Flowers and Fruits—August to October.

Cucumis setosus Cogn. (Cucurbitaceae)

A slender climber, monoecious. Stem furrowed, clothed with minute coarse hairs. Tendrils slender. Leaves 2-2·4 × 2·1—2·6 cm., membranous, deltoid; acute, minutely dentate, 3-lobed, 5-nerved, petiole 6-9 mm long. Flowers small, solitary, yellowish. Calyx tube campanulate, hairy. Corolla glabrous. Ovary globose, oblong; covered with short soft hairs. Fruit setose (covered with bristles).

Pavagadh Hill, in the forest at an altitude of 461 m. on 26th September 1959.

The plant seems to be endemic in S. India but so far only two specimens for India have been available to Chakravarty (1959) who monographed the Indian Cucurbitaceae; in Eastern India (*Ritchie* 321 Herb. Ddin.); and without precise locality, probably peninsular India (*Witt*, no 191 A. 5-D, 25/10/12 Herb. Cal). In view of its most uncertain recording of the geographical distribution, the rare occurrence of the species in the Western India has more significance and does need more observation in the field.

Curcuma inodora Blatter (Zingiberaceae)

A monsoon herb. The number of leaves per plant is three and in some cases four. Usually the leaves and spikes come out at the same time or leaves come out before the flowering. Corolla purplish with a yellow streak on the lip, bracts green with a purplish to rosy tinge.

Pavagadh, in rocky places.

Flowers and Fruits—July to August.

Curcuma pseudomontana Grah. (Zingiberaceae)

A stemless monsoon herb sprouting up after the first few rains. Leaves green, entire, oblong, lanceolate, acuminate, base acute.

Flowers—July to August.

Hemigraphis hirta (Vahl) T. Anders. (Acanthaceae)

Soft, pubescent herbs; villous with white hairs. Stems creeping, flexuose. Leaves small, ovate, crenate. Flowers in small, close terminal heads; pale blue; corolla long-cylindric below, bracts elliptic, bracteoles 0; calyx-lobes linear, obtuse, green. Capsule linear-obovoid, glabrous except at tip, about 12-seeded.

In the ravines of Por (District Baroda). Data on its further geographical range are not available. The species is confined to India.

Ischaenum diplopogon Hook. f. (Gramineae)

In patches, on old walls and rocks on top of the Pavagadh Hill.

Flowers and Fruits.—Almost throughout the rainy season.

Nepeta bombaiensis Dalz. (Labiatae)

Pavagadh.

Flowers.—July to August.

Neuracanthus sphaerostachyus (Nees) Dalz. (Acanthaceae)

Erect herbs, 30-60 cms high. Leaves sub-sessile, elliptic-bolong, obtuse, base rounded, subcordate. Inflorescence—usually a spherical ball, at times in elongated spikes, blue coloured. Fruit an ovoid capsule.

Abundant on the Pavagadh Hill. Apparently, plant produces large numbers of viable seeds.

Flowers—August to February. Fruits—January onwards, till the following season.

Senecio dalzellii Clarke (Compositae)

Erect herbs. Leaves white cottony beneath, linear-oblong, margins often recurved. Heads on slender peduncles; flowers yellow. Achenes scabrid with short hairs; pappus white, rigid, feathery.

On the higher parts of the Pavagadh Hill.

Flowers and Fruits—December to January.

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33

Observations on Identities of some Plants from Maharashtra

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For the last four years the author is engaged in taxonomic studies of Flora of Savantwadi, a taluka in former Ratnagiri District, now in Sindhudurg District, which is vegetationally an important region of Southern Konkan. Many important species have been collected from this region which were not collected earlier. Many of these species are not represented in any of our regional herbaria; their identities have remained confused, and are discussed in the following pages.

1. HERACLEUM EQUILEGIFOLIUM C. B. Clarke in Hook f. Fl. Brit. India 2: 715, 1879 : (APIACEAE alt. name UMBELLIFERAE).

During the course of search for some rare endemic plants from the Konkan region, the author found that the above mentioned taxon was not available in any of the regional herbaria of Western India. In the original description, Clarke (l.c.) gives "Concan; tropical region", as the type locality and mentions Law and Stocks as the collectors. Cooke, in Flora of Presidency of Bombay, cited Konkan and Ooran as the localities on the authority of Stocks and Law. The Konkan as we know today is a very vast area for the search of any particular species and therefore Ooran was selected for the search of this species, and on higher elevations of the hills, author succeeded in locating a fleshy umbellifer growing under *Euphorbia antiquorum* L. bushes. At first sight the plant looked like *Peucedanum grande* C. B. Clarke, but critical studies revealed that it was not *P. grande* but the actual plant which the author was in search of. In Blatter Herbarium, the author was able to locate 4 sheets of same taxon collected by P. Divakaran from the same locality, which was labelled as *P. grande* C. B. Clarke. Similarly in the herbarium of B.S.I., Western Circle, Poona two more sheets of this taxon collected by K.V. Billore from Hills near Mumbra in Thana District were seen. These specimens were also labelled as *P. grande* C. B. Clarke. Following distinguishing characters could be used for separation of these two confused taxa:

	H. equilegifolium		*P. grande*
1.	Inflorescence racemose umbels.	1.	Inflorescence simple or compound umbels.
2.	Ultimate umbels ebracteate	2.	Bracts prominent in ultimate umbels.
3.	Primary umbels 6-10 rayed	3.	Primary umbels 10-20 rayed
4.	Fruit ellipsoidal, narrowing at the base.	4.	Fruit obovate, grooved at base.

2.GARCINIA SPICATA (Wight & Arn.) Hook. f. in Journ. Linn. Soc. (London) 14: 486, 1875. *Xanthochymus spicatus* Wight & Arn. Prodr. 102, 1834.

There is certain confusion regarding this species in our floras. Type of this species No. 138 from Wight's herbarium is reported to have been collected from Peninsular India, without an exact locality. T. Cooke (1901) and J. K. Maheshwari (Bull. Bot. Surv. India 6: 112-3. 1964) have reported it from Western Ghats, from Konkan southwards. Cooke's report is apparently based on Talbot's report only and it appears that he had actually not seen the plant. Dr. J. K. Maheshwari's exsiccata for this species does not confirm his inclusion of Konkan for the distribution of this taxon.

The author has not been able to distinguish this species from *Garcinia talboti* Raizada ex Santapau, either in the field or in the herbarium materials. Dr. J. K. Maheshwari's Key for separation of these two taxa, which is given below is strange mixture of characters selected from literature and far from giving exact alternatives.

D. Leaves obtuse, often emarginate; flowers about 10 mm. in diam. ...*G. spicata*

D. Leaves obtuse; flowers larger, 18-27 mm in diam.; anthers 8-12 in a fascicle.....*G. talboti*

Only difference one can see here is in the size of flowers. We have examined number of herbarium specimens in Blatter Herbarium as well as in Herbarium of Western Circle of Botanical Survey of India and observed that all the herbarium material formerly identified as *G. spicata, G. malabarica* and *G. ovalifoila* is corrected as *G. talboti* Raiz.

Rev. Fr. H. Santapau in Flora of Khandala (Revised 3rd ed. 14, 1967) states that Blatter in his manuscript catalogue and in his revision mentions of having seen this species from Khandala. But he includes it only on authority of Blatter and also adds *G. talboti* Raizada.

Author's personal observations suggest that the plant under study is a very variable species and merely herbarium study of the types is not enough to decide the status of the confused related taxa.

Due to these reasons one comes to the conclusion that *Garcinia talboti* Raizada ex Santapau (*G. malabarica* Talbot) does not enjoy a separate specific identity and should be merged with *G. spicata* (Wt. & Arn.) Hook. f.

3. BUTEA SUPERBA Roxb. Cor. Pl. 1: 23, t. 22, 1975. (FABACEAE).

In spite of thorough search we have been unable to locate this species from Konkan areas. A number of areas recorded on herbarium sheets for occurrence of this species have been visited and every time the author has stumbled upon *Butea parviflora* Roxb. (—*Spatholobus roxburghii* Benth.) Floristic literature on this species has only added to the confusion rather than helping to arrive at any decision. Dalzell & Gibson (Bombay Flora, 71, 186) who have reported this species from Northern Concan, describe it as shrubby twiner. Talbot and

Cooke have reported this species apparently on Dalzell & Gibsons authority from N. Konkan and described it as scandent climber and gigantic climber respectively. It appears that all the latter workers relied on Dalzell & Gibsons report of this species from N. Konkan.

Rev. Fr. H. Santapau, in Flora of Khandala (3rd Ed. 66, 1967) while commenting on this species states, "I have seen nothing but leaves in nearly ten years of observation."

A number of herbarium specimens in Blatter Herbarium as well as in Herbarium of Western Circle (BSI) have been examined and it is found that none of the specimen from N. Konkan is satisfactory to decide the identity of this species. There is not even one single specimen which shows either flowers or fruits. Most of the specimens are either sterile branches with a single leaf or there are few loose flowers or few loose fruits. The sterile specimens are exactly similar to those of *Butea parviflora* Roxb. and loose flowers and fruits are undistinguishable from those of *Butea monosperma* (Lamk.) Taub.

The local name for *Butea parviflora* Roxb. as recorded in different area is "Pallas Vel." Dalzell & Gibson while giving the local name "Pullus wail" for *Butea superba* Roxb., state, "this takes the place of parviflora in the Northern Concan". If at all *B. superba* occurs in Konkan areas one good flowering or fruiting specimen is desirable.

4. SALACIA BRUNONIANA Wight & Arn. Prodr. 105, 1834. (CELASTRACEAE).

This species is reported from Ram Ghat by Dalzell and Gibson (Bombay Flora 33, 1861). Later authors like Woodrow, Talbot and Cooke have reported it on authority of Dalzell and Gibson only. Ramghat falls in the area presently under study of the author and search for this species has so far not met with success.

There is only one herbarium specimen from N. Kanara in Poona Herbarium (B.S.I.) from Talbot's collection, which was marked as *S. brunoniana* Wt. & Arn. It is now identified as *S. macrosperma* Wight. Latter species is quite common all over Ramghat area. The flowers arising from axillary or extra axillary tubercles vary from 1-10, sometimes on the same plant. In absence of type material it is difficult to decide if these two taxa are conspecific or not. But if they are conspecific then name *Salacia brunoniana* has priority over *S. macrosperma* Wt.

5. IMPATIENS RIVALIS Wight, in Madras Journ. 5: 13, t. 8, 1837. (BALSAMINACEAE).

This species has been reported from Ramghat by Dalzell (Dalzell & Gibson, Bombay Flora, 42, 1861). This species is differentiated from other acaulescent species of *Impatiens* by its spur which is longer than the flower and its lateral wings being 3-partite. In Blatter Herbarium there is no specimen of this species and in Poona Herbarium (B.S.I.) there is only one specimen collected by Talbot from North Kanara (No. 1923) collected on 10th August, 1889.

The author has collected this specimen from Amboli Ghat. It is very much allied to *I. acaulis* Arn. It has very thin pedicels compared to *I. acaulis* Arn., and this can serve for separating this species from its allies in herbarium materials.

Some authors have united this taxon with. *I. scapiflora* Heyne ex Roxb., But the author has failed to locate Hooker's reference (mentioned in Fl. Brit. Ind. 1: 1143, 1874) of *I. scapiflora*.

6. BLUMEA SESSILIFLORA Decaisne, Nouv. Ann. Mus. Paris. 3: 140, 1834. (ASTERACEAE).

During studies on Flora of Savantwadi the author has collected this species from Charatha and Amboli. It is quite common plant on embankments during December—January in partially shady places. This report constitutes a new record of this species for Maharashtra. Dr. A. J. Randeria, in monograph on this genus states that it is a more insular species than the *B. fistulosa* (Roxb.) Kurz growing in most localities at altitude of up to 700 m above sea level. It is very much allied to *B. fistulosa* and could be very easily confused with the latter. Some nomenclature confusion exists regarding these two taxa. Dr. A. J. Randeria quotes *B. fasciculata* DC. being synonymous with this species, while Dr. T. Cooke gives *B. fasciculata* DC. synonymous with *B. glomerata* DC. a synonym of *B. fistulosa* (Roxb.) Kurz. But Dr. T. Cooke has reported *B. glomerata* on the authority of Dalzell & Gibson and mentions of not having seen the actual plant. There is only one specimen of *B. fistulosa* in Blatter Herbarium, collected by T.R.D. Bell (no. 3774), from Maharashtra from Thana forests (N. Konkan). After careful studies of this specimen and specimen personally collected the author has found the following differences for distinguishing these two taxa.

B. fistulosa	*B. sessiliflora*
1. Lower leaves seldom lobed.	1. Lower leaves lyrate.
2. Phyllaries purple and acute.	2. Phyllaries herbaceous and acuminate.
3. Receptacle pubescent.	3. Receptacle glabrous.
4. Capitulum shortly stalked, spreading at maturity.	4. Capitulum sessile not spreading.

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The Dwindling Plant Species of Andaman and Nicobar Islands

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Insular biology has always been interesting, intriguing and innovating. It has contributed much to our knowledge on speciation, adaptability, invasion, colonisation and evolution. Nonetheless it has also opened our eyes on the processes towards extinction of various organisms, most of which are endemic to the islands. Bioconservationists all over the world are becoming aware of the dwindling populations and species owing to the impact of modernization and population pressure. A casual look through the list of endangered species in IUCN Red Data Book would show that a large number of species facing extinction are insular endemics. Islands tend to have higher percentage of endangered species than other areas because of the very small area of distribution for each species. In the words of Bramwell (1979): "The vast majority of island biota are, however, at the present time under serious pressure from the activities and influence of Man who is destroying their natural ecosystems at an alarming rate. It is extremely doubtful if we will ever arrive at an alpha-taxanomy state of knowledge of some insular floras before catastropic numbers of endemic island plants (and animals) become extinct". The situation is all more true as far as Andaman and Nicobar Islands are concerned, where nearly 10% of the flora are endemic (Balakrishnan, 1977) and most of the islands of this archipelago are subjected to serious deforestation in the past few decades. It is also important to note that endemism is so narrow and confined to small areas that several species occur only in small isolated localities in one or a few islands only.

The Andaman and Nicobar archipelago in Bay of Bengal form an arched string of about 300 islands and islets stretching from Burma in the north to Sumatra in the south between 6° and 14° N latitudes and 92° and 94° E longitudes. They are summits of a submarine range connecting Arrakkan Yoma of Burma in the North and Pegungan Barrisan of Sumatra in the South enclosing the deep Andaman sea between this archepelago and Malayan peninsula. Geographically these islands can be distinguished as two groups, i.e. the Andaman group and the Nicobar group, separated by the deep 10° N channel with a width of about 150 km. The Andaman group covers a gross length of about 464 km and the Nicobar group about 293 km. The maximum width of these islands is about 57 km. The northernmost island, the Landfall island is

situated at about 190 km south of Burma and the southernmost Great Nicobar island at about 150 km northwest of Sumatra. The total land area of all these islands put together amounts to only about 8300 sq km. Geologically the Andaman group is the southern continuation of the Arrakkan-Yoma tectonic unit and the Nicobar group the northern continuation of Sumatran range. This geological connection is also expressed in the floristic affinities and differences of these two groups between themselves and from continental land masses.

The flora of these islands is still insufficiently known. Earlier explorations were confined to only a few inhabited islands leaving many islands which were unapproachable untouched. Only recently with the intensive explorations of Botanical Survey of India these outlying islands and virgin forest areas are becoming increasingly known botanically. Except for scattered travelogues, vegetation accounts, enumeration lists, new species and records of earlier workers like Wallich (1850), Kurz (1870, 1875 & 1876), Prain (1890/a-b & 1893), King and Gamble (1889-1936), Sahni (1953), Bhargava (1958), Thothathri (1960, 1961, 1962 & 1973), Balakrishnan (1976), Balakrishnan and Chakraborty (1978), Balakrishnan and Nair (1976 & 1977) and Chakraborty (1978), the only comprehensive flora available is that of Parkinson (1923) who deals mainly with the woody species of Andaman islands only leaving Nicobar group without any flora of its own. There are many more scattered notes on plants of these islands published recently in various Indian and foreign journals.

The total land area of these islands is almost the size of some district on mainland, yet the flora is unique. Out of over 2000 angiospermous species so far known from these islands, about 210 are endemic. Among the rest about 50% do not occur on mainland, but extend to SE Asia, including Burma, Thailand, Malesia, etc. Recent explorations, particularly in Nicobar islands have added several new records as additions to Indian flora. It is evident that with more explorations these islands will add many more new species and records in future. Such a unique flora trapped and confined to these small islands is subjected to various biotic pressures like colonisation, deforestation and extension of agricultural plantations. The flora is becoming endangered, getting poorer in number of species and populations of rare species. We should note the conclusion of Mac Arther & Wilson (1967) that the smaller the land area, the higher the rate of natural extinction, leave alone those facing extinction by the activities of man. In all tropical evergreen rain forests there is stiff competition between species and most species remain confined to small areas unable to extend their range. This process has produced an ecological balance which, if disturbed, will lead many species to extinction.

Most of the species of these islands are poorly known not only taxanomically but also from economic point of view. The islands possess many potentially useful plants, awaiting screening for medicinal and other economic uses. In order to know the species at least by name, and to strengthen our knowledge on the origin, phytogeography and uses of the flora, it is necessary that as a first step towards a modern flora a thorough comprehensive list is prepared of

plants of these islands. Studies on endemic or endangered plants facing extinction cannot be taken up without knowing other plants.

According to Drury (1980), "an operational definition of a rare species might include the characteristics that it either occurs in widely separated small subpopulations so that interbreeding among the subpopulations is seriously reduced or eliminated or is restricted to a single population". As per this definition, a vast majority of species known only from type localities or from type collection are rare and endangered in these islands. Even if they occur in widely separated populations in separate islands their chances of interbreeding are greatly reduced or if they occur only in a single population in a particular island it is totally eliminated with no scope for improvement of the species. In order to focus attention on the matter a status report of rare species is presented here. List-A gives taxa endemic to these islands which are rare and endangered because they are either known from type collections only or from type localities only so far. List-B gives non-endemic taxa which are extra-Indian in the sense that they do not extend to Indian mainland but are distributed to SE Asia including Burma, Thailand, Malaysia, Indonesia, Philippines, etc., These lists are updated with reference to all recent collections and literature. Future explorations and taxonomic studies may add to these lists.

The flora of these islands is the only last bit of tropical evergreen Malesian flora available within our territory with great potential use for future generations. It is also clinging on a very delicate balance in the face of grave threat from encroaching civilized man. In order to protect it and preserve it for posterity the following urgent steps are strongly recommended for immediate implementation :

(1) Declare selected virgin forest areas at different places from north to south as Biosphere Reserves and provide foolproof laws and restrictions to prevent any sort of human interference. These reserves should represent different floristic and phytogeographic regions from North Andaman to Great Nicobar Island in the south.

(2) Establish immediately a tropical botanic garden near Port Blair where rare, endemic and endangered species of these islands can be cultivated and propagated. In this connection, it is worth quoting Synge (1979), "The high number of species known to be endangered and the scientific interest of most of island floras indicate that island botanic gardens are of crucial importance both in terms of undertaking rescue work and of giving technical advice and help to conservation bodies".

(3) The botanical survey of these islands should be intensified to know more about the flora, particularly in those islands which still remain largely unexplored. Special efforts should be made to locate and study the identity of rare and endemic species so that they could be protected *in situ* and/or rescued and propagated in botanic gardens as germplasm collections for future research.

(4) While nothing can be done about reversing history and those virgin forests already destroyed for ever, very severe restrictions on further utilisation of the remaining natural vegetation is an urgent necessity on the basis of a masterplan to be evolved by a conservation task force consisting of local administrators and knowledgeable scientists with sufficient experience in these islands. Consultation with such task force should be made mandatory for all future developmental activities involving forest land.

(5) As these small islands cannot sustain large populations, all further rehabilitation and settlement programmes, immigration and encroachment of forest lands should be strictly stopped forthwith. Tribal land should be clearly demarcated and all outside interference into those areas should be legally stopped and prevented.

No amount of sacrifice should be considered great for protecting and preserving our natural heritage, the result of millions of years of evolution by mother nature, which it is humanly impossible to recreate.

LIST—A

RARE AND ENDANGERED ENDEMIC TAXA OF ANDAMAN AND NICOBAR ISLANDS

Arranged family-wise in alphabetical order; type locality given for each taxa on never collected after type collections marked with TC and those collected so far only from the type localities or islands are marked TL.

Acanthaceae

1. *Hypoestis andamanica* Thoth. – M. Andaman Is. ..... TC
2. *Strobilanthes andamanensis* Bor– Andamans ..... TC

Amaryllidaceae

3. *Crinum pusillum* Herb.—Nicobar Is. ..... TC

Anacardiaceae

4. *Mangifera andamanica* King S. Andaman Is. ..... TL

Annonaceae

5. *Artabotrys nicobarianus* D. Das—Gt. Nicobar Is. ..... TC
6. *Miliusa tectona* Hutch. ex Parkinson—Andamans ..... TL
7. *Mitrephora andamanica* Thoth. & Das –Baratang Is. ..... TL
8. *Orophaea salicifolia* Hutch. —M. Andaman Is. ..... TC
9. *Orophaea torulosa* Hutch.—M. Andaman Is. ..... TC
10. *Popowia parvifolia* Kurz– Nicobar Is. ..... TC
11. *Sageraea listeri* King var. *andamanica* Chatterjee —Andaman Is. ..... TL

12. *Uvaria hamiltonii* Hook. f. & Th. var. *kurzii* King –Andaman Is. .....TC
13. *Uvaria nicobarica* Raiz. & Sahni –Gt. Nicobar Is.....TC

Araceae

14. *Aglaonema nicobaricum* Hook. f. –Nicobar Is. .....TC
15. *Amorphophalus carnosus* Engl. –Andamans .....TC
16. *Amorphophalus longistylus* Kurz ex Hook. f.—S. Andamans .....TC
17. *Amorphophalus oncophyllus* Prain ex Hook. f.—S. Andamans .....TC

Arecaceae

18. *Bentickia nicobarica* (Kurz) Becc.—Kamorta Is. .....TL
19. *Calamus dilaceratus* Becc.—Andaman Is. .....TC
20. *Calamus nicobaricus* Becc. –Nicobar Is. .....TC
21. *Corypha macropoda* Lindel ex Kurz—S. Andaman Is. .....TC
22. *Korthalsia rogersii* Becc.—Havelock Is. .....TL

Bombacaceae

23. *Bombax insigne* Wall. var. *polystemon* Prain—Narcondum Is. .....TC

Caesalpiniaceae

24. *Phanera nicobarica* Balakr. & Thoth.—Gt. Nicobar Is. .....TL

Celastraceae

25. *Hippocratea andamanica* King –S. Andaman Is. .....TC
26. *Hippocratea nicobarica* Kurz—Nicobar Is. .....TC

Clusiaceae

27. *Garcinia cadelliana* King –S. Andaman Is. .....TC
28. *Garcinia calycina* Kurz –Kamorta Is. .....TC
29. *Garcinia kingii* Pierre ex Vesque –Andamans.....TC
30. *Mesua manii* (King) Kosterm.—S. Andaman Is. .....TC

Connaraceae

31. *Connarus nicobaricus* King –Gt. Nicobar Is. .....TC
32. *Ellipanthus calophyllus* Kurz –S. Andaman Is. .....TL

Cyperaceae

33. *Cyperus kurzii* Clarke –Andamans .....TC
34. *Hypolytrum balakrishnanii* Nooteboom –M. Andaman Is. .....TC

Dichapetalaceae

35. *Dichapetalum gelonoides* (Roxb.) Engl. ssp. *andamanicum* (King) Leenh.—S. Andaman Is. .....TL

Dioscoreaceae

36. *Dioscorea rogersii* Prain & Burk.—Andamans .....TC
37. *Dioscorea vexans* Prain & Burk.—Andamans .....TC

Euphorbiaceae

38. *Antidesma andamanicum* Hook. f.—S. Andamans .....TC
39. *Cnesmone javanica* Bl. var.
glabriuscula Balakr. & N. G. Nair —S. Andamans. .....TL
40. *Drypetes andamanica* (Kurz) Pax & Hoffm.—S. Andamans. .....TL
41. *Drypetes leiocarpa* (Kurz) Pax & Hoffm.—S. Andaman.....TC
42. *Bridelia kurzii* Hook. f. —Kamorta Is. .....TC
43. *Excoecaria rectinervis* (Kurz) Kurz —Katchal Is. .....TC
44. *Glochidion andamanicum* Kurz —S. Andamans .....TL
45. *Sphyranthera lutescens* (Kurz) Pax & Hoffm.—M. Andaman Is. .....TC

Gesneriaceae

46. *Cyrtandra burttii* Balakr.—Gt. Nicobar Is. .....TL
47. *Cyrtandra occidentalis* Balakr. & Burtt —Gt. Nicobar Is. .....TL

Icacinaceae

48. *Gomphandra comosa* King - S. Andaman Is. .....TC

Lamiaceae

49. *Scutellaria andamanica* Prain—S. Andaman Is. .....TL

Lauraceae

50. *Cryptocarya ferrarsi* King—M. Andaman Is. .....TC
51. *Litsea leiantha* (Kurz) Hook. f. —S. Andamans .....TL
52. *Neolitsea andamanica* Kosterm.—Andamans .....TC
53. *Neolitsea nicobarica* Kosterm. —Nicobars .....TC

Loganiaceae

54. *Strychnos narcondamensis* A. W. Hill —Narcondam Is. .....TC

Loranthaceae

55. *Ginalloa andamanica* Kurz - S. Andaman Is. .....TC

Marantaceae

56. *Phrynium cadellianum* Baker— Andamans .....TC
57. *Phrynium paniculatum* Balakr. —Gt. Nicobar Is. .....TL

Meliaceae

58. *Aglaia fusca* King —Andamans .....TC
59. *Amoora manii* King ex Brandis—S. Andamans.....TL

Menispermaceae

60. *Stephania andamanica* Diels—S. Andaman Is. .....TC
61. *Tinospora andamanica* Diels—Andamans .....TC

Moraceae

62. *Ficus andamanica* Corner—S. Andaman Is. .....TC

Myristicaceae

63. *Horsfieldia macrocarpa* var. *canarioides* (King) Sinclair—Andamans .....TC

Myrsinaceae

64. *Ardisia andamanica* Kurz var. *effusa* Clarke—S. Andaman Is. .....TC
65. *Embelia microcalyx* Kurz—Katchal Is. .....TC

Myrtaceae

66. *Cleistocalyx nicobaricus* (King) Merr. & Perry—Katchal Is. .....TL
67. *Syzygium andamanicum* (King) Balakr.—Andamans .....TC
68. *Syzygium kurzii* (Duthie) Balakr. var. *andamanica* (King) Balakr.—S. Andaman Is. .....TL
69. *Syzygium manii* (King) Balakr.—M. Andaman Is. .....TL

Olacaceae

70. *Olax imbricata* Roxb. var. *membranifolia* Kurz—Katchal Is. .....TC

Oleaceae

71. *Jasminum andamanicum* Balakr. & N. G. Nair—S. & M. Andamans....TC
72. *Jasminum unifoliolatum* Balakr. & N. G. Nair—N. Andaman Is.....TC

Orchidaceae

73. *Anoectochilus nicobaricus* Balakr. & Chakra.—Gt. Nicobar Is. .....TL
74. *Dendrobium tenuicaule* Hk. f.—M. Andamans .....TL
75. *Eulophia nicobarica* Balakr. & N. G. Nair—Car Nicobar Is.....TL
76. *Habenaria andamanica* Hook. f.—S. Andaman Is. .....TL
77. *Malleola andamanica* Balakr. & Bhargava—S. & L. Andamans.....TC
78. *Phalaenopsis speciosa* Reichb. f.—Andamans .....TC
79. *Taeniophyllum andamanicum* Balakr. & Bhargava—Baratang Is.....TC
80. *Zeuxine andamanica* King & Pantl.—S. Andaman Is. .....TL
81. *Zeuxine rolfiana* King & Pantl.—S. Andaman Is. .....TC

Rubiaceae

82. *Diplospora andamanica* Balakr. & N. G. Nair—N. Andaman Is. .....TL
83. *Hedyotis andamanica* Kurz—S. Andaman & Nicobar Is. .....TC

84. *Hedyotis congesta* Wall. var. *nicobarica* King—Nicobars ..... TC
85. *Ixora andamanica* Bremek. –Andamans ..... TC
86. *Ixora cuneifolia* Roxb. var. *macrocarpa* Kurz—Pulu Milo Is. ..... TC
87. *Ixora capituliflora* Bremek.—Andamans ..... TC
88. *Ixora hymenophylla* Bremek.—Andamans ..... TC
89. *Ixora longibracteata* Bremek.—Nicobars ..... TC
90. *Ixora tenuifolia* Bremek. —Nicobars ..... TC
91. *Nauclea gageana* King—Andamans ..... TC
92. *Ophiorrhiza nicobarica* Balakr. —Gt. Nicobar Is. ..... TL
93. *Prismatomeris andamanica* Ridley—S. Andaman Is. ..... TC
94. *Psychotria andamanica* Kurz. Andaman Is. ..... TC
95. *Psychotria helferi* Kurz var. *angustifolia* King —S. Andaman Is. ..... TC
96. *Psychotria nicobarica* Kurz —Katchal Is. ..... TC
97. *Psychotria pendula* Hook. f. S. Andaman Is. ..... TC
98. *Psychotria polyneura* Kurz var. *longipetiolata* King —Andamans ..... TC
99. *Psychotria tylophora* Kurz —Katchal Is. ..... TC
100. *Pubistylis andamanensis* Thoth.—Andamans ..... TC
101. *Urophyllum andamanicum* King & Gamble—S. Andamans ..... TL
102. *Wendlandia andamanica* Cowan—N. Andaman Is. ..... TL

Santalaceae

103. *Henslowia erythrocarpa* Kurz —Kamorta Is. ..... TC

Sapotaceae

104. *Mimusops andamanensis* King & Gamble —Andamans ..... TC

Verbenaceae

105. *Clerodendrum lankaviense* King & Gamble var. *andamanense* Moldenke—S. Andamans Is. ..... TL
106. *Vitex wimberleyii* Kurz—S. Andaman Is. ..... TL

Vitaceae

107. *Tetrastigma andamanicum* (King) Susseng.—Andamans ..... TC

Zingiberaceae

108. *Bosenbergia alba-lutea* (Baker) Schecht. —Andamans ..... TC
109. *Globba pauciflora* Baker —S. Andaman Is. ..... TL
110. *Kaempferia siphonantha* Baker —Andamans ..... TC

Total TC : — 73
TL : — 37

LIST—B

RARE AND ENDANGERED EXTRA INDIAN TAXA OF ANDAMAN AND NICOBAR ISLANDS

Arranged family-wise in alphabetical order; known localities in Andaman and Nicobar Islands followed by world distribution given for each; most are endangered only as far as Indian territory is concerned.

Anacardiaceae

1. *Buchanania sessiliflora* Bl. --Katchal Is.--Burma, Loas, Vietnam, Thailand, Malaya and Borneo.

Annonaceae

2. *Cyathostemma viridiflorum* Griff.—N. Andaman Is.—Burma and Malaya.
3. *Polyalthia lateriflora* Kurz-- Car Nicobar Is.—Burma.
4. *Polyalthia macrophylla* (Bl.) Hk. f.--Andamans--Burma, Borneo, Sumatra and Java.
5. *Saccopetalum horsfieldii* Benn.--Katchal Is.—Java.
6. *Uvaria andamanica* King—S. Andaman Is.—Perak.
7. *Uvaria sumatrana* (Miq.) Hook. f.— Andamans-Sumatra.

Apocynaceae

8. *Micrechites polyantha* (Bl.) Miq.—Andamans--Malacca and Java.

Araceae

9. *Amorphophalus rex* Prain ex Hook. f.—Narcondum Is. (Type locality)—Java.
10. *Cryptocoryne ciliata* (Roxb.) Schott.—Gt. Nicobar Is.—Malaya and Java.
11. *Homalonema griffithii* (Schott) Hook. f. var. *ovata* (Schoott) Engl.--Gt. Nicobar Is.—Malaya.
12. *Homalonema nutans* Hook. f.--Gt. Nicobar Is. --Malaya.
13. *Scindapsus cuscuaria* (Aubl.) Presl.—Nicobars—Malaya, Java and Moluccas.

Asclepiadaceae

14. *Tylophora globifera* Hook. f. --S. Andaman Is.—Malacca.

Asteraceae

15. *Vernonia patula* (Dryand) Merr. -S. Andaman Is.--Burma, Malaya and Philippines.

Begoniaceae

16. *Begonia andamanica* Parish ex Hook. f. Andamans Burma.

Boraginaceae

17. *Tournefortia wallichii* DC.—Nicobars—Malaya.

Burmanniaceae

18. *Burmannia championii* Thw.—Gt. Nicobar Is.—Sri Lanka, China, Japan, Malaysia, Java, Borneo and New Guinea.

Celastraceae

19. *Cassine viburnifolia* (Juss.) Ding Hou—S. Andaman Is.—Thailand, Malaya, Borneo, Celebes and Sumatra.
20. *Lophopetalum wallichii* Kruz—Andamans—Burma, Indo-china and Thailand.

Clusiaceae

21. *Calophyllum kuntsleri* King—S. Andaman Is.—Malaya, Borneo and Philippines.
22. *Calophyllum wallichianum* Planch. & Triana—Nicobars—Malaya.
23. *Garcinia brevirostris* Scheff.—Andamans—Malaya, Sumatra, Java and Philippines.
24. *Garcinia hambroniana* Pierre—S. Andaman Is.—Indo-china and Malaya.

Connaraceae

25. *Connarus monocarpus* L. ssp. *malayensis* Leenh.—Nicobars—Malesia.
26. *Ellipanthus tomentosus* Kurz var. *gibbosus* (King) Leenh.—Andamans—Burma, Thiland and Malaya.

Cornaceae

27. *Mastixia tetrandra* (Thw.) Clarke—S. Andaman Is.—Sri Lanka.
28. *Mastixia trichotoma* Bl. var. *maingayii* (Clarke) Danser—Gt. Nicobar Is.—Malaya, Borneo and Sumatra.

Cyperaceae

29. *Carex cryptostachys* Brongn.—Gt. Nicobar Is.—S. China, Formosa, Thiland, and throughout Malesia.
30. *Carex rafflesiana* Boott.—Gt. Nicobar Is.—throughout Malesia and Australia.
31. *Cyperus sanguinolentus* Vahl ssp. *cyrtostachys* (Mig.) Kern—Andamans—throughout Malesia.
32. *Hypolytrum conspectum* Kunth—Andamans—Indo-china, Malaya, Borneo, Philippines to New Guinea and Australia.
33. *Scirpodendron ghaeri* (Gaertn.) Merr.—Gt. Nicobar Is.—Sri Lanka, Thailand, Malesia to Australia and Polynesia.
34. *Scleria neesii* Kunth—Car Nicobar Is.—Sri Lanka, Thailand, Indo-china and Malaya.

Dipterocarpaceae

35. *Dipterocarpus kerrii* King—S. Andaman Is.—Thailand and Malaya.
36. *Hopea helferi* (Dyer) Brandis—N. Andaman Is.—Burma, Cambodia, Thailand and Malaya.

Ebenaceae

37. *Diospyros multibracteata* (Merr.) Bakh.—Car Nicobar Is. —Philippines.

Elaeocarpaceae

38. *Elaeocarpus macrocerus* (Turcz.) Merr.—Gt. Nicobar Is.—Java.

Euphorbiaceae

39. *Antidesma coriaceum* Tul.—Kamorta Is.—Malaya, Sumatra and Borneo.
40. *Antidesma tomentosum* Bl.—Kamorta Is.—Malaya, Sumatra, Java and Celebes.
41. *Blumeodendron kurzii* (Hook. f.) J. J. Sm.—Andaman & Nicobar—Burma, Thailand, Malaya, Sumatra and Java.
42. *Breynia racemosa* (Bl.) Muell.—Arg.—Nicobars—Malaya, Sumatra and Java.
43. *Claoxylon longipetiolatum* Kurz—Andamans—Burma.
44. *Endospermum peltatum* Merr.—S. Andaman Is. —Philippines.
45. *Neoscrotechinia nicobarica* (Hook. f.) Pax & Hoffm.—Nicobars—Malaya.
46. *Phyllanthus gomphocarpus* Hook. f.—Car Nicobar & Gt. Nicobar Is.—Malaya.
47. *Spathistemon javense* Bl.—Gt. Nicobar Is.—Malaya, Sumatra and Java.
48. *Trigonostemon aurantiacus* (Teijsm & Binn.) Boerl.—S. Andaman Is.—Thailand, Malaya and Java.
49. *Trigonostemon laevigatus* Muell.-Arg.—Andamans—Indo-china, Thailand, Malaya, Borneo and Philippines.

Fabaceae

50. *Derris elliptica* (Wall.) Benth.—Gt. Nicobar Is.—Burma, Bangladesh, Thailand, Cambodia, Malaya and Sumatra.
51. *Strongylodon ruber* Vogel—S. Andaman Is.—Sri Lanka and Polynesia.
52. *Tadehagi triquetrum* (L.) Ohashi. ssp. *auriculatum* (DC.) Ohashi—S. Andamans—Burma and Malaya.

Flacourtiaceae

53. *Casearia grewiaefolia* Vent. var. *deglabrata* Koord. & Val.—Nicobars Malaya to Solomon Islands.
54. *Scolopia kermodii* C. E. C. Fischer—Andamans—Burma.

Gesneriaceae

55. *Aeschynanthes griffithii* R. Br.—S. Andamans Is.—Burma.

Gonostylaceae

56. *Gonostylus macrophyllus* (Miq.) Airy-Shaw --Gt. Nicobar Is. ---Malaya.

Hypoxidaceae

57. *Molineria latifolia* (Dryand) Kurz—M. Andaman Is. - -Malaya and Sumatra.

Lauraceae

58. *Actinodaphne macroptera* Miq.--S. Andaman Is.—Malaya and Sumatra.
59. *Cryptocarya ferrea* Bl.—Kamorta Is.--Malaya and Java.

Malpighiaceae

60. *Aspidopterys elliptica* (Bl.) Juss.— Andamans—Malaysia, Sumatra, Java, Borneo and Phillippines.
61. *Aspidopterys tomentosa* (Bl.) Juss. - -Andamans—Burma, Malaya, Borneo, Philippines and Java.

Meliaceae

62. *Sandoricum indicum* Cav. --Andamans - -Burma and Malaya.

Melastomaceae

63. *Memecylon excelsum* Bl.—Nicobars—Malaya.
64. *Memecylon coeruleum* Jack -Andamans—Burma, Malaya and Philippines.

Menispermaceae

65. *Tinomiscium petiolare* Miers. --Nicobars—Malaya, Sumatra nad Java.

Mimosaceae

66. *Archidendron ellipticum* (Bl.) Niels—Kamorta Is. -Malaysia, Sumatra and Java.
67. *Pithecellobium monadelphum* Kosterm. - Nicobars—Malaysia.

Monimiaceae

68. *Kibara coriacea* Endl.—Nicobars.- Malaysia, Sumatra, Java and Celebes.

Moraceae

69. *Artocarpus peduncularis* Kurz- -Nicobars --Malaya.
70. *Ficus capillipes* Gagnep. -Andamans - -Indo-china, Burma, and Thailand.
71. *Ficus chrysocarpa* Reinw.- -Kamorta Is. - -Burma and Malaya.
72. *Ficus costata* Ait.—Nicobars --Sri Lanka.
73. *Ficus fulva* Reinw. --Andamans --Burma and Malaya.
74. *Plecospermum andamanicum* King ex Hook. f. --Andamans- -Burma.

Myrsinaceae

75. *Ardisia andamanica* Kurz—Andamans --Burma and Malaya.

Nymphaeaceae

76. *Barclaya longifolia* Wall.—S. Andaman Is. -Burma and Malaya-Probably already disappeared from these islands.

Ochnaceae

77. *Brackenridgea hookeri* (Planch.) A. Gray—M. Andaman Is.—Thailand, Malaya and Borneo.

Orchidaceae

78. *Appendicula reflexa* Bl.- -Gt. Nicobar Is.- Malaya, Sumatra and Java.
79. *Bulbophyllum crassipes* Hook. f.—Andamans—Burma.
80. *Bulbophyllum rufinum* Reichb. f.—Andamans -Burma, Cambodia, Vietnam and Thailand.
81. *Ceratostylis subulata* Bl.—Gt. Nicobar Is.—Thailand, Malaya, Sumatra and Java.
82. *Cleisostoma elegans* Seidenf.- -Andaman & Nicobars- -Burma and Thailand.
83. *Coelogyne thailandica* Seidenf. -Saddle Peak, N. Andamans—Thailand.
84. *Coelogyne trinervis* Lindl.—S. Andaman Is.- Burma, Indo-China, Thailand, Malaya and Java.
85. *Cymbidium pubescens* Lindl. -Gt. Nicobar Is.—Thailand, Malaya, Sumatra, Java and Borneo.
86. *Dendrobium pensile* Ridl.—Gt. Nicobar Is. —Malaya.
87. *Grossourdya muscosa* (Rolfe) Garay—M. Andamans—Burma and Malaya.
88. *Nervilia punctata* (Bl.) Makino—Nicobars -Thailand, Malaya, Borneo, Sumatra and Java.
89. *Phalaenopsis tetraspis* Reichb. f. -Andaman & Gt. Nicobar Is.- -Java.
90. *Phractia secunda* (Bl.) Lindl. -Saddle Peak, N. Andamans—Thailand, Malaya, Sumatra, Java and Philippines.
91. *Plocoglottis javanica* Bl.—Gt. Nicobar Is.—Thailand, Malaya, Sumatra and Java.
92. *Podochilus microphyllus* Lindl.—Gt. Nicobar Is. Burma, Thailand, Malaya, Borneo and Sumatra.
93. *Pteroceras alatum* (Holtt.) Holtt.—Nicobars Thailand and Malaya.
94. *Schoenorchis minutiflora* (Ridl.) J. J. Sm.- Saddle Peak—Malaya.

Passifloraceae

95. *Adenia penangiana* (G. Don) de Wilde -Nicobars —Thailand, Malaya, Sumatra and Borneo.

Philydraceae

96. *Philydrum lenuginosum* Banks—Andamans—Burma, China, Malasia to Australia.

Piperaceae

97. *Piper clypeatum* Wall.—Gt. Nicobar Is. –Malaya.
98. *Piper miniatum* Bl. –Katchal Is. –Malaya, Java and Philippines.

Pittosporaceae

99. *Pittosporum ferrugineum* Ait.—Nicobars throughout Malesia to Australia.

Rhamnaceae

100. *Smythea calpicarpa* Kurz –Andamans –Burma.

Rosaceae

101. *Parastemon urophyllus* A. DC. Nicobars –Burma and Malaya.
102. *Prunus javanica* (T. & B.) Miq. –Andamans –Burma, Malaya and Java.

Rhizophoraceae

103. *Gynotroches axillaries* Bl. –Gt. Nicobar Is, –Burma, Thailand, throughout Malesia to Australia and Micronesia.

Rubiaceae

104. *Aulacodiscus premnoides* Hook. f.—Andamans –Burma and Malaya.
105. *Coelospermum truncatum* (Hook. f.) King & Gamble –M. Andamans-Malaya.
106. *Diplospora abnormis* (Korth.) Val.—Katchal Is.—Sumatra and Java.
107. *Greenia jackii* W. & A. –Gt. Nicobar Is, –Burma, Thailand, Malaya and Sumatra.
108. *Hedyotis macrophylla* Wall.—Nicobars –Burma and Malaya.
109. *Hedyotis nicobariensis* W. H. Lewis—Nicobars –Burma, Indo-China, Thailand and Malaya.
110. *Ixora cuneifolia* Roxb. –Barren Is.—Bangladesh and Burma.
111. *Ixora fluminalis* Ridley S. Andaman Is. Malaya.
112. *Lasianthus andamanicus* Hook. f. Andamans –Burma.
113. *Lasianthus constrictus* Wt. –Andamans Burma.
114. *Lasianthus kurzii* Hook. f. –Andamans –Burma and Malaya.
115. *Lasianthus obscurus* Bl. Andamans Burma, Sumatra and Java.
116. *Musaaenda wallichii* G. Don—Gt. Nicobar Is. Burma.
117. *Psychotria helferiana* Kurz –Andamans Burma and Malaya.

Sapindaceae

118. *Cupania adenophylla* Planch. ex Hiern. –Nancoury Is. –Burma and Malaya.
119. *Cupania lessertiana* Camb. –Andamans Burma and Malaya.

Sapotaceae

120. *Payena lucida* (G. Don) DC.—Andamans Malaya.

Smilacaceae

121. *Smilax polyacantha* Wall. ex Kunth--Kamorta Is.—Malaya.

Sterculiaceae

122. *Helicteres angustifolia* L.—Kamorta Is.—Burma, China, Thailand, Malaya and Java.
123. *Sterculia macrophylla* Vent.—Gt. Nicobar Is.—Malaya and Java.

Symplocaceae

124. *Symplocos fasciculata* Zoll.—Gt. Nicobar Is.—Malaya, Sumatra and Java.

Thymelaceae

125. *Enkleia malaccensis* Griff.—Andamans—Burma, Indo-China, Malaya, Borneo and Sumatra.
126. *Phaleria macrocarpa* (Scheff.) Boerl.—Gt. Nicobar Is.—Malaya.

Tiliaceae

127. *Colona javanica* (Bl.,) Burr.--Kamorta Is.—Java.
128. *Grewia acuminata* Juss.--Gt. Nicobar Is.—Burma and Malaya.

Urticaceae

129. *Cyphophus moluccanus* (Bl.) Miq.—Gt. Nicobar Is.—Malaya and and Sumatra.
130. *Procris frutescens* Bl.—Nicobars—Burma, Malaya and Java.

Verbenaceae

131. *Clerodendrum penduliferum* Wall.—Nicobars—Burma and Malaya.
132. *Premna pyramidata* Wall. ex Schauer—Gt. Nicobar Is.—Burma, Thailand and Malaya.
133. *Teijsmanniodendron pteropodum* (Miq.) Bakh. f.—Gt. Nicobar Is. Malaya, Sumatra and Java.

Violaceae

134. *Rinorea longiracemosa* (Kurz) Craib—Nicobars—Burma, Indo-china, Thailand, Malaya, Borneo, Sumatra and Java.

Zingiberaceae

135. *Amomum aculeatum* Roxb.—S. Andaman Is.—Malaya and Java.
136. *Amomum maximum* Roxb.—S. Andaman Is.—Java.

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35

Distribution and Collections of Rare Umbellifers in India

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An attempt at the taxonomic studies of the Indian Umbellifers presents several interesting facts about the distribution and collection of Umbellifers. The two generalisations that are necessary in the context of the present topic, are, (a) most of the members of the Umbellifers are temperate or alpine plants, except a few weedy and cultivated species; and (b) the fruits provide most of the characters for identification of genera and even species.

Umbellifers are represented in our herbaria in good numbers. A significant amount of these representative collections are, unfortunately without fruits. This creates problems in proper identification and even mis-identifications are not rare. Examples of such affairs are the cases of mis-identification of *Cortia depressa* Norman vs. *Trachydium roylei* Lindl.; *Chaerophyllum villosum* DC. vs. *C. reflexum* Lindl.; *Eriocycla thomsonii* (Clarke) Wolff vs. *Heracleum thomsonii* Clarke vs. *Seseli trilobum* (Edgw.) Clarke; species of *Bupleurum, Selinum; Heracleum nepalense* Don vs. *H. obtusifolium* DC. vs. *H. candicans* DC. and many others.

The apparent reason for a large number of specimens without fruits is that collections are made in wrong seasons. Explorations in mountainous regions in the north during the months of September to November and in the south during the months of November to January yield good fruiting specimens; the time of fruiting varies with latitude and altitude. Of course, flowers are important, so also are the roots and basal leaves, bracts and bracteoles, which provide important characters, and care must be taken to preserve a specimen with all these features.

Of the 55 genera and 186 species of Umbellifers in India (Mukherjee, 1978), 150 species under 45 genera are Himalayan and 70 species under 23 genera are recorded for Eastern Himalaya. To be precise, Sikkim has 56 species under all these 23 genera. Of the other Umbellifer rich regions, Western Himalaya has got 95 species under 47 genera, Peninsular India has got 42 species under 23 genera and the general area of Assam represents 28 species belonging to 19 genera.

The taxonomic study of these plants presents many problems. The incomplete materials, very few collections and often the existence of only the 'type' materials, result in mis-identification, difficulties in ascertaining the range of distribution and probably also description of two extremities of a large variational range as novelties and thus creating taxonomic increments.

To the knowledge of the author, the following taxa are represented in our herbaria only by the 'Type' or a few materials.

1. *Acronema nervosa* Wolff —Only type, collected in 1911 from Sikkim.
2. *A. pseudotenera* Mukh. —Only from the type, collected in 1892 from Sikkim.
3. *A. johrianum* Babu —Only type, in flowers, collected from Nepal in 1965.
4. *A. hookeri* (Clarke) Wolff var. *graminifolia* (W.W.Sm.) Wolff —Only from the types, collected in 1844 to 1909 from Sikkim.
5. *A. wolffiana* Wolff —Only from types, collected from Sikkim between 1870 and 1888.
6. *Angelica nubigena* (Clarke) Mukh. (*Heracleum nubigenum* Clarke) —from types and one last collection by Cave in 1909.
7. *Trachydium affine* W. W. Sm.—Only from types, collected in 1911 from Sikkim.
8. *Pimpinella wallichii* Clarke —Only from types collected in 1870 from Sikkim.
9. *Peucedanum sikkimensis* Clarke—Only from types collected between 1870 and 1875 and the other collected probably before 1900.
10. *Pternopetalum radiatum* (W. W. Sm.) Mukh. —Only types, last collected in 1892 from Sikkim.
11. *Chaerophyllum cachemiricum* Clarke —from type, collected in 1874 from Dalhousie,
12. *Heracleum jacquemontii* Clarke—Only type in Paris, no specimen in India.
13. *Meeboldia selinoides* Wolff —Type collected in Nainital in 1905, no specimen in India.
14. *Pycnocycla glauca* Lindl. —last collected from Ranchi in 1918.
15. *Carum villosum Haines* —Only type, no specimen in India, last and only collection in 1918.
16. *Ligusticum albo-alatum* Haines—Type and the other collection in 1940 from Sarguja, M.P.
17. *Bunium nothum* (Clarke) Mukh. (*Carum nothum* Clarke) —Only type (not in India) and the other collected in 1883 from Nilgiri.
18. *Schulzia benthamii* Clarke —Probably collected before 1849 from Canara, no specimen in India.
19. *Zosimia absinthifolia* (Pers.) Link —only collection from Bombay Presidency in 1845?
20. *Heracleum pinda* Dalz. —probably only the type (?)

21. *Polyzygous tuberosus* Dalz. —Only two specimens, one of Dalzell and the other by Stocks in flowers, immature fruits.
22. *Chaerophyllum reflexum* var *orientalis* Clarke —Only type collected in 1885 from Naga hills.
23. *Pimpinella flaccida* Clarke —Only type, not in India, last collected from Kohima in 1895.
24. *Pimpinella evoluta* Clarke —Same situation.
25. *Heracleum burmanicum* Kurz —Last collection 1895 by Clarke.

It is believed that the rarity of specimens in herbaria may be due to under exploration rather than extinction or otherwise. The exploration of Sikkim at places like Lhonak, Zemu and Sebu are extremely necessary not only for Umbellifers but also for other families. As for the general area of Assam including Arunachal Pradesh and Nagaland, the recent explorations by the BSI are very encouraging. When the temperate and alpine flora of Arunachal Pradesh become known to us the affinity of Sino-Himalayan plants will be most investigative. At our present state of exploration, Nagaland needs more attention. It appears curious that recent and repeated explorations from Bihar, Orissa and Madhya Pradesh have failed to locate and collect the specimens of *Carum villosum* or *Ligusticum alho-alatum*. There is a glut of recent collection of of Umbellifers from remote and previously underexplored regions of Western Himalaya by the BSI and this undoubtedly will help in future for a better taxonomic work. The effort of RRL, (Jammu-Tawi) is also commendable in this respect. It is felt however that efforts must be made to locate and collect such plants as *Polygygus tuberosus, Heracleum pinda, Schulzia benthamii* etc from Western ghats. It remains a puzzle why *Bunium nothum* could not be collected from Nilgiri since 1883. British Museum is contributing a lot by intensive explorations in Nepal as well as Bhutan.

Our estimate of the endemic species of Umbellifers remains tentative. The publication of accounts of Umbellifers from China by Hwa & Sheh (1979) and associates and of USSR by Chichkine (1950), Pimenov (1978) and others as well as of Iran by Leute & Speta (1972), Turkey by Hedge et al. (1972) Afghanistan by Kitamura (1960, '64), Japan by Hiroe and Constance (1958), Pakistan by Nasir (1972) etc. help in the understanding of the taxonomy of this family in this continent. *Physospermopsis* Wolff, *Vicatia* DC., *Cortiella* Norman, *Cortia* DC., *Trachydium* Lindl. once held as endemic in India is not tenable now. It can be said with certain amount of conjecture that our estimate of the number of endemic species has also to be changed when we have the chance of comparing our species against those from the adjoining countries. To list a few, mention may be made of *Hydrocotyle hookeri* (Clarke) Craib, *H. himalaica* Mukh,. *Chaerophyllum villosum* DC., *Physospermopsis obtusiuscula* (DC.) Norman, *Pleurospermum pilosum* Clarke, *P. amabile* Craib ex W. W. Sm. *P. angelicoides* (DC.) Clarke, *Vicatia coniifolia* DC, *Trachydium roylei* Lindl., *Bupleurum dalhousieanum* (Clarke) K.-Pol, *B. longicaule* DC., *B. hamiltonii* Balak.,

B. candolii DC. etc., which have also been reported from China. The difficulty that is faced is the general lack of more recent and exhaustive representative collections in our herbaria from China, Japan, Pakistan, Afghanistan, USSR etc. for comparison. The cooperation between the herbaria of these countries need to be exploited more. There is another class of plants, reported previously from other countries, but now have their extended distribution chiefly in the Himalaya. *Acronema handelii* Wolff, *A. paniculatum* (Franch.) Wolff, *Angelica cyclocarpa* (Norman) Cannon, *Tongoloa elata* Wolff, *Pimpinella tibetica* Wolff, *Pternopetalum tanakae* (Franch. & Sav.) Hand.-Mazz. are recent additions to our flora. *Apium leptophyllum* (Pers.) Muell. has already established well around Mussoric.

Disjunct distribution of species of Umbellifers between the Himalaya and Peninsular hills are very few. *Peucedanum dhana* Buch.-Ham. ex D. Don reported from Himalaya, Goruckpur (?) and Dinajpur (?) has been collected from Araku valley in the Andhra Pradesh. *Pycnocycla glauca* Lindl. originally reported from northwestern India, have its distribution on the Satpura hills as well as from Ranchi. This has its extended distribution in Abyssinia and Yemen. *Peucedanum nagpurense* (Clarke) Prain, otherwise known from Chotanagpur has recently been reported by Cannon (1979) from Nepal. The hills of Bihar, Madhya Pradesh and Andhra Pradesh needs immediate intensive exploration before much of their flora is lost by mining and other activities for much of the hypotheses relating to the affinity of Himalayan and Peninsular hill flora are yet to be fully assessed. Inspite of the author's efforts for the last three years, *Ligusticum albo-alatum* could not be collected from Bihar.

It is a well known fact that wide collections in herbaria enables one to study the range of variations and finally unearthing of synonymous plants. The synonymy of *Hydrocotyle javanica* are too many. *Pimpinella monoica* Dalz. having a very wide distribution throughout the hills of Peninsula have atleast two recent names viz. *P. duthei* Wolff and *P. katrajensis* Rao & Hemadri.

The only endemic genus *Vanasushava* Mukh. & Const. is monotypic represented by *V. pedata* (Wight) Mukh. & Const. The plant has been collected since 1836 and the author located atleast 20 collections of this plant collected upto 1968 but all without fruit in different herbaria in India. The species was described properly under the present genus after the author succeeded in collecting mature fruits in 1972. All the places of its occurance, previously reported, were searched but the successful collection was made only from a small patch at Kodaikanal. A repeat visit in 1975 yielded not a single plant. The rarity of this plant is probably due to its non availability in recent years and it is apprehended that the species is truly endangered. The non availability may be due to its failure in competetion and rapid multiplication and some flaw in its breeding behaviour as indicated by the formation of a number of aberrant fruits; however this aspect has not been fully investigated.

The author has been successfull in collecting *Acronema wolffiana*, *Bupleurum longicaule* var. *stricta*, *Pleurospermum pilosum* etc. from Sikkim in perfect conditions

and also *Selinum candollii, Acronema johnianum, A. hookeri, Vicatia achilleifolia* from Nepal. These taxa were known from 'types' or imperfect specimens only. *Acronema bella* (Clarke) Mukh. growing in the Singalelah range in the Darjeeling Dist. has been found in the field to vary in leaf form and root nature with change of altitude and suspect holds it to be same to *A. nervosa* Wolff. This observation also indicates the need of examining the boundaries between the genera *Pimpinella* and *Acronema*.

Finally, it can be said that much exploration and revisionary studies are needed before we can embark on the study of floristic affinities, endemism or forecast about endangered plants.

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36

New Observations on Distribution of Plants Endemic to India

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Critical analysis on the occurrence and distribution of endemic taxa of the families, Urticaceae, Moraceae, and Ulmaceae, in India have shown the following 17 taxa as restricted to different sectors of India. It is noticed that (i) 3 species of the genus—*Elatostema* Gaud. and 2 species of *Pilea* Lindl. are restricted in distribution to the Eastern Himalayas: from Darjeeling to Arunachal Pradesh (ii) 5 taxa of the genus *Pouzolzia* Gaud. are restricted to Kerala (2 spp.), Tamilnadu, Karnataka and Maharashtra (Western Ghats) (3 spp.); (iii) two species of *Pouzolzia* considered endemic to the South India extend their range to Orissa and Mikir hills respectively; (iv) *Artocarpus hirsutus* Lamarck and *Ficus laevis* Blume var. *macrocarpa* (Miq.) Corner are restricted to Kerala-Tamilnadu-Maharashtra sector; (v) *Morus serrata* Roxb. is restricted to the northern India, Uttar Pradesh (Garhwal) to Himachal Pradesh; and finally, (vi) *Gironniera lucida* Kurz originally recorded from Andamans has been collected from Tripura and Meghalaya whereas *G. thomsoni* King ex Cowan et Cowan known to be endemic to Sikkim only, has now been collected from the Assam region.

Notes on the habit and diagnostic features of the species, type localities and the extension of its range of distribution in India are presented below. The number cited within bracket refers to the field number of the collectors and the specimens are preserved in CAL.

URTICACEAE

(1) ELATOSTEMA DECIPIENS Wedd.

Undershrub; stem fleshy, 60-90 cm, stout, erect from a long creeping base; leaves 9-20 cm long, caudate acuminate, coarsely serrate from above the subauricled base; outer involucre bracts 2.

After *Griffith's* collection from the Mishmi hills (Arunachal Pradesh), it has since been collected from Nunklow (Meghalaya) by *J. D. Hooker* in 1848-1851, from Kohima (Nagaland) by *Clarke* and from Assam by *Burkill* (37527) in 1911.

The taxon is endemic to the Assam region.

(2) ELATOSTEMA NASUTUM Hook. f.

Herb or undershrub; stem 60-100 cms; leaves 4-7 cm., sessile, ovate

acuminate, coarsely sharply serrate from auricled base to the tip; male receptacle peduncled; female receptacle sessile; bracts with spur.

After its collection from Rungbee and Tonglu (Darjeeling) by *Clarke* and from Sikkim by *J. D. Hooker*, *Kurz* and *King* between 1850-1878, the species was again spotted by Hara at Darjeeling only in 1972 (Hara in Ohashi, 1975).

Therefore, this species endemic to Darjeeling-Sikkim Himalayas may be considered as extremely rare.

(3) Elatostema sikkimense Clarke

Herb or undershrub; stem 30-90 cm, erect; leaves 9-20 cm, sessile, cuneate, coarsely serrate above the middle, acute; receptacle long-peduncled; bracts produce long spreading spur.

After *Clarke's* collection (s.n.) from Tonglu, Darjeeling the species was collected from Sikkim by King in 1875, by Smith *et al* in 1909 and by *Hara* in 1966. However, a collection from the Jaintia Hills by *G. Mann* (912) in 1898, shows the extension of the range from the Sikkim-Himalayas to Meghalaya.

(4) Pilea insolens Wedd.

Small herb, 15-30 cm high; leaves remotely serrate, 5-7 cm, triveined, broadly ovate, caudate acuminate; stipules oblong ovate; achenes very minute, obliquely ovoid.

Subsequent to *Griffith's* s. n. collection from Mishmi Hills, it has since been collected from the Upper Rotung in Upper Assam by *Burkill* (36094) in 1912, from Sonegodam, Lohit distr. by *R. S. Rao* (10354) in 1957 and from Geling, Siang distr. by *R. S. Rao* (17490) in 1958. Although Das (1940) recorded its distribution within the range of the Flora of Assam, it may be presumed to be endemic only to the north eastern mid-sector of Arunachal Pradesh.

(5) Pilea ternifolia Wedd.

Small herb; stem 25-45 cm from a thickened base; leaves 6-9 × 0·7-1·5 cm, flaccid, subsessile, base obliquely cordate, opposite, ternately-whorled, coarsely serrate; peduncles longer than the petioles; stipules obscure; flowers very minute.

Typified by *J. D. Hooker* s.n. from Sikkim, it has also been collected from the area by *Kurz* and *R. S. Rao* (1080) and from Darjeeling by *D. Chatterjee* in 1956, by *Das et al* (125) in 1966 and by *Hara* in 1972 (Hara in Ohashi 1975).

This is an endemic in the Sikkim Darjeeling sector and may be considered a conspicuous element to draw attention of plant collectors.

(6) Pouzolzia integrifolia Dalz.

Small herb, 90-120 cm; leaves 5-13 cms, sessile, opposite, ternately-whorled, sparsely hairy above, triangular-lanceolate from sub-amplexicaul base; stamens 3-4; stipules short, broad.

After *Dalzell's* s.n. collection from Syhadree hills, it has been also collected from Bombay by *Gibson*, from Belgaum by *Ritchie* and from Bababoodan Hills (Karnataka) by *Law*.

The taxon endemic to Maharastra-Karnataka sector, may be treated as threatened.

(7) POUZOLZIA MEEBOLDII W. W. Smith et Ramas.

Plants erect, 60 cm; stem 3-angled; leaves 3-verticillate. 10-16 × 2-3 cm, sessile, lanceolate acuminate, base rounded or cordate, margin subentire, upper side minutely scabrid, glabrous beneath; stipules 3-fid, interfoliar, membranous, 1 cm long, deciduous; inflorescence axillary, male perianth 4-fid, female perianth cupuliform; fruits 3 × 4 mm.

Although based on *Meebold* (12137) from Kavalay in Kerala, Fischer recorded it from the Anamalais and Travancore in 1928.

Endemic to a restricted area in Kerala only, it is a rare element in the flora of South India.

(8) POUZOLZIA PENTANDRA Benn. et Br. var. RAMOSISSIMA (Wight) Hook. f.

Annual herb or undershrub; stem 60-90 cm, erect or decumbent; leaves ovate lanceolate; floral leaves small ovate-cordate-acuminate; perigone often trialato.

Although *P. ramosissima* Wight was originally collected from the Nilgiri Hills (Tamil Nadu) and was subsequently recorded from Konkan (Karnataka-Maharashtra sector) by *J. D. Hooker* (1888) and by *T Cooke* (1907), Deb (35379) collected it in 1963 from Phulani in the Mikir Hills distr. Assam.

This taxon so long considered as endemic to Deccan, extends its range of distribution to the eastern India.

(9) P. PENTANDRA Benn. et R. Br. var. STOCKSII (Wight) Hook. f.

P. stocksii Wight

Herb or slender undershrub, often branched and prostrate, flaccid, glabrous; lower leaves oblong lanceolate, nearly glabrous, lower floral leaves larger.

After *Dalzell's* s.n. collection from the Anamally forest and Belgaum, this has been collected by *Stocks* from Deccan and by *Wight* from Peninsular India and it was recorded also from Konkan, Kanara and Supa, all in Karnataka by *Cooke* as early as 1907.

This taxon is endemic to Tamil Nadu and Karnataka and is a rare element in our flora.

(10) POUZOLZIA WIGHTII var. WIGHTII Benn.

Herb or undershrub, stem stout, pubescent, terminating in a bracteate spike; leaves gradually or suddenly become smaller, lower leaves opposite or trinately whorled, subsessile, shortly oblong to narrowly lanceolate; stamens 4.

Subsequent to Wight's collection from Travancore, it has been collected from

Tinnevelly by *Sebastine* (9580) in 1959, from Mysore by *Talbot* (815 & 1947) in 1883 & 1889 and from the Mahendragiri Hills (Orissa) by *Fischer* (102) in 1904.

Endemic in Kerala, Karnataka and Tamil Nadu, it thus extends its range to Orissa.

(11) P. WIGHTII Benn. et R. Br. var. CAUDATA (Benn. et R. Br.) Fischer

P. caudata Benn. et R. Br.

Stem slender, 60-90 cm, glabrous; leaves cauline, lanceolate to ovate-lanceolate, acuminate, 15×3·5 cm, glabrous; spikes slender, pubescent; bracts very small, caudate.

Based on *Urtica caudata* Wall. List no. 4600 A (1831) *nom. nud.* collected from Travancore and Courtallam, it has since been recorded from Cochin in 1909 and from Annamalai Hills by *Fischer* (3859) in 1916.

The taxon is restricted to Kerala and Tamil Nadu.

(12) P. WIGHTII Benn. et R. Br. var. NILGHIRENSIS (Wight) Hook. f.

P. neilgherrensis Wight

Herb, stem scabrid, tomentose; leaves coriaceous, broadly ovate, elliptic or oblong lanceolate, 15×8 cm, scabrid above, tomentose beneath.

After *Wight* (26) from the Kotegherry pass (Nilgiri), it has since been collected from Madras by *Fischer* (140) in 1905 and by Rev. *Saulieres* (855) in 1913 and from Santaveri, Bababoodan Hills (Karnataka) by *Meebold* (8392) in 1908.

This endemic taxon appears restricted to Tamil Nadu and Karnataka only.

MORACEAE

(13) ARTOCARPUS HIRSUTUS Lamarck

Tree, leaves broadly ovate, more or less entire, harsh beneath; inflorescence catkin; male flowers pendulous; female catkins hirsute.

Based on "Ansjli" Rheeds Hort. Mal. 3, t. 32 (1682) from Malabar, it has been collected from Travancore by *Lawson* (266), from Mysore by *Meebold* (8340) in 1908 and from Kalladikod (Tamil Nadu) by *Fischer* (2620) in 1911 and also reported from Bombay by *Dalzell & Gibson* in 1861.

Endemic to Kerala, Karnataka, Tamil Nadu and Maharashtra.

(14) FICUS LAEVIS Blume var. MACROCARPA (Miq.) Corner.

Ficus macrocarpa (Miq.) Wt. ex King.

Pogonotrophe macrocarpa Miq.

Scandent shrub; leaves 12 cm long, subcordate, petiole 4-5 cm; stipule 1 cm, lanceolate; receptacles 2·5—6 cm diam., spotted; peduncles 1 cm with several bracts at base, female flowers subsessile, sepals 6, style subterminal, hairy; stigma bilobed.

Originally based on *Wight* from the Pulney mountains, it has also been collected from the Nilgiri in 1883 and from Travancore (cf. Corner, 1960, 1965).

This species is endemic to Tamil Nadu and Kerala.

(15) MORUS SERRATA Roxb.

Tree; leaves 4-20 cm, ovate cordate accuminate, coarsely serrate; petiole 2-4·5 cm, tomentose; stipules broadly lanceolate; female spike short cylindric with 2-4, equal sepals oblong and ciliate.

Originally based on Capt. *Hardwicke (Morus-1)* from Dosa, Srinagur in Garhwal Himalaya, it has been collected from Kumaon, Chakrata and Kunawar in Uttar Pradesh and from Chamba, Himachal Pradesh by *Lace* (1911) in 1899.

This endemic species restricted to the hilly regions of the Uttar Pradesh-Himachal Pradesh, is often cultivated for its edible fruits.

ULMACEAE

(16) GIRONNIERA LUIGDA KURZ

Tree; leaves 12-20 cm, rounded or cuneate, very coriaceous with 10-15 pairs of impressed veins, reticulate beneath, petiole 0·5—1·3 cm, male cymes shortly peduncled, much branched, glabrous; drupes large, solitary, axillary, ovoid, hardly compressed.

After the collection of *Kurz* s.n. from the tropical forests of the South Andamans, this species was also collected by King's collector in 1870, from Rangat Bay in South Andamans by Parkinson in 1915 & 1916. But *Deb* (25800) collected the species from Lailong (Meghalaya) and also from Agartala, Tripura (*Deb* 2697).

It is interesting to note that this species endemic in the Andamans extends its range to the mainland of India.

(17) G. THOMSONI King ex Cowan et Cowan

A tree; leaves alternate, 10-15 × 4·5—7·5 cm, ovate oblong, entire acuminate, coriaceous, glabrous, base rounded, lateral veins 10-12 pairs, petiole 1-1·2 cm long; male flowers in axillary cymes; sepals oblong, obtuse, glabrous.

Based on *King* s.n. from Sikkim, it has been recorded by Das in 1940 from within the area of the *Flora of Assam*, but without any specific locality. Five specimens in CAL annotated as *G. thomsonii* by King are all from Sikkim only.

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37

Rare and Endemic species of Indian Commelinaceae

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The family Commelinaceae is represented in India by about 80 species under 13 genera. After Hooker (1892) who mainly followed Clarke's (1881) monograph for the distribution of various species, no attempt was made to study the phytogeography of the Indian species. Subsequently, exhaustive collections were made from various parts of the country during the last about 100 years. The author had the opportunity to study the collections of the family from almost all important Indian herbaria in connection with the revision of the Indian species. Some field work was undertaken to collect and study the various species in their habitat especially those which are rare and less known from the herbarium collections. Over 60 species were also studied under cultivation. Such studies helped for a better understanding of the various species which were often confused and misidentified due to lack of flowers, capsules, seeds and other parts. In addition, certain genera were subjected to critical taxonomic study by recent workers (Bruckner, 1930; Sprague & Fischer 1928; Rolla Rao & Kammathy (1966). An analysis of the data collected so far on the distribution of Indian commelinaceae is presented in this paper.

Table I shows the phytogeography of the various Indian species. Of the 80 species, 61 species show common distribution in other countries; 3 species are cosmopolitan; 27 species are found in Sri Lanka; 25 in Bangladesh, 35 species in Burma, Java and Malaya; 28 species in China; 6 species in Australia and 8 species are common to Africa. Only 19 species are found endemic to India. Table II shows the areawise distribution of the endemics. 17 species are distributed in the south-west India and only 2 species are restricted to Eastern India. Of these 9 species are observed to be fairly common in areas where they are reported. 10 species are very rare as observed from the field studies and herbarium work and deserve consideration for the purpose of conservation.

Similarly, certain other species show restricted distribution in India (Table III). Of these, 9 species are found to be very rare and require further study for conservation.

Thus in all 19 species out of 80 species require further consideration for the purpose of conservation and these are listed below:

(The genera and species are listed alphabetically. Under each species the distribution, habitat, notes on important finding and phenology is given).

1. ANEILEMA GLANDULIFERUM Joseph et Rolla Rao

Distrib: Endemic to Eastern India, Arunachal Pradesh 1200 m.

TABLE—1. *Phytogeography of Indian Commelinaceae*

Sl. No.	Name of Genus	No. of sps. in India	No. of cosmo-politan	No. of sps. common to Sri Lanka	No. of sps. common to Bangla-desh	No. of sps. common to Burma, Malaya/ Java	No. of sps. common to China	No. of sps. common to Austra-lia	No. of sps. common Africa	No. of sps. Ende-mic to India
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	*Aneilema* s.s.	1	-	—	—	—	—	—	—	- -
2.	*Amischophacelus* Rolla Rao & Kammath	2			11	1	-	1	1	1
3.	*Amischotolype* Hask.	2	-	—	1	2	1	-	—	-
4.	*Belosynapsis* Hasl.	3		-	-	1	1		—	2
5.	*Commelina* L.	23	2	9	10	10	5	4	4	4
6.	*Cyanotis* s. s.	15	-	5	2	3	3	—	1	6
7.	*Dictyospermum* Wt.	4	-	2	—	1	2	—	- -	1
8.	*Floscopa* Lour.	1	-	1	1	1	1	1	- -	—
9.	*Murdannia* Royle	21	1	7	8	10	9	1	3	4
10.	*Pollia* Thunb.	5	-	1	2	4		- -	—	1
11.	*Rhopalephora* Hask.	1	—	1	- -	1	- -	- -	—	—
12.	*Streptolirion* Edgew.	1	—	—	—	1	1	—	—	-
13	*Tricarpelema* Morton	1	—	—	- -	1	—	-	—	—
		60	3	27	25	36	28	6	8	19

Habitat: On wet rocky slopes on river banks.

Note: Only the type collections from Tini, North Bhalukpong, Kameng District are available. All other species hitherto included under the genus *Aneilema sensu lato* from India were transferred to either *Murdannia* Royle, *Dictyospermum* Wt., *Rhopalephora* Hassk. or *Tricarpelema* Morton. This species deserves critical study based on fresh collections.

Fls. & Fts. September.

TABLE—II. *Species endemic to India*

I. Species endemic to South—West India
1. *Belosynapsis kewensis* Hassk.
2. *B. vivipara* (Dalz.) Sprague et Fischer.
3. *Commelina hirsuta* (Wt.) Cl.
4. *C. indehiscens* Barnes
5. *C. tricolor* Barnes
6. *C. wightii* Rolla Rao
7. *Cyanotis adscendens* Dalz.
8. *C. burmanniana* Wt.
9. *C. cerifolia* Rolla Rao et Kammathy
10. *C. concanensis* Hassk.
11. *C. vaginata* Wt.
12. *C. wightii* Cl.
13. *Dictyospermum ovalifolium* Wt.
14. *Murdannia crocea* (Griff.) Faden Subsp. *ochracea* (Dalz.) Faden.
15. *M. juncoides* (Wt.) Rolla Rao et Kammathy
16. *M. koenigii* (Wall. ex Cl.) Bruckn.
17. *M. lanuginosa* (Wall. ex Cl.) Bruckn.

II. Species endemic to Eastern India
1. *Aneilema glanduliferum* Joseph et Rolla Rao
2. *Pollia pentasperma* Cl.

TABLE—III—*Species restricted to India, Sri Lanka, Bangladesh and rare in India.*

I. Species restricted to India and Sri Lanka
1. *Commelina attenuata* Koen. ex Vahl
2. *Cyanotis fasciculata* (Heyne ex Roth) J. A. & J. H. Schult.
3. *C. pilosa* J. A. & J. H. Schult.
4. *C. thwaitesii* Hassk.
5. *C. tuberosa* (Roxb.) J. A. & J. H. Schult.
6. *C. villosa* (Spreng.) J. A. & J. H. Schult.
7. *Dictyospermum montanum* Wt.
8. *Murdannia glauca* (Thw. ex Cl.) Bruckn.
9. *M. dimorpha* (Dalz.) Bruckn.

II. Species restricted to India, Sri Lanka and Bangladesh
1. *Commelina appendiculata* Cl.

III. Species sestricted to India and Bangladesh
1. *Commelina hasskarlii* Cl.
2. *C. sikkimensis* Cl.

IV. Species distributed elsewhere but rare in India
1. *Commelina albescens* Hassk.
2. *C. kotschyii* Hassk.
3. *C. paleata* Hassk.
4. *Murdannia blumei* (Hassk.) Bruckn.
5. *M. hookeri* (Cl.) Bruckn.
6. *M. triquetra* (Wall. ex Cl.) Bruckn.

2. BELOSYNAPSIS KEWENSIS Hassk.

Cyanotis kewensis (Hassk.) Cl. (FBI. 6: 338. 1892.)

Distrib: Endemic to Southern Peninsula-Kerala and Tamil Nadu, 300-600 m.

Habitat: On rocks and cliffs moistened by rain or spray from stream.

Note: Live material was first collected from Mahendragiri hills by Beddome and cultivated at Royal Botanic Garden, Kew. Hasskaral described the species from the cultivated material and hence the specific name *kewensis*.

There are only 3 collections of this from Tirunelveli and Kanyakumari districts of Tamil Nadu. During field studies the species is observed to be very rare due to its peculiar habitat and ecological preference and is suspected to be endangered due to its rarity. The critically low populations together with the habitat disturbances due to establishment of Tea gardens appear to have seriously affected its dispersal and survival. The author collected live materials in 1963 and cultivated them at Poona where they flowered in October 1964. It is a beautiful ornamental plant worth introduction to botanical gardens, Fls. & Fts: October to January.

3. COMMELINA ALBESCENS Hassk. (FBI. 6: 373).

Distrib; INDIA: Confined to Rajasthan and Gujarat; PAKISTAN; AFRICA.

Habitat: In crevices of rocks. The rootstock sprouts soon after rains.

Notes: There are about 10 collections of this species in India, from Jodhpur, Jaisalmir and Barmer districts of Rajasthan and Saurastra coast. The Indian populations are diploid whereas the African populations are tetraploids (Rolla Rao *et al*, 1968).

4. C. APPENDICULATA Cl. (FBI 6: 374).

Distrib: INDIA: Uttar Pradesh, Bihar, West Bengal, Sikkim, Assam: BANGLADESH; SRI LANKA 150-1000 m.

Habitat: On hill slopes and grassy meadows.

Note: There are about 15 collections of this species. Recent field studies could not locate the species. Very rare.

5. C. HIRSUTA (Wt.) Cl. (FBI. 6: 371).

Distrib: INDIA: Endemic to Southern Peninsula, Western ghats. Tamil Nadu 600-1000 m.

Habitat: In grassy hill slopes.

Note: There are about 10 collections of this species, all from Naduvattum, Pykara and Ootacamund in Nilgiris and Kodaikanal and Palni hills of Tamil Nadu. Recent field studies reveal that the species is rare in places where it was reported earlier due to disturbance in habitat-grazing and clearing.

Fls. & Fts.: June to November.

6. C. KOTSCHVI Hassk.

C. heterosperma Blatter & Hallb.

Distrib: INDIA: Confined to Maharastra 600-800 m. AFRICA.

Habitat: On moist banks of streams and gravelly river beds soon after water receeds.

Note: There are only 5 collections of this species from Poona district. One more collection of this species from Sangli, Satara district, Maharastra by I. H. Burkill in 1902 was recently located in the Economic herbarium of the Industrial Section, Calcutta. The plant appears to be very rare in India.

Fls. & Fts.: August to November.

7. C. PALEATA Hassk. (FBI. 6: 373).

Distrib: INDIA: Concan, Maharastra, Karnataka; JAVA.

Habitat: Prostrate on moist shady and rocky areas with arching internodes and tuberous roots. There are many collections of this species from Bombay and adjoining hilly areas and only one collection of Talbot from Carwar, Karnataka in 1885. Recent field studies indicate that it is not available anywhere except in hilly areas of Bombay and adjoining areas. Arrey colony, Kanhericaves where the plants grow luxuriently has been cleared on account of urbanisation.

Fls. & Fts.: July to September.

8. C. TRICOLOR Barnes

Distrib: INDIA, Endemic to Western ghats of Karnataka, Tamil Nadu 1500 m.

Habitat: On humus covered forest floor and rocks in shade.

Note: Collected only from the type locality Gudalur ghat, Nilgiri by he author in 1962.

Fls. & Fts.: July to November.

9. C. WIGHTII Rolla Rao

C. glabra (Wt.) Cl. (FBI. 6: 371)

Distrib: INDIA: Endemic to Southern Peninsula, Tamil-Nadu, Kerala.

Habitat: In moist and swampy areas.

Note: There are about 8 collections from Anamalais, Palghat, Walayar, and Kerala without precise locality. Recent field studies reveal that the species is very rare.

10. CYANOTIS BURMANNIANA Wt. (FBI. 6: 335)

Distrib.: INDIA: West cost. Maharastra, Karnataka, Kerala.

Habitat: In undisturbed loose sandy soil.

Note: Except for one collection of Dalzel from Bombay about 6 collections of this species are from Kerala coast. This species was very common throughout the coastal region of Kerala especially from Quilon to Cochin until a decade ago, but it has now become very rare in the coastal region due to urbanisation, farming activities and consequent disturbances of its habitat. The small reddish succulent leaves are very characteristic for the species.

11. C. CERIFOLIA Rolla Rao et Kammathy

Distrib.: INDIA: Endemic to Western Ghats, Kerala, Tamil Nadu. 1000 m.

Habitat: On moist rocky areas amidst grass.

Note: Only the type collections are available. The species was collected from Waverly estate, Anamalai hills by the author in 1962 and cultivated at Poona where it flowered and described as a new species.

Fls. & Fts.: August—October.

12. C. VAGINATA Wt. (FBI. 6: 335)

Distrib.: INDIA: Endemic to Southern Peninsula, Kerala, Tamil Nadu upto 1000 m.

Habitat: On moist rocks, and forest clearings.

Note: About 8 collections of this species from Anamalais, Tenmalai, and Orukomban, Kerala are only available. The species is not well understood due to its rarity and poorly preserved collections.

Fls. & Fts.: August—October.

13. MURDANNIA BLUMEI (Hassk.) Brenan

Aneilema hamiltonianum Wall. ex Cl. (FBI. 6:330)

Distrib.: INDIA: Upper Gangetic plain to Eastwards. Uttar Pradesh, Bihar, Assam, Meghalaya; JAVA.

Habitat: In marshy areas and rice fields.

Note: There are only 5 collections of this species in India, one collection each from near Rai Bereily, Assam, without precise locality; Sonapur, Meghalaya. Prain (1908), Haines (1924) includes this species. Recent field studies could not locate the plant.

Fls. & Fts.: September—November.

14. M. GLAUCA (Thw. ex Cl.) Bruckn.
Aneilema glaucum Thw. ex Cl. (FBI. 6:375)
Distrib.: INDIA: Southern Peninsula, Western ghats, Kerala, Tamil Nadu; SRI LANKA. 350-1000 m.
Habitat: Epiphytic on tree trunks in humid forest and also on rocks.
Note: There are only 5 collections of this species from Peermede forest, Kerala and Kannikatti and Agastiar-malai, Tirunelveli district of Tamil Nadu. Recent field studies could not locate the plant.
Fls. & Fts.: May to November.

15. M. HOOKERI (Cl.) Bruckn.
Aneilema hookeri Cl. (FBI. 6:376)
Distrib.: INDIA: Meghalaya, Nagaland; CHINA. 1500-2000 m.
Habitat: On wet moss covered forest floor and also on banks of streams.
Note: There are only 5 collections of this species from India from Khasia hills and Nagaland. The species which was fairly common in Mawphlong appears to be fast disappearing due to clearing of forests.

16. M. KOENIGII (Wall. ex Cl.) Bruckn.
Aneilema koengii Wall. ex Cl. (FBI. 6:381)
Distrib.: INDIA: Endemic to Southern Peninsula, Kerala, Tamil Nadu.
Habitat: In rice fields and moist areas among grass.
Note: There are only 3 collections including the type; from Malabar & Concan by Stocks & Law and Tirunelvali, Tamil Nadu. Recent field studies could not locate the plant.
Fls. & Fts.: March to June.

17. M. TRIQUETRA (Wall. ex Cl.) Bruckn.
Aneilema triquetrum Wall. ex Cl. (FBI. 6:378)
Distrib.: INDIA: Arunachal Pradesh, Assam: BANGLADESH; CHINA.
Habitat : In marshy areas.
Note: There are only 3 collections of this species from Assam without precise locality and from subansiri in Arunachal Pradesh. It appears to be very rare.
Fls. & Fts.: August—October.

18. POLLIA PENTASPERMA Cl. (FBI. 6:368)
Distrib.: INDIA: Meghalaya, Nagaland.
Note: There are about 10 old collections from Shillong, Khasia hills, Kohima, Nagaland and Lushai hills and Assam. Recent field studies in Khasia hills could not locate this species.
Fls. & Fts.: June to October.

19. TRICARPELEMA GIGANTENUM (Hassk.) Hara
Aneilema thomsonii (Cl.) Cl. (FBI. 6:376)

Distrib.: INDIA: Eastern Himalaya: Sikkim (Bhutan) Arunachal Pradesh, West Bengal, Nagaland, BURMA?

Habitat: On the banks of streams in shady areas.

Note: There are about 15 collections of this species mostly a century old and there are no recent collections. Morton (1967) erected the genus *Tricarpelema* based on this species as monotypic. Rao (1979) mentions this genus as endemic to India. Hong (1974) has described another species, *T. chinensis* Hong from China.

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Rare and Endemic Species of Rhododendron in India—A Preliminary Study

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Rhododendrons are very popular among flowering plants and have attracted many people all over the world for their fine evergreen foliage and showy flowers. There are about 1000 species distributed throughout the world. Of these, *ca* 65 species, 12 subspecies and 5 varieties are known from India. The Sino-Himalayan region forms the most important distribution centre for Rhododendron species.

The following is an abstract giving the number of species found in different parts of India :—

Arunachal Pradesh	— 52 species, 5 subspcies and 5 varieties
Himachal Pradesh	— 5 species
Kashmir	— 4 species
Manipur	— 9 species, 1 subspecies and 1 variety
Meghalaya	— 1 species and 3 varieties
Nagaland	— 4 species
Sikkim	— 37 species and 2 varieties
Tamilnadu	— 1 subspecies
Uttar Pradesh	— 4 species and 1 variety
W. Bengal (Darjeeling Himalaya)	— 17 species

The following 7 sp., 2 subsp. and 3 var. are not at present known to occur outside India:

R. arboreum Sm. subsp. *nilagiricum* (Zenker) Tagg
Tamilnadu.

R. concinnoides Hutch. & Kingdon Ward
Arunachal Pradesh.

R. elliottii Watt
Manipur, Nagaland.

R. falconeri Hook. f. subsp. *eximium* (Nutall) Chamberlain
Arunachal Pradesh.

R. formosum Wall. var. *formosum*
Meghalaya.

R. formosum Wall. var. *inaequale* (Hutch.) Cullen
Arunachal Pradesh, Meghalaya, Nagaland.
R. johnstoneanum Watt ex Hutch.
Manipur, Mizoram.
R. macabeanum Watt ex Balf. f.
Manipur, Nagaland.
R. santapaui Sastry *et al*
Arunachal Pradesh.
R. subansiriense Chamberlain
Arunachal Pradesh.
R. triflorum Hook. f. var. *bauhiniflorum* (Watt ex Hutch.) Cullen
Manipur.
R. wattii Cowan
Manipur.

There are two distinct flowering seasons viz. (i) March—May and (ii) May—July. However, a large number of species flower during April—June. Except for a few species, like *R. edgeworthii, R. griffithianum* and *R. maddenii,* etc., the flowers are not fragrant. There are a few species which are poisonous and some have medicinal properties also.

Several species of the genus *Rhododendron* are gradually becoming rare in their original habitats. This is due to uncontrolled clearing of forests for cultivation and for developmental projects taking place in the entire range of distribution in the country and Selection of areas rich in Rhododendron species and declaring these as 'Rhododendron sanctuaries' in different parts of the country, as the one in Sikkim can save the depleting Rhodedendrons in the country.

The following is an enumeration of Rare, Threatened and Endangered species of *Rhododendron* in India. The species are arranged alphabetically. The data under each species include correct binomial with original citation, short description, flowering time (where known), ecological notes and distribution.

RHODODENDRON BAILEYI Balfour f. in Notes Roy. Bot. Gard. Edinb. 11: 23. 1919.

Shrubs upto 2.0 m high. Leaves elliptic to narrowly elliptic. Inflorescence 5-8-flowered. Corolla purplish, often with darker spots.

Rare. Alpine and subalpine region, in open places, 3000—4000 m.

Sikkim; BHUTAN, CHINA.

RHODODENDRON BEANIANUM Cowan, New Flora & Silva 10:245, f. 80. 1938.

Straggling shrubs, upto 3 m high. Leaves obovate to elliptic, upper surface rugulose, glabrous, lower surface tomentose. Inflorescence 6-10-flowered. Corolla carmine to blood-red.

Rare. In bamboo forests, 3000—3350 m

Arunachal Pradesh; N.E. UPPER BURMA.

RHODODENDRON BOOTHII Nutt. in Hook. Kew Journ. Bot. 5: 346. 1853.

Shrubs *ca* 2 m high; young branchlets yellow-tomentose. Leaves ovate to ovate-elliptic. Flowers in clusters of 7-10, bright yellow, sometimes spotted.

Fls. : April—May.

Threatened. In forests, 1800—2450 m

Arunachal Pradesh; BHUTAN, CHINA.

RHODODENDRON BULU Hutch. Rhod. Notes 1929-31, 3(5): 280. 1932.

Shrubs, up to 1·5 m high. Leaves elliptic or oblong-elliptic, apex rounded. Inflorescence 1-3-flowered. Corolla prinkish-purle.

(Threatened. In open places, 3000-3800 m.

Arunachal Pradesh; CHINA (Tsangpo-valley).

RHODODENDRON CALOSTROTUM Balfour f. et Kingdon Ward subsp. RIPARIUM (Kingdon Ward) Cullen in Notes Roy Bot. Gard. Edinb. 36:112. 1978.

R. riparium Kingdon Ward

Prostrate shrubs, upto *ca* 1.0 m high. Leaves suborbicular to oblong-ovate. Inflorescence 1-5-flowered. Corolla magenta-coloured, rarely pink or purple.

Rare. On rocky slopes and near streams, 3050-4550 m.

Arunachal Pradesh; N.E. BURMA, CHINA.

RHODODENDRON CAMPYLOGYNUM Franchet in Bull. Soc. Bot. Fr. 32: 10. 1885.

Creeping, prostate or decumbent, shrublets upto 60 cm high. Leaves obovate or narrowly elliptic, papillose and often whitish or silvery beneath. Inflorescence 1-2-flowered. Corolla pink to red or purple.

Rare. 2750—4250 m

Arunachal Pradesh; N. E. BURMA, CHINA.

RHODODENDRON CEPHALANTHUM Franchet var. CEPHALANTHUM Notes Roy. Bot. Gard. Endinb. 39(1): 162. 1980. *Rhododendron crebreflorum* Hutch. & Kingdon Ward in Notes Roy. Bot. Gard. Edinb. 16:173. 1931.

Prostrate or erect undershrubs. Leaves broadly elliptic, densely scaly beneath. Flowers in trusses of 8-12, pale pink, corolla tube 6.5—13 mm.

Rare. On rocky slopes and open meadows, 3050—4500 m.

Arunachal Pradesh; N. BURMA, CHINA.

RHODODENDRON CINNABARINUM Hook. f. subsp. XANTHOCODON (Hutch.) Cullen in Notes Roy. Bot. Gard. Edinb. 36: 113. 1978.

Shrubs, upto 5 *ca* m high. Leaves persistently lepidote above. Inflorescence 5-flowered. Flowers cinnabared.

Threatened. In forests and forest margins, 3050—3950 m.

Arunachal Pradesh; BHUTAN, CHINA.

RHODODENDRON CONCINNOIDES Hutch. & Kingdon Ward in Notes Roy. Bot. Gard. Edinb. 16: 180. 1931.

Shrubs *ca* 3.0—3.5 m high. Leaves elliptic or obovate-elliptic, densely covered with brown scales beneath. Flowers in trusses of 3, pinkish or purplish with dark-spots.

Fls: April--May.

Endemic and Endangered.

Known only from the type collection from Arunachal Pradesh.

RHODODENDRON DENDRICOLA Hutch. in Notes Roy. Bot. Gard. Endinb. 12: 60. 1919.

Shrubs. Leaves narrowly elliptic to narrowly obovate, undersurface scaly. Calyx disc-like. Corolla white, often with yellow or orange blotch or with pink tint.

Rare. Epiphytic or on moss covered rocks, 1200—1400 m.

Arunachal Pradesh; N.E. BURMA, CHINA.

RHODODENDRON EDGEWORTHII Hook. f. Rhod. Sikkim Himal. 22. t. 21. 1849

Straggling shrubs, upto 3.5 m high; branchlets densely woolly-tomentose. Leaves elliptic to ovate-elliptic, dark-green and bullate above, brown-tomentose beneath. Inflorescence 2-3-flowered. Flowers white or rosy tinged, sweet scented.

Fls. : April--May.

Rare. Epiphytic or on moss covered rocks, in dense forests, 2100—3300 m.

Arunachal Pradesh, Sikkim, W. Bengal; BHUTAN, E. BURMA, CHINA.

RHODODENDRON ELLIOTII Watt ex Brandis, Indian Trees 410. 1906.

Small tree, *ca* 4 m high or straggling shrub. Inflorescence 6-10-flowered. Flowers scarlet or crimson with darker flecks. Ovary densely rufous stellate-tomentose.

Fls.: May—June.

Endangered and Endemic, *ca* 3000 m.

Manipur, Nagaland.

RHODODENDRON EXASPERATUM Tagg in Notes Roy. Bot. Gard. Edinb. 16: 192. 1931; Cullen in Notes Roy. Bot. Gard. Edinb. 39(2): 1980.

Small tree, *ca* 4 m high. Leaves broadly ovate to elliptic , dark-green above, pale-green beneath. Inflorescence 10-12-flowered. Corolla brick red.

Fls.: April—May.

Rare. In conifer forests, 3,000—4000 m.

Arunachal Pradesh; N. E. UPPER BURMA & CHINA.

RHODODENDRON FALCONERI Hook. f. subsp. EXIMIUM (Nuttall) Chamberlain in Notes Roy. Bot. Gard. Edinb. 37: 330. 1979.

Tree upto 15 m high. Leaves boradly elliptic to obovate. Corolla pale pink with darker lips; leaves scurfy above even at maturity.

Endangered. Endemic.

Arunachal Pradesh.

RHODODENDRON FORMOSUM Wall. var. INAEQUALE (Hutch.) Cullen in Notes Roy. Bot. Gard. Edinb. 36: 108. 1978. *Rhododendron inaequale* Hutch. in Notes Roy. Bot. Gard. Edinb. 12: 75. 1919.

Shrubs, 1.0—3.0 m high. Leaves lanceolate or elliptic-oblanceolate, dull dark green above, scaly beneath, 15-20 mm broad. Flowers in trusses of 4-6, white.

Fls.: March —May

Threatend. Endemic. On open hill slopes or near streams, 1500—2000 m.

Arunachal Pradesh, Manipur, Meghalaya (Khasi Hills), Nagaland.

RHODODENDRON HOOKERI Nutt. in Hook. Journ. Bot. Kew 5: 359. 1853.

Shrubs, 4—5 m high. Leaves oblong or oblong-ovate, smooth above, glaucous green beneath. Inflorescence 10-15—flowered. Corolla blood red or pink or crimson, with 5 deep red blotches at base.

Fls. : March—April

Rare. In forests, 3200—3800 m.

Arunachal Pradesh; BHUTAN.

RHODODENDRON JOHNSTONEANUM Watt ex Hutchinson in Notes Roy. Bot. Gard. Edinb. 12: 72. 1919.

Shrubs, 2-4 m high. Leaves elliptic to obovate-elliptic, ciliate when young, dark green above, glacuous and densely scaly beneath. Inflorescence 3-4-flowered. Flowers fragrant, pale yellow or white or sometimes white tinged with pink, spotted with red, yellow blotched.

Fls.: April—May.

Endangered. Endemic.

At the edge of the forests on hill slopes, 1700-3000 m.

Manipur, Mizoram.

RHODODENDRON KASOENSE HUTCH. & Kingdon Ward in Notes Roy. Bot. Gard. Edinb. 16: 181. 1931.

Shrubs. Leaves oblong-lanceolate, scaly on both surfaces. Flowers in trusses of 3, yellow.

Rare. In forests, 2500—2700 m.

Arunachal Pradesh (Delei Valley); CHINA.

RHODODENDRON KENDRICKII Nutt. in J. Bot. (Lond.) 5: 358. 1853.

Shrubs or small trees, 2-8 m high. Leaves oblong-lanceolate to lanceolate, apex acuminate. Inflorescence 10-20-flowered. Flowers pink, scarlet or crimson, with red or deep crimson spots.

Fls. : April—May.
Rare. In forests, 2300—2800 m.
Arunachal Pradesh; BHUTAN, CHINA.

RHODODENDRON KEYSII Nutt. in Hook. Journ. Bot. Kew 5: 353. 1853.

Shrubs, 2-4 m high. Leaves oblong-lanceolate to elliptic, densely scaly on both surfaces. Flowers bright red, tipped yellow or orange.

Fls. : May—June.
Rare. In forests, 2440 m—3650 m.
Arunachal Pradesh, Sikkim; BHUTAN, CHINA.

RHODODENDRON MACABEANUM Watt ex Balf. f. in Notes Roy. Bot. Gard. Edinb. 12: 128. 1920.

Trees, upto 15 m high. Leaves broadly ovate to broadly elliptic, apex rounded to retuse, upper surface glabrous when mature, reticulate with impressed veins, lower surface with a dense bistrate indumentum. Inflorescence 15-25-flowered. Corolla lemon-yellow with a purple blotch.

Rare and Endemic
On hill tops, 2500—3000 m.
Manipur, Nagaland.

RHODODENDRON MADDENII Hook. f. subsp. CRASSUM (Franchet) Cullen in Notes Roy. Bot. Gard. Edinb. 36: 170. 1978. *R. manipurense* Balfour and Watt.

Shrubs, upto 2 m high. Leaves usually more than 40 mm broad, elliptic; capsules oblong-cylindrical, abruptly rounded to almost truncate at apex; filaments pubescant.

Rare. On hill slopes, 2400—3650 m.
Manipur; BURMA, CHINA, VEITNAM.

RHODODENDRON MEGACALYX Balfour f. & Kingdon Ward in Notes Roy. Bot. Gard. Edinb. 9: 246. 1916.

Shrubs, 1.5—5.0 m high. Leaves elliptic to obovate, lower surface brownish, scaly. Inflorescence 2-5-flowered. Calyx very large, cup like, reddish. Corolla white or cream or with pink tint.

Rare. In forests, 2000—3000 m.
Arunachal Pradesh; CHINA, N. E. BURMA.

RHODODENDRON MEGERATUM Balfour f. & Forrest in Notes Roy. Bot. Gard. Edinb. 12: 140. 1920.

Shrubs, upto 1.0 m high. Leaves elliptic or elliptic obovate, upper surface glabrous, lower surface whitish-papillose. Inflorescence 1-2-flowered. Corolla yellow or rarely creamy.

Rare. Terrestrial or epiphytic, among boulders, 3050—4150 m.
Arunachal Pradesh; N. E. BURMA, CHINA.

RHODODENDRON MEKONGENSE Franchet var. RUBROLINEATUM (Balfour f. & Forrest) Cullen in Notes Roy. Bot. Gard. Edinb. 36: 115. 1978. *R. rubrolineatum* Balfour f. & Forrest.

Shrubs, *ca* 2.0 m high. Leaves obovate; loriform, setae restricted to petioles and leaf margins and sometimes at the base of midrib beneath. Inflorescence 2-4-flowered. Corolle yellow to greenish yellow.

Rare. Forest margins, 3350 --4250 m.

Arunachal Pradesh; CHINA.

RHODODENDRON MICROMERES Tagg in Notes Roy. Bot. Gard. Edinb. 16: 211. 1931.

Shrubs, *ca* 2 m high. Leaves narrowly elliptic, glabrous, undersurface scaly. Inflorescence 5-10-flowered. Corolla yellow, pilose within.

Rare. Ephytic or terrestrial, 2450-4000 m.

Arunachal Pradesh; BHUTAN, N. E. BURMA, CHINA.

RHODODENDRON NERIIFLORUM Franchet subsp. PHAEDROPUM (Balfour f. & Farrer) Tagg in Stevenson (ed) The Spec. Rhododendron 533. 1930. *R. phaedropum* Balf. f. & Farrer in Notes Roy. Bot. Gard. Edinb. 13 : 283. 1922.

Shrub to 8 m high. Leaves oblong-lanceolate, upper surface smooth, deep green, glaucous papillate underneath. Inflorescence *ca* 13-flowered. Flowers deep red.

Threatened. On open hill slopes, 3000 m.

Arunachal Pradesh (Tawang); BHUTAN, CHINA, UPPER BURMA.

RHODODENDRON NUTTALLII Booth in Kew Journ. 5: 355. 1853.

Shrubs or small trees, 2-10 m. Leaves oblong-elliptic or oblong-obovate, upper surface rugose, elepidote, lower surface densely scaly; scales unequal. Inflorescence 2-5-flowered. Flowers white with a yellow blotch.

Fls. : April—May.

Rare. Terrestrial or epiphytic. Open forests, 1200—3650 m.

Arunachal Pradesh; CHINA.

RHODODENDRON PAPILLATUM Balfour f. & Cooper in Notes Roy. Bot. Gard. Edinb. 13: 282. 1922.

Shrubs or small trees, 2-5 m high. Leaves oblanceolate to oblong, upper surface glabrous when mature, lower surface with stellate indumentum. Inflorescence 5-10-flowered. Corolla pale cream to pink with a basal blotch.

Rare. In conifer forests, 1800- -3300 m.

Arunachal Pradesh; BHUTAN.

RHODODENDRON PEMAKOENSE Kingdon Ward in Gard. Chron. 88: 298. 1930. *R. patulum* Kingdon Ward.

Prostrate to erect shrubs. Leaves obovate or obovate elliptic, upper surface lepidote, lower surface scaly. Inflorescence 1-2-flowered. Corolla pink to pale purplish mauve.

Rare. 2900—3050 m.

Arunachal Pradesh; CHINA.

RHODODENDRON PENDULUM Hook. f. Rhod. Sikkim Himal. t. 13. 1849.

Straggling epiphytic shrubs, 0.3—1.3 m high. Leaves oblong-elliptic, upper surface smooth, shining, glabrous and elepidote. Inflorescence 2-3-flowered. Corolla white, with pink tint or creamy.

Rare. In dense forests, 2270—3630 m.

Fls. : April—May

Sikkim; NEPAL, BHUTAN, CHINA.

RHODODENDRON POGOPHORUM Balfour f. ex Tagg in Notes Roy. Bot. Gard. Edinb. 15: 316. 1927.

Shrubs, upto 3 m high. Young shoots stipitate-glandular. Leaves oblong to obovate, glabrous above, continuous indumentum beneath. Inflorescence dense, 10-flowered. Corolla light to deep crimson.

Rare. In open rocky slopes, 3650—4600 m.

Arunachal Pradesh; CHINA.

RHODODENDRON PRUNIFLORUM Hutchinson & Kingdon Ward in Stevenson (ed.) Spec. Rhododendron 302. 1930.

Shrubs to 1.0 m. Leaves obovate or narrowly obovate, densely lepidote beneath. Inflorescence 4-6-flowered. Corolla dull crimson to purple.

Rare. In sheltered slopes and thickets, 3050-3950 m.

Arunachal Pradesh; N. E. BURMA.

RHODODENDRON REX Leveille in Feddes Repert. 13:340. 1940 subsp. ARIZELUM (Balfour f.) Chamberlain in Notes Roy. Bot. Gard. Edinb. 36 : 330. 1979.

Trees, *ca* 15 m high. Leaves oblong-obovate, rugose above, brown-tomentose beneath, hairs cup-shaped, strongly fimbriate. Flowers in trusses of 15-20. Corolla pale-yellow or rosy pink.

Fls. : April

Rare. In open conifer forests, 3,000—4000 m.

Arunachal Pradesh; N. E. BURMA, CHINA.

RHODODENDRON SANTAPAUI Sastry et al. in J. Bomb. nat. Hist. Soc. 65(3): 744-747. 1969.

Epiphytic shrubs, 0.5—1.5 m high. Leaves subverticillate, elliptic or elliptic-lanceolate, rugulose above, pale green, sparsely brown punctate scaly beneath. Inflorescence 2-flowered. Flowers white.

Fls.: July
Endangered and Endemic. In dense temperate forests, 2300 m.
Arunachal Pradesh (Subansiri). Known from Types only.

RHODODENDRON SUBANSIRIENSE Chamberlain in Notes Roy. Bot. Grad. Edinb. 36 124. 19 '8.

Shrubs or trees, upto 14 m. Leaves oblong, upper surfaceg labrous, lower surface epapillate, with numerous red punctate hair-bases on the veins, each with the vestige of a branched hair, otherwise glabrous. Inflorescence dense, upto 15-flowered. Corolla scarlet.

Endangered. Endemic. In mossy rain forest, 2600—2800 m.
Arunachal Pradesh.
Note: Known only from Type specimen.

RHODODENDRON SUGGOTHII Davidian in Rhododendron Year Book 20: 103. t. 8. 1965. *R. nishiokae* Hara in J. Jap. Bot. 45:94. 1970.

Shrubs or small trees, 1-6 m high. Leaves oblong to elliptic, apex rounded, minutely apiculate, upper and lower surfaces glabrous. Inflorescence 10-15-flowered, corolla crimson.

Rare. In forests, 3400—4200 m.
Arunachal Pradesh; BHUTAN.

RHODODENDRON TANASTYLUM Balfour f. & Kingdon Ward in Trans. Bot. Soc. Edinb. 27: 217. 1917.

Shrubs or small trees, 1-4 m high. Leaves elliptic to oblanceolate, apex acuminate, upper surface glabrous, lower surface glabrous or hairy. Inflorescence lax, 4-8-flowered. Corolla deep pink to deep crimson.

Rare. In conifer forests, 1850-3350 m.
Arunachal Pradesh; N. E. BURMA, CHINA.

RHODODENDRON TEPHROPEPLUM Balfour f. & Farrer in Notes Roy. Bot. Gard. Edinb. 13: 302. 1922.

Shrubs to 1.0 m high. Leaves narrowly elliptic and mucronate at apex, scaly beneath with small uniform black scales. Inflorescence 7-8-flowered. Flowers deep purple or pink.

Rare. Alpine meadows, 2450—4300 m.
Arunachal Pradesh; N. E. BURMA; CHINA.

RHODODENDRON TRIFLORUM Hook. f. var. BAUHINIIFLORUM (Watt ex Hutch.) Cullen in Notes Roy. Bot. Gard. Edinb. 36: 109. 1978.

Shrubs, 2-3 m high. Leaves oblong-lanceolate or ovate-lanceolate. Flowers in clusters of 2-3, brown-yellow or almost green with or without brown or green spots. Corolla very openly funnel-shaped to almost flat.

Fls.: May—June.
Rare and Endemic. On hill slopes, 2450—2750 m
Manipur.

RHODODENDRON WALONGENSE K'ngdon Ward in Gard. Chron. 133.5. 1953.

Shrubs, 2.0—3.0 m high. Leaves elliptic, under-surface brownish, scaly. Inflorescence 3-6-flowered. Calyx disc-like. Corolla creamy-white with a greenish blotch.

Rare. Epiphytic or terrestrial, 1500—2150 m.
Arunachal Pradesh; CHINA.

RHODODENDRON WATTII Cowan in Notes Roy. Bot. Gard. Edinb. 19: 163. t. 253. 1936.

Shrubs or small trees, 3-7 m high. Leaves obovate to oblong, glabrous above, white felted indumentum beneath. Inflorescence *ca* 15-flowered, dense. Corolla pink with darker flecks and purplish basal patches.

Endangered. Endemic, 2700 m.
Manipur.
Note : Known only from the type ocality.

RHODODENDRON XANTHOSTEPHANUM Merrill in Bri tonia i: 148. 1941.

Shrubs, *ca* 2.0 m high. Leaves narrowly-elliptic to elliptic or oblong. Inflorescence 4-5-flowered. Corolla yellow.

Rare. In forests and forest margins, 1500—3000 m.
Arunachal Pradesh; N. E. BURMA, CHINA.

39

Studies on Rare and Endemic Legumes in the Tribe Hedysareae

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Introduction

A critical taxonomic revision of the tribe *Hedysareae* (Fabaceae) has been undertaken for the Flora of India. Valuable data have been gathered on the distribution, rarity and endemic nature of the species of *Hedysarum* Linn *Uraria* Desv., *Lourea* Desv. and *Alysicarpus* Desv. which are presented in this paper.

Members of the genus *Hedysarum* Linn. are mostly Himalayan herbs or shrubs which range from decumbent acaulescent to erect robust habit with pinnate leaves and showy flowers of deep, rose-purple colour. Baker (1876) recognised 8 species, all considered endemic to the Himalayas, mostly to the West Himalaya. Among them, 6 species are becoming rare in distribution.

The restricted distribution of *Hedysarum sikkimense* Baker in Sikkim was known first from the type collection of Hooker in 1848 and subsequent collections of King's collector in 1885, 1887 and 1888. After a lapse of 25 years it was again collected from the same area, sometimes between 1903 and 1919 by different collectors. Since 1919 there was no collection of this plant.

H. astragaloides Baker was first collected from Lahul, Kashmir, by Thomson in 1848 and by R. Ellis and Jaescheke also in the same year (type material). After a lapse of about 85 years N. L. Bor collected 2 specimens from Lahul in 1938 and in 1941. Afterwards there is no report of this plant.

H. kumaonense Baker was originally described from Kumaon-Himalaya in 1876 and collected again in 1886 by Duthie and in 1900 by Inaijat from Kumaon. However, after a wide gap of about 5 decades this species was reported from the same locality recently (viz., in 1950 by D. D. Awasthi, in 1958 by T. A. Rao and in 1969 by Pant & Naithani).

H. microcalyx Baker was collected first from Lahul in 1860 by Brandis. After a gap of 80 years, it was collected from the same locality by N. L. Bor in 1941, by K. C. Sahni in 1960, by N. C. Nair in 1961 and by U. C. Bhattacharya in 1970. From Simla it was collected by Hole in 1913 and by N. L. Bor in 1941. In Uttar Pradesh it was collected from Gurwhal in 1864 by Falconer (type material), in 1877 and 1888 by Duthie. After about 70 years, it was again collected from Jammunatri and Kulu Valley by S. N. Mitra and Hackney in 1953 and in 1954, respectively.

H. falconeri Baker, a tibetan plant described in 1876, has been reported by a single collection from Kashmir in 1892.

H. cachemirianum Baker is rare and endemic to Kashmir (Jain & Sastry, 1980). There are only 3 subsequent collections after the type, made by Capt. F. E. Koebel in 1913, T. A. Rao in 1953 and N. C. Nair in 1966.

Uraria Desv. is a genus with the characteristic raceme which often looks like fox's tail. One of its species *U. lacei* Craib was first collected from Kohima in 1885 by Duthie, followed by Meebold from Naga hills and Manipur in 1907. After a lapse of 37 years, the plant was again collected from Manipur in 1944 by N. L. Bor. No more collection of the species was found till to-date.

U. pulchra Haines is known only from one sheet of Haines (*Haines* 3952) collected from Rannagar, Bihar in 1916 which is incidentally the type at Kew.

There are also many non-endemic species which were widespread earlier but have become rare now-a-days. Such species too deserve to be actively considered for conservation.

Uraria lagopus DC. is one such species. It occurs at elevations between 3000 5000 ft. In the last part of the nineteenth century it was reported from many areas like Sikkim, Kumaon, Uttar Pradesh, Assam and Bengal. In the present century, it was recollected from Sikkim in 1914, from Uttar Pradesh in 1961 and 1970, from Assam in 1919 and from West Bengal in 1914.

Similarly, *Lourea vespertilionis* (*L.*) Desv. was collected from Bengal in 1860, from Tamil Nadu in 1883 and from Assam, approximately in 1890 (Master). Since then no more collection of the species was found in any herbarium.

Alysicarpus gamblei Schindl. was first collected by Gamble in 1889 from Cuddapah district, Andhra Pradesh which constitutes the type collection. Later in 1912 it was collected from Karnataka by Paranjbya. Thereafter, the plant was never collected from its original locality. Only two more specimens collected from Orissa in 1949 (*Mooney* 3646) and Madhya Pradesh in 1958 (*Subramanyam* 7261) are found in the Calcutta herbarium.

It is interesting to point out that there is no record or mention of the above species in any regional flora except the following: Coventry enumerated only *Hedysarum cachemirianum* in his book 'Wild flowers of Kashmir (1927)' and marked its distribution saying '...not outside of Kashmir'. Babu (1976) remarked about *Uraria lagopus* as '...not seen from this area'. Kanjilal in Assam Flora (1938) recorded only *U. lagopus* under the name *U. alopecuroides* whereas Balakrishnan (1981) recorded it under the name *U. arboreum*. Prain in 'Bengal Plants' recorded only *Lourea vespertilionis* on the basis of earlier published reports of Roxburgh in 'Flora Indica (1832)' without mentioning any particular collection. Gamble (1918) recorded *L. vespertilionis* as an introduced species, being occasional or weed in waste places and sometimes in gardens.

Rarity of species can therefore be evaluated through field and herbarium studies. Their rarity/extinction may be due to several factors. During field

survey, authors observed barren grasslands which were once virgin forests and subsequently cleared for agriculture. Besides, construction of multipurpose river valley projects, hydro-electric projects, etc. without taking adequate precautions to protect natural resources cause the extinction of such rare plants.

International Union for Conservation of Nature (IUCN) has formulated certain basic criteria on which species should be regarded rare, threatened or endangered, etc. It has further suggested that in order to evaluate the term 'rare', 'threatened', 'endangered', etc., autecological study of the species is the prime need. In the above studies the term 'rare' is used depending on the degree of approximate distribution-frequency, dominance, etc. with notable field data.

Sufficient knowledge on the autecology of a species and well documented causes of its disappearance can assist conservationists to take proper steps in preserving the country's rich heritage of floral wealth.

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40

Endemic Species of Hedychium Koen. in India

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Hedychium Koen. (Zingiberaceae) has about 60 species in the world with the distribution limited to South-East Asia. Of these, 35 species and 7 varieties occur in India. Except one species i.e. *H. venustum* Wt. in Penninsular India, all other species are distributed in the North-East region, in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and hills of West Bengal. Six species are common to Northern and North-East India. 76·4% of the 34 species of North-East India i.e. 26 species occur within Meghalaya. Excepting *H. coronarium* Koen. Which also occur in the plains of Bihar, Madhya Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and in Andaman and Nicobar Island, all the other species have their habitat in the hills, at altitudes of 1000—2500 m.

The species of *Hedychium* Koen. are very much alike morphologically. Even microscopic characters like stomatal patterns and pollen grains are also very similar in various species. Thus, critical determination of *Hedychium* species only on herbarium material is difficult. Field work and observation of the species in the natural habitat considerably help in a confident recognition of the various species.

Apart from the few epiphytic species like *H. teneuiflorum, H. longipedunculatum* and *H. aureum,* all other species are terrestrial, growing in moist places and along water margins, usually at the top or slope of hills making the genus *Hedychium* biologically as well as ecologically interesting.

Following analysis, in detail of the distribution pattern of *Hedychium. H. venustum* Wt. is endemic to peninsular India and 10 species listed below, are endemic to North-East India.

1. *H. coronarium* var. *urophyllum* Lodd.
2. V. *coronarium* var. *subditum* Turrill.
3. *H. elwesii* Baker
4. *H. hookeri* Baker
5. *H. speciosum* Wall.
6. *H. luteum* Baker
7. *H. wardii* Fisch.
8. *H. gratum* Wall.
9. *H. tenuiflorum* Schumn.
10. *H. marginatum* Clarke

Field tours and the study of the living collections was made by Rao and

Verma, Rao and Hajra, and A. R. K. Sastry and Verma for the monocot Flora of Assam. During their study they described the following species.

1. *H. calcaratum* Rao and Verma
2. *H. dekianum* Rao and Verma
3. *H. gracillimum* Rao and Verma
4. *H. rubrum* Rao and Verma
5. *H. robustum* Rao and Hajra
6. *H. radiatum* Rao and Hajra
7. *H. longipedunculatum* Sastry and Verma

So far the above species are known from the type locality and not from any other place. Thus they are also endemic. 51·4% of the 35 species i.e. 18 species are endemic to the country.

Applying the criteria listed by Cain (1944) we find that several closely related genera of *Hedychium* like *Hitchenia*, *Alpinia*, *Amomum*, *Cautleya* and *Globba* all occur in this region. Further, species diversity itself is very pronounced, in addition to the species concentration i.e. out of 60 species of the world 34 are present in North-East India. All these together lead to the conclusion that in all probability North-East India is the centre of origin of the genus *Hedychium*.

Wight in his description of *H. venustum* doubtfully mentioned its locality as Coorg but there is no collection from Coorg, whole subsequent workers collected *H. venustum* from Nilgiris. To determine the type locality and present distribution of this species, a tour was undertaken during September 1980, it was possible to locate a population of 30 plants at Naduvattam. This marks the first recent collection after, 1925, a gap of almost 55 years. This, and the absence of collections, so far from Coorg, in all probability indicates that the type locality is not Coorg but only Nilgiris.

Following species are poorly represented in herbaria.

1. *H. gratum* Wall.
2. *H. hookeri* Baker
3. *H. marginatum* Clarke
4. *H. aureum* Baker
5. *H. luteum* Baker
6. *H. tenuiflorum* Schumn.
7. *H. greenii* Smith

During field tours to Meghalaya and Assam specially for collection of *Hedychium*, it was not possible to find the above species.

The available information and personal field experience suggest that the causes of rarity could be developmental activities like broadening of roads, constructions of new buildings, townships, deforestation and natural calamities like landslides, change in Courses of Nalahs, streams and rivers courses.

In 1966 several species of *Hedychium* had been brought and grown at 'woodlands' the head quarters of the Eastern Circle, B. S. I. at Shillong, with a few species at Barapani, at a lower elevation. They are all doing well even now. Further, during the current studies of the revision of the genus, an attempt

has been made to conserve the *Hedy hium* species. About 15 of them have been collected from South-India and Meghalaya. They have been introduced in the Indian Botanic Garden, Howrah. They are flourishing with two of them *H. calcaratum* and *H. ellipticum* flowering in June 1981 at the Indian Botanic Garden, Howrah.

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41

Endemic and Rare Species of Calanthe R. Br. (Orchidaceae) in India

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Calanthe R. Br. is a genus of beautiful terrestrial orchids. It has about 200 species distributed in tropical and sub-tropical Asia, Islands of the pacific ocean, Africa and America. Of these, 21 occur in India, distributed in the states of Himachal Pradesh, Punjab and Uttar Pradesh in the north; West Bengal, Sikkim, Arunachal Pradesh, Assam, Nagaland, Mizoram, Manipur, Meghalaya and Tripura in the east; Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Andaman Islands in the south, and Maharashtra and Goa in the west. However, they exhibit maximum concentration in the Himalayas, particularly in the Eastern Himalayas. Of the 21 species in India, 17 are 'wide'. The few common ones that may be mentioned in this category are *Calanthe brevicornu* Lindl., *C. masuca* (D. Don) Lindl., *C. plantaginea* Lindl., *C. puberula* Lindl., *C. tricarinata* Lindl. and *C. triplicata* (Willem.) Ames. Although, they are widespread in general, a close look in the localities of their occurrence, reveals that they are actually scarce. The plants occur as single scattered individuals and only after sustained search, a few plants could be gathered. This conclusion was arrived at after 3 year's detailed study of the genus in the Herbarium and field, taxonomically and phytogeographically.

The situation is still worse in the case of four species which are endemic or rare. These are *Calanthe pachystalix* Hook. f., *C. wightiana* K. & P., *C. alpina* Lindl. and *C. trulliformis* K. & P. all from the Himalayas.

Falconer's collection from N. W. Himalaya was the basis for describing *Calanthe pachystalix* by J. D. Hooker. Later, it was collected thrice by Mackinnon during June 1898 -July 1899 around Mussoorie at an altitude of 1525 to 1830 m. No subsequent collection has been made till now!

Calanthe wightiana K. & P. was collected first in 1886, from Dulkajhar, Sikkim and also from Tsungthang in 1895 by Pantling, although, the species has been established on the basis of Pantling's collection of May 1897 from Tsungthang, at 1830 m. A search has been made specifically in the type locality and other similar localities for about 15 days, during May -June 1980, but in vain. No subsequent collection has been made till now!

J. D. Hooker's collection from Lachen, Sikkim Himalaya, at about 3050 m in the month of July, was the basis for Lindley's *Calanthe alpina*. Later, it was collected thrice by Pantling in the years 1895-1897, from Tsungthang and Lachen Valley at an altitude of 1675-2440 m. Smith and Cave have also

collected it from Lachen, at an altitude of 2600 m on July 20th 1909. After this, no collection has been made from Sikkim. Incidentally, during the present study, it was discovered that a problematic collection of Champion in 1920 from Dwali, N. W. Himalaya, at 2750 m was really *C. alpina*. This extends the range from Sikkim to Kumaon Himalaya with a long gap in-between.

Based on Pantling's collection during July 1891 from Mahaldaram, Sikkim at 1830 m, King and Pantling described *C. trulliformis*. Later, it was collected every year between 1894-1897 by Pantling from Mahaldaram, Lachoong Valley, Sinchal and again from Mahaldaram respectively. A visit at Sinchal and Lachoong in 1979 and 1980 respectively, has been made but in vain. However, Balakrishnan had collected a vegetative plant from Eastern Bhutan which flowered at the National Orchidarium, Shillong, in June 1966. This proved to be *C. trulliformis*, thus, extending its distribution towards north.

While the above two rare species of Sikkim have been located, at least once in N. W. Himalaya and Bhutan respectively, it is felt that *Calanthe pachystalix* Hook. f. and *C. wightiana* K. &. P. are very near extinction or might have even already become extinct! It is preferable to wait for some more time before pronouncing the verdict. Meanwhile, further attempts should be made to search for these rare species.

There is an urgent need for protecting and propagating these obviously vanishing species. A practical method is by *ex situ* cultivation in Botanical Gardens. There is a good case for special sections in botanical gardens (rare plant garden) devoted to the rescuing and rearing of rare plant species, particularly orchids, in different parts of the country.

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Endemic Grasses of India with an Emphasis on Rare, Indeterminate and Extinct Species

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Introduction

J. D. Hooker (1896) reported 135 genera, 734 species, 2 subspecies and 39 varieties of grasses (including bamboos) from the areas of the present day India. Since then, 448 species, 1 subspecies and 109 varieties have been added, either as new species or new records from this region (Bor, 1960; Calder, *et al.* 1926; Nayar & Karthikeyan, 1981; Nayar & Ramamurthy, 1973; Razi, 1959). Owing to the changing taxonomic concepts and nomenclatural changes in addition to the publication of new genera the total number of genera is presently considered to be 248. Of these, 16 genera, 299 species, 2 subspecies and 43 varieties are found to be endemic to India. The endemic species and varieties are spread over 92 genera.

A table has been provided to clearly illustrate the point. (Table. 1).

Enumeration : Endemic Genera

According to Nayar (1980) there are about 141 endemic genera distributed over 47 families in India, and Acanthaceae and Gramineae have the largest number of endemic genera. It is found that 16 genera of Gramineae are endemic in India, and they are as follows (number of species under each genus has been indicated within brackets). Their distribution in India has also been indicated.

I. *Andropogoneae :*

(a) Peninsular India : *Bhidea* Stapf ex Bor (1), *Manisuris* L. (9 spp. + 2 var.), *Pogonachne* Bor (1), *Pseudodichanthium* Bor (1) and *Triplopogon* Bor (1).

(b) Himalaya : *Ischnochloa* Hook. f. (1).

(c) *General: Indochloa* Bor (2) and *Lophopogon* Hack. (3) from Peninsular India to Madhya Pradesh and Bihar.

II. *Maydeae:*

Peninsular India : *Trilobachne* Schenck & Henr. (1).

III. *Pooideae:*

(a) Peninsular India : *Danthonidium* Hubb. (1), *Hubbardia* Bor (1), *Indopoa* Bor (1), *Limnopoa* Hubb. (1), and *Normanboria* Butzin (1).

Table 1

Groups of Gramineae	Genera reported by Hooker		Genera added		Spp. reported by Hooker		Spp. added		S. spp. reported by Hooker		S. spp. added		var. reported by Hooker		var. added	
	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W
ANDROPOGONEAE	2	23	6	31	24	137	19	70	—	—	—	—	1	6	7	25
MAYDEAE	—	3	1	4	1	7	—	5	—	—	—	—	2	—	—	—
PANICEAE		14		16	8	101	4	67				1	2		8	10
FOOIDEAE	1	80	9	44	63	274	40	175	1	1	1	1	12	14	9	20
BAMBUSOIDEAE	—	12	—	5	24	43	4	3	—	—	—	—	6	—	—	—
Total	3	132	15	100	172	562	127	321	1	1	1	1	19	20	24	89

(E—Endemic; W—Wide)

(b) Himalaya : *Cyathopus* Stapf (1), and *Pseudodanthonia* Bor & Hubb. (1).

Their distribution pattern shows that majority of them, i.e. 11 are from peninsular India, which reinforces the view of Turrill (1964) that endemism is often marked in peninsular than in continental areas.

Endemic Species

A list of the state-wise endemic species has been provided. A few species occurring only in Himalayas and Nilgiris have been separately listed. Those species which have been found to occur in more than one State or phyto-geographic range have been listed under 'General' category.

I. State-wise

1. Andaman & Nicobar Islands :

Bambusa schizostachyoides (Kurz) Kurz ex Gamble, *Dendrocalamus strictus* (Roxb.) Nees var. *pariniana* Gamble, *Dinchloa tjankorreh* (Schultes) Buse var. *andamanica* (Kurz) Gamble.

2. Andhra Pradesh :

Arthraxon echinatus (Nees) Hochst., *Arundinella setosa* Trin. var. *lanifera* Fischer, *Chrysopogon velutinus* (Hook. f.) Bor, *Dimeria fischeri* Bor, *Iseilema venkateswarlui* Satyavathi.

3. Assam :

Bambusa mastersii Munro, *Hymenachne assamica* (Hook. f.) Hitchc., *Misconthus wardii* Bor, *Paspalum longifolium* Roxb. var. *larirhachis* Bor, *Phyllostachys assamica* Gamble ex Brandis, *Poa wardiana* Bor, *Rottboellia goalparensis* Bor, *Sclerostachya milroyi* Bor, *Thamnocalamus prainii* (Gamble) E. G. Camus.

4. Bihar :

Agrostis brachiata Munro ex Hook. f., *Chrysopogon hamiltonii* (Hook. f.) Haines, *Dendrocalamus sericeus* Munro, *Dimeria ornithopoda* Trin, var. *gracillima* Bor, *Indochloa clarkei* (Hack.) Bor, *Iseilema holei* Haines, *Lophopogon kingii* Hook. f.

5. Goa :

Manisuris goaensis Rolla Rao & Hemadri, *M. talbotii* (Hook. f.) Bor.

6. Himachal Pradesh :

Deyeuxia simlensis Bor, *Poa lahulensis* Bor.

7. Jammu & Kashmir :

Agropyron cognatum Hack. var. *shingonense* Melderis ex Bor, *A. dentatum* Hook. f. var. *elatum* Hook. f., *A. dentatum* Hook. f. var. *kashmiricum* Melderis ex Bor,

A. striatum Nees ex Steud. var. *validum* Melderis ex Bor, *Calamagrostis decora* Hook. f., *Deyexia kashmiriana* Bor, *Digitaria stewartiana* Bor, *Festuca levingei* Stapf, *Lophochloa clarkeana* (Domin) Bor, *Schizachyrium impressum* (Hack.) A. Camus.

8. Karnataka :

Arthraxon depressus Stapf ex Fischer, *Dichanthium magdaleni* (Almeida) Jain & Deshpande, *D. paranjpyeanum* (Bhide) Clayton, *Dimeria bialata* Fischer, *D. hohenackeri* Hochst. ex Miq., *D. ornithopoda* Trin. var. *khasiana* Bor, *D. ornithopoda* Trin. var. *megalantha* Bor, *D. santapaui* Almeida, *Hubbardia heptaneuron* Bor, *Isachne gracilis* Hubb., *I. meeboldii* Fischer, *I. mysorensis* Sundararaghavan, *Ischaemum lisboae* Hook. f., *Manisuris divergens* (Hack.) O. Ktze. var. *hirsuta* (Fischer) Jain, *M. mysorensis* Jain & Hemadri, *Ochlandra talbotii* Brandis, *Urochloa panicoides* P. Beauv. var. *marathensis* (Henr.) Bor

9. Kerala :

Garnotia puchiparensis Bor, *Isachne fischeri* Bor, *I. setosa* Fischer, *Ischaemum travancorense* Stapf ex Fischer, *I. vembanadense* Patil & D'Cruz, *Limonopoa meeboldii* (Fischer) Hubb., *Ochlandra enbracteata* Raizada & Chatterji, *O. scriptoria* (Dennst.) Fischer, *O. travancorica* (Bedd.) Benth ex Gamble var. *hirsuta* Gamble, *O. wightii* (Munro) Fischer, *Oxytenanthera bourdillonii* Gamble.

10. Maharashtra :

Arthraxon deccanensis Jain, *A. inermis* Hook. f., *A. inermis* Hook. f. var. *tzvelvii* Jain, *A. jubatus* Hack., *A. junnarensis* Jain & Hemadri, *A. purandharensis* Bharucha, *A. raizadae* Jain, Hemadri & Deshpande, *A. santapaui* Bor, *Arundinella spicata* Dalz., *Bhidea burnsiana* Bor, *Coelachne minuta* Bor, *Danthonidium gammiei* (Bhide) Hubb., *Dichanthium armatum* (Hook. f.) Blatt. & McC., *D. compressum* (Hook. f.) Jain & Deshpande, *D concanensis* (Hook. f.) Jain & Deshpande, *D. jainii* (Deshpande & Hemadri) Deshpande, *D. maccannii* Blatt., *D. odoratum* (Donna Lisboa) Jain & Deshpande, *D. panchganiensis* Blatt. & McC., *D. woodrowii* (Hook. f.) Jain & Deshpande, *Dimeria blatteri* Bor, *D. stapfiana* Hubb. ex Pilger, *D. woodrowii* Stapf, *Isachne bicolor* Naik & Patunkar, *I. borii* Hemadri, *Ischaemum bolei* Almeida, *I. bombaiense* Bor, *I. diplopogon* Hook. f., *I. huegelii* Hack., *I. impressum* Hack., *I. ritchiei* Stapf ex Bor, *I. santapaui* Bor, *I. tumidum* Stapf ex Bor, *Manisuris ratnagirica* Kulkarni & Hemadri, *M. santapaui* Jain & Deshpande, *Panicum deccanense* Naik & Patunker, *P. paianum* Naik & Patunkar, *P. paianum* var. *minor* Naik & Patunkar, *P. pholniclados* Naik & Patunkar, *Pogonachne racemosa* Bor, *Pseudanthistiria intermedia* Birari & D'Curz, *Pseudodichanthium serrafalcoides* (Cooke & Stapf) Bor, *Triplopogon ramosissimus* (Hack.) Bor, *Tripogon polyanthus* Naik & Patunkar, *Urochloa panicoides* P. Beauv. var. *velutina* (Henr.) Bor.

11. Madhya Pradesh :

Dichanthium grahami (Haines) Cope, *Digitaria duthieana* Henr. ex Bor, *Eremopogon tuberculatus* (Hack.) A. Camus, *Iseilema hubbardii* Uppuluri, *Lophopogan duthiei* Stapf ex Bor.

12. Manipur :

Agrostis wardii Bor, *Dichanthium planipedicellatum* (Bor) Jain & Deshpande.

13. Meghalaya :

Agrostis filipes Hook. f., *A. griffithiana* (Hook. f.) Bor, *Arundinaria hirsuta* Munro, *A. mannii* Gamble, *Arundinella intricata* Hughes, *Cephalostachyum pallidum* Munro, *Chimonobambusa khasiana* (Munro) Nakai, *Deyeuxia elatior* (Griseb.) Hook. f., *Digitaria compacta* (Roth ex R. & S.) Veldk., *D. jubata* (Griseb.) Henr., *Eragrostiella leiopetra* (Stapf) Bor, *Eulalia speciosa* (Debeaux) O. Ktze. var. *velutina* (Hack.) Bor, *Festuca rubra* L. var. *clarkei* Stapf, *Hierochloe khasiana* Cl. ex Hook. f., *Isachne scabrosa* Hook. f., *Ischaemum hubbardii* Bor, *Panicum khasianum* Munro ex Hook. f., *Phyllostachys mannii* Gamble, *Pogonatherum rufo-barbatum* Griff.

14. Nagaland :

Agrostis nagensis Bor, *Andropogon munroi* C. B. Cl., *Arundinaria rolloana* Gamble, *Dichanthium nagense* (Bor) Deshpande, *D. pteropechys* (Cl.) Jain & Deshpande, *Deyeuxia nagarum* Bor, *Isachne clarkei* Hook. f., *Panicum incisum* Munro ex Cl., *Themeda huttonensis* Bor.

15. Orissa :

Dimeria orissae Bor, *Themeda mooneyi* Bor, *T. saxicola* Bor.

16. Punjab :

Digitaria sanguinalis (L.) Scop. ssp. *vulgaris* var. *rottleriana* Henr.

17. Rajasthan :

Cenchrus prieurii (Kunth) Maire var. *scabra* Bhandari, *C. rajasthanensis* Kanodia & Nanda, *Ischaemum kingii* Hook. f., *Lasiurus scaudatus* Satyanar. & Shankarnar.

18. Sikkim :

Agropyron sikkimense Melderis ex Bor, *Agrostis debilis* (Hook. f.) Bor, *A. inaequiglumis* Griseb., *A. pilosula* Trin. var. *ciliata* (Trin.) Bor, *A. sikkimensis* Bor, *A. triaristata* (Hook. f.) Bor, *Anthoxanthum sikkimense* (Maxim.) Ohwi, *Arthraxon hookeri* (Hack.) Henr., *Catabrosa sikkimensis* Stapf ex Hook. f., *Cyathopus sikkimensis* Stapf. *Deyeuxia nivicola* Hook. f., *Festuca polycolea* Stapf var. *brevis* Stapf, *F. rubra* L. ssp. *schlagintweitii* St. Yves, *F. undata* Stapf, *F. undata* var. *aristata* Stapf, *Helictotrichon parviflorum* (Hook. f.) Bor, *Hierochloe flexuosa* Hook. f., *Isachne dimyloides* Bor, *I. sikkimensis* Bor, *Poa gammieana* Hook. f., *Poa polyneuron* Bor, *P. sikkimensis* Bor, *Themeda hookeri* (Griseb.) A. Camus, *Trisetum scitulum* Bor.

19. Tamil Nadu :

Anthoxanthum borii Jain & Pal, *Arundinella setosa* Train. var. *nilagiriana* Subbarao & Kumari, *A. vaginata* Bor, *Brachiaria nilagirica* Bor, *Cenchrus glaucus* Mudaliyar

& Sundararaj, *Chloris wightiana* Nees ex Steud., *Dichanthium foulkesii* (Hook. f.) Jain & Deshpande, *Dimeria acutipes* Bor, *D. deccanensis* Bor, *Enteropogon coimbatorensis* K. K. N. Nair, Jain & Nayar, *Eragrostis rottleri* Stapf apud Hook. f., *Helictotrichon schmidii* (Hook. f.) Henr., *Heteropogon fischerianus* Bor, *Isachne angladei* Fischer, *I. dispar* Trin. var. *villosa* Fischer, *I. kunthiana* (Wt. & Arn. ex Steud.) Miq. var. *latifolia* Hook. f., *Ischaemum koenigii* (Hook. f.) Stapf ex Fischer, *Normanboria henrardiana* (Bor) Butzin, *Sorghum stapfii* (Hook. f.) Fischer, *Tripogon pungens* Fischer, *Zenkenia sebastinei* Henry & Chandr.

20. Uttar Pradesh :

Arundinaria jaunsarensis Gamble, *Eragrostis ciliaris* (L.) R. Br. var. *clarkei* Stapf ex Hook. f., *Eulaliopsis duthiei* Sur, *Festuca lucida* Stapf, *Hemarthria hamiltoniana* Steud., *Imperata cylindrica* (L.) P. Beauv. var. *latifolia* (Hook. f.) Hubb., *Ischnochola falconeri* Hook. f., *Oryzopsis humilis* Bor, *Poa pseudomoena* Bor, *P. rhadina* Bor, *Pogonatherum santapaui* Sur, *Stipa duthiei* Hook. f., *Themeda dacruzii* Birari, *Trisetum micans* (Hook. f.) Bor.

II. Species in Himalayas & Nilgiris :

1. *Himalayas:*

Agropyron duthiei Melderis ex Bor, *Agrostisp ilosula* Trin. var. *royleana* (Trin.) Bor, *Arundinaria suberecta* Munro, *Bromus himalaicus* Stapf *apud.* Hook. f. var. *grandis* Stapf, *Bromus japonicus* Thunb. var. *falconeri* (Stapf) Stewart, *Calamagrostis garhwalensis* Hubb. & Bor, *Danthonia jacquemontii* Bor var. *minor* (Hook. f.) Bor, *Dendrocalamus parishii* Munro, *Deyeuxia pulchella* (Griseb.) Hook. f., *Eulalia mollis* (Griseb.) O. Ktze., *E. hirtifolia* (Hack.) A. Camus, *Festuca modesta* Steud., *Isachne himalaica* Hook. f., *Poa stapfiana* Bor, var. *micranthera* (Stapf ex Hook. f) Bor, *Pseudodanthonia himalaica* (Hook. f.) Bor & Hubb., *Sehima notatum* (Hack.) A. Camus, *Spodiopogon dubius* Hack., *Stipa roylei* (Nees) Mez, *Tripogon filiformis* Nees ex Steud. var. *tenuispica* Hook. f.

2. Nilgiris :

Agrostis schmidii (Hook. f.) Bor, *Arundinaria wightiana* Nees var. *hispida* Gamble, *Arundinella purpurea* Hochst. ex Steud. var. *laxa* Bor, *Dichanthium pallidum* (Hook. f.) Stapf ex Fischer, *Eriochrysis rangacharii* Fischer, *Helictotrichon polyneurum* (Hook. f.) Henr., *Isachne deccanensis* Bor, *I. oreades* (Domin) Bor, *Ochlandra setigera* Gamble, *Poa gamblei* Bor.

III. General :

Agrostis myriantha Hook. f. (Assam, Meghalaya, Nagaland, Sikkim), *A. peninsularis* Hook. f. (Kerala, Tamil Nadu), *A. zenkeri* Trin. (Meghalaya, Nilgiris, Sikkim), *Apocopis vaginata* Hack. (Andhra Pradesh, Bihar, Madhya Pradesh, Uttar Pradesh), *Aristida redacta* Stapf (Andhra Pradesh, Karnataka, Tamil Nadu, Madhya Pradesh, Maharashtra), *A. stocksii* (Hook. f.) Domin (Karnataka, Maharashtra), *Arthraxon lanceolatus* (Roxb.) Hochst. (Peninsular

India), *A. lancifolius* (Trin.) Hochst. var. *hindustanicus* Jain & Deshpande (Goa, Gujarat), *A. meeboldii* Stapf (Peninsular India to Rajasthan and Madhya Pradesh), *A. nitidulus* Stapf ex Bor (from Karnataka to Rajasthan), *A. satarensis* Almeida *emend* Deshpande & Hemadri (Karnataka, Maharashtra), *A. villosus* Fischer (Karnataka, Maharashtra), *Arundinella ciliata* (Roxb.) Nees ex Miq. (S. India), *A. decempedalis* (*O.* Ktze.) Janowski (Sikkim, Terai, Plains of Bengal and Assam), *A. khaseana* Nees ex Steud. (Assam, Meghalaya, Nagaland), *A. mesophylla* Nees ex Steud. (S. India), *A. metzii* Hochst. ex Miq. (Peninsular India), *A. nervosa* (Roxb.) Nees ex Hook. & Arn. (Karnataka, Tamil Nadu), *A. purpurea* Hochst. ex Steud. (Kerala, Tamil Nadu), *A. tuberculata* Munro ex Lisboa (Concan and Central India), *Bambusa khasiana* Munro (Meghalaya, Manipur), *Cephalostachyum capitatum* Munro var. *decompositum* Gamble (Meghalaya, Sikkim), *Chimonobambusa polystachya* (Kurz ex Gamble) Nakai (Meghalaya, Sikkim), *Chloris bournei* Rang. & Tad. (S. India), *Chrysopogon asper* (Heyne ex Hook. f.) Blatt. & McC. (Peninsular India), *C. hackelii* (Hook. f.) Fischer (S. India), *C. lancearius* (Hook. f.) Haines (Bihar, Sikkim), *C. polyphyllus* (Hack.) Blatt. & McC. (Peninsular India to Central India), *C. verticillatus* (Roxb.) Trin. ex Steud. (Peninsular India), *Cleistachne stocksii* Hook. f. (Peninsular India), *Cymbopogon coloratus* (Nees ex Hook. f.) Stapf (Peninsular India to Madhya Pradesh), *C. gidarba* Ham. ex Hook. f.) Haines (Peninsular India to Bihar and Bengal, Western Himalaya), *Cyrtococcum longipes* (Wt. & Arn. ex Hook. f.) A. Camus (S. India), *Dendrocalamus patellaris* Gamble (Nagaland, Sikkim), *Dichanthium filiculme* (Hook. f.) Jain & Deshpande (Peninsular India), *D. huegelii* (Hack.) Jain & Deshpande (Peninsular India), *Digitaria tomentosa* (Koenig ex Willd.) Henr. (Andhra Pradesh, Tamil Nadu), *Dimeria connivens* Hack. (Bihar, Orissa), *Dimeria lawsonii* (Hook. f.) Fischer (S. India), *D. mooneyi* Raizada ex Mooney (Orissa, Tamil Nadu), *Eragrostiella brachyphylla* (Stapf) Bor (Peninsular India to Bengal and Bihar), *E. nardoides* (Trin.) Bor (Bihar to Himalayas), *Eragrostis deccanensis* Bor (S. India), *Eulalia wightii* (Hook. f.) Bor (Andhra Pradesh, Tamil Nadu), *Garnotia arborum* Stapf ex Cooke (Karnataka, Maharashtra), *G. arundinacea* Hook. f. (S. India), *G. elata* (Arn. ex Miq.) Janowsky (S. India, Uttar Pradesh), *G. schmidii* Hook. f. (Karnataka, Tamil Nadu), *Heteropogon polystachyos* (Roxb.) Schult. (S. India), *H. ritchiei* (Hook. f.) Blatt. & McC. (Karnataka to Central India), *Indochloa oligantha* (Hochst. ex Steud.) Bor (Kerala, Tamil Nadu to Maharasthra), *Indopoa paupercula* (Stapf) Bor (Western Ghats), *Isachne bourneorum* Fischer (Karnataka, Tamil Nadu), *I. elegans* Dalz. ex Hook. f. (Tamil Nadu, Maharashtra), *I. lisboae* Hook. f. (Karnataka, Maharashtra), *Ischaemum duthiei* Stapf ex Bor (Bihar, Bengal, Madhya Pradesh), *I. flumineum* Bor (Karnataka, Tamil Nadu), *I. hirtum* Hack. (Bihar, Bengal to Meghalaya), *I. molle* Hook f. (Kerala, Karnataka, Maharashtra), *I. nilagiricum* Hack. (S. India.) *I. pilosum* (Klein ex Willd.) Wt. (Peninsular India to Madhya Pradesh), *I. raizadae* Hemadri & Billore (Karnataka, Maharashtra), *I. rangacharianum* Fischer (Kerala, Tamil Nadu), *I. thomsonianum* Stapf ex C.E.C. Fischer (Karnataka,

Kerala), *Iseilema anthephoroides* Hack. (Peninsular India), *Lophopogon tridentatus* (Roxb.) Hack (Peninsular India to Madhya Pradesh), *Manisuris acuminata* (Hack.) O. Ktze. (Peninsular India), *M. acuminata* var. *woodrowii* Bor (Goa, Karnataka), *M. clarkei* (Hack.) Bor *apud* Santapau (Peninsular India upto Bihar, Gujarat and Madhya Pradesh, *M. furficulata* Fischer emend. Jain (Peninsu'ar India), *M. myuros* L. (Andhra Pradesh, Tamil Nadu), *Ochlandra beddomei* Gamble (Kerala, Tamil Nadu), *O. scriptoria* (Dennst.) Fischer var. *sivagiriana* (Gamble) Fischer (Kerala, Tamil Nadu), *O. travancorica* (Bedd.) Benth. ex Gamble (Karnataka, Tamil Nadu), *Ophiuros bombaiensis* Bor (Karnataka, Maharashtra, Tamil Nadu), *Oropetium roxburghianum* (Steud.) S. M. Phillips (Andhra Pradesh, Maharashtra), *O. villosulum* Stapf ex Bor (Andhra Pradesh, Madhya Pradesh, Maharashtra, Orissa), *Oryza officinalis* Wall. ex Watt. ssp. *malampuzhaensis* (Krishnasw. & Chandrasek.) Tateoka (Andhra Pradesh, Kerala, Tamil Nadu,) *Oxytenanthera monostigma* Bedd. (Karnataka, Tamil Nadu), *O. ritcheyi* Blatt. & McC. (Maharashtra, Tamil Nadu), *Panicum fischeri* Bor (Andhra Pradesh, Tamil Nadu), *Parahyparrhenia bellariensis* (Hack.) W. D. Clayton (Andhra Pradesh, Gujarat), *Paspalum canarae* (Steud.) Veldk. (Khasia and Naga Hills Rajasthan, S India), *P. canarae* var. *fimbriatum* (Bor) Veldk. (Karnataka, Maharashtra), *Poa khasiana* Stapf ex Hook. f. (Meghalaya, Naga Hills), *Pseudanthistiria heteroclita* (Roxb.) Hook. f. (Karnataka, Kerala, West Bengal), *P. hispida* Hook. f. (Karnataka, Madhya Pradesh, Maharashtra), *Pseudoraphis minuta* (Mez) Pilger (Assam, Bihar, W. Bengal), *Sehima sulcatum* (Hack.) A. Camus (S. India to Madhya Pradesh), *Sorghum deccanense* Stapf ex Bor (W. India and Madhya Pradesh), *Spodiopogon rhizophorus* (Steud.) Pilger (Peninsular India). *Teinostachyum beddomei* Fischer (Kerala, Tamil Nadu), *Themeda strigosa* (Ham. ex Hook. f.) A. Camus (Assam, Bihar, Maharashtra, W. Bengal), *Trilobachne cookei* (Stapf) Schenck ex Henr. (Karnataka, Maharashtra), *Tripogon capillatus* Jaub. & Spach. (W. Ghats in Kerala & Karnataka to Bihar), *T. jacquemontii* Stapf (Gujarat, Kerala, Tamil Nadu), *T. lisboae* Stapf (W. India) *T. wightii* Hook. f. (India), *Vetiveria lawsonii* (Hook. f.) Blatt. & McC. (Peninsular India).

Rare, Indeterminate or Extinct Grasses:

1. *Rare species :*

The 'IUCN Red Data Book' (Lucas & Synge, 1978) defines this as "taxa with small world populations that are not at present endangered or vulnerable but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range."

About 84 species and 4 varieties of grasses are considered as rare. It is stressed that this is a tentative judgement and may be altered with more field studies and reference to the Herbaria in India.

Agrostis schmidii (Hook. f.) Bor (Nilgiris), *Anthoxanthum borii* Jain & Pal (Pulneys), *Arthraxon depressus* Stapf ex Fischer (Karnataka), *A. nitidulus*

Stapf ex Bor (Peninsular India), *Arundinella setosa* Trin. var. *lanifera* Fischer (E. Ghats), *A. tuberculata* Munro ex Lisboa (Concan & C. India), *A. vaginata* Bor (Tamil Nadu), *Bhidea burnsiana* Bor (Maharashtra), *Brachiaria nilagirica* Bor (Nilgiris), *Cleistachne stocksii* Hook. f. (Karnataka, Kerala), *Coelachne minuta* Bor (Maharashtra), *Cyathopus sikkimensis* Stapf (Sikkim), *Danthonidium gammiei* (Bhide) Hubb. (Maharashtra), *Deyeuxia nagarum* Bor (Nagaland), *Dichanthium foulkesii* (Hook. f.) Jain & Deshpande (Tamil Nadu), *D. maccannii* Blatt. (Maharashtra), *D. pallidum* (Hook. f.) Stapf ex Fischer (Nilgiris), *D. panchganiensis* Blatt. & McC. (Maharashtra), *Digitaria jubata* (Grisseb.) Henr. (Meghalaya), *D. tomentosa* (Koenig ex Willd.) Henr. (Tamil Nadu), *Dimeria acutipes* Bor (Tamil Nadu), *D. bialata* Fischer (Karnataka), *D. blatteri* Bor (Maharashtra), *D. deccanensis* Bor (Tamil Nadu), *D. fischeri* Bor (Tamil Nadu), *D. hohenackeri* Hochst. ex Miq. (Karnataka, Maharashtra), *D. lawsonii* (Hook. f.) Fischer (S. India), *D. mooneyi* Raizada ex Mooney (Orissa), *D. orissae* Bor (Orissa), *D. stapfiana* C. E. Hubb. ex Piler (Maharashtra), *Eulalia wightii* (Hook. f.) Bor (Andhra Pradesh, Tamil Nadu), *Festuca levingei* Stapf (Jammu & Kashmir), *Garnotia arborum* Stapf ex Cooke (Maharashtra, Karnataka), *G. puchiparensis* Bor (Silent Valley, Kerala), *Heteropogon fischerianus* Bor (Tamil Nadu), *H. ritchiei* (Hook. f.) Blatt. & McC. (C. India, Maharashtra), *Indochloa clarkei* (Hack.) Bor (Bihar, Rajasthan) *I. oligantha* (Hochst. ex Steud.) Bor (Kerala, Maharashtra, Tamil Nadu), *Indopoa paupercula* (Stapf) Bor (Karnataka, Kerala, Maharashtra), *Isachne angladei* Fischer (Tamil Nadu), *I. bourneorum* Fischer (Karnataka, Tamil Nadu), *I. deccanensis* Bor (Nilgiris), *I. dimyloides* Bor (Sikkim) *I. dispar* Trin. var. *villosa* Fischer (Tamil Nadu), *I. fischeri* Bor (Kerala), *I. gracilis* Hubb. (Karnataka), *I. lisboae* Hook. f. (Karnataka, Maharashtra), *I. meeboldii* Fischer (Karnataka), *I. oreades* (Domin) Bor (Nilgiris), *I. setosa* Fischer (Kerala), *Ischaemum bombaiense* Bor (Maharashtra), *I. flumineum* Bor (Maharashtra, Tamil Nadu), *I. impressum* Hack. (Maharashtra), *I. lisboae* Hook. f. (Karnataka), *I. rangacharianum* Fischer (Kerala, Tamil Nadu), *I. ritchei* Stapf ex Bor (Maharashtra), *I. santapaui* Bor (Maharashtra), *I. thomsonianum* Stapf ex Fischer (Kerala, Karnataka), *I. travancorense* Stapf ex Fischer (Kerala), *I. tumidum* Stapf ex Bor (Maharashtra), *Ischnochloa falconeri* Hook. f. (N. W. Himalayas), *Lophochloa clarkeana* (Domin) Bor (Jammu & Kashmir), *Lophopogon duthiei* Stapf ex Bor (Madhya Pradesh), *Manisuris acuminata* (Hack.) O. Ktze. var. *woodrowii* Bor (Goa, Karnataka), *Ochlandra beddomei* Gamble (Kerala Tamil Nadu), *O scriptoria* (Dennst.) Fischer (Kerala), *O. talbotii* Brandis (Karnataka), *O. travancorica* (Bedd.) Benth. ex Gamble var. *hirsuta* Gamble (Kerala), *Ophiuros bombaiensis* Bor (Karnataka, Tamil Nadu, Maharashtra), *Oropetium roxburghianum* (Steud.) S. M. Phillips (Andhra Pradesh), *Oxytenanthera bourdillonii* Gamble (Kerala), *O. ritcheyi* Blatt. & McC. (Maharashtra, Tamil Nadu), *Panicum fischeri* Bor (Andhra Pradesh, Tamil Nadu), *P. khasianum* Munro ex Hook. f. (E. Himalayas), *Parahyparrhenia bellariensis* (Hack.) W. D. Clayton (Andhra Pradesh, Gujarat), *Pogonachne racemosa* Bor (Maharashtra), *Pseudodanthonia himalaica* (Hook. f.) Bor & Hubb. (N. W. Himalayas), *Pseudodichanthium*

serrafalcoides (Cooke & Stapf) Bor (Maharashtra), *Sorghum deccanense* Stapf ex Bor (Madhya Pradesh, W. India), *Teinostachyum beddomei* Fischer (Kerala, Tamil Nadu), *Trilobachne cookei* (Stapf) Schenck ex Henr. (Karnataka, Maharashtra), *Themeda mooneyi* Bor (Orissa), *T. saxicola* Bor (Orissa), *Tripogon capillatus* Jaub. & Spach. (W. Ghats, Bihar), *T. jacquemontii* Stapf (Gujarat to Kerala), *T. lisboae* Stapf (W. India), *T. pungens* Fischer (S. India), *T. wightii* Hook. f. (S. India).

2. *Indeterminate Species*

The appropriate status of the species enumerated below can be finalised only after intensive field studies as currently no data on these species are available.

(i) *Andropogon munroi* C.B.Cl.

"So far found only on the high hills in the neighbourhood of Kohima, Naga Hills" (Bor, 1960). Bor states he has seen only the type specimen. No specimen is available for study.

(ii) *Eragrostis rottleri* Stapf *aupd* Hook. f.

This species has not been collected since the type collection.

(iii) *Eriachrysis rangacharii* Fischer

This species also has not been collected after the type collection.

(iv) *Heteropogon polystachyos* (Roxb.) Schult.

Bor (l.c.) states that this is a very obscure species of which he has seen only Wight's gathering, probably the type specimen. It has not been collected again.

(v) *Limnopoa meeboldii* (Fischer) Hubb.

There are no collection of this in MH. Probably known only from the type.

(vi) *Normanboria henrardiana* (Bor) Butzin.

No collections after the type collection which has been made about 40 years ago.

(vii) *Poa gamblei* Bor

The species has been published based on specimens collected by Gamble and Mayuranathan (Bor, 1948) from Nilgiris more than 5 decades ago. No collections have been made afterwards.

(viii) *Schizachyrium impressum* (Hack.) A. Camus

According to Bor (l.c.) the type collection is the sole representative of this species.

(ix) *Trisetum micans* (Hook. f.) Bor

This species is also known from the type collection only, which has been collected about 70 years ago (Bor, l.c.).

3. *Extinct species :*

Hubbardia heptaneuron Bor, could not be collected after the type collection. The *IUCN plant red data book* suggests that it is "presumed extinct".

It is apprehended that a few more species may join this category from the 'indeterminate' species, unless steps are initiated to locate and conserve them.

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43
Threatened species of Indian Araceae

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Ignorance of economic potential and ecological functions of plants have caused indiscriminate annihilation of vegetation and it has resulted in depletion of plant resources, decline in genetic diversity and even their extinction. Many factors, both man-made and natural have been responsible for limiting the distribution and existence of various species.

Demolition of special habitats are due to reclamation of marsh-lands, development of drainage schemes, construction of dams for irrigation and electricity and subsequent alteration of ground water level, indiscriminate encroachment of forest areas for agriculture and plantation crops, deforestation for extraction of timber and uncontrolled grazing. In addition to these short-sighted and ecologically disruptive acts by man, natural causes such as land upheavels, protracted periods of rain and drought, spreading of desert lands, forest fire etc. also considerably contribute to the extinction of many species. In addition to these the spread of harmful chemicals in the form of fertilizers, pesticides and fungicides and industrial effluents; competition of alien weeds with endemics; spread of plant pests and diseases have also been sources of threat to several native floras. While such man-made and natural processes in the past had no doubt led to the extinction of floras, the resulting new environmental conditions had also resulted in isolation, evolution, speciation and even further extinction of many species.

The threatened taxa are represented by two groups, the first includes endemic species and deserves top priority in conservation, since the preservation of disappearing endemic plants depends solely on the efforts of a single country. Whereas, the second group consists of vanishing peripheral species whose distribution is both within and outside the territory of India and the range and number of which are small even in the neighbouring countries and their conservation need a joint effort of two or more countries. But our major and immediate concern is over the endemic species which occupy limited and specialized habitats. The populations of many of the endemics are not great, which does not mean however, that they are vanishing since there are no evident threat to their existence. Any disturbance or imbalance in their narrowly confined ecosystem could mean extermination of the species and hence such narrow-endemics are considered as threatened plants. In order to have a total list of Indian threatened plants we need to assess all the narrowly endemic plants also.

In the present paper, distributional range of twenty two species of Indian aroids are given, based on studies in field and at various national and international herbaria. Along with the above data acronyms of various herbaria (as given by Holmgren & Keuken, 1974) where representative specimens of those species are available and examined by the author are given in brackets.

1. *Acorus calamus* L. Sp. Pl. 1: 324, 1753.

A native of north temperate and sub-tropics and recorded to be distributed throughout India, but now very rare in natural habitats and seen mostly under cultivation. The high potential of the rhizome as a source of medicine has rendered the plant very valuable and are being extensively collected for medicinal purposes. Reclamation of marshy areas have also resulted in its rarity. (BM, CAL, CALI, K, M, PCM, US).

2. *Amorphophallus hohenackeri* (Schott) Engler et Gehrm., Pflanzenr. IV. 23C (48): 103, 1911.

Usually found among bushes of scrub jungles and other open areas. Distributed in northern districts of Kerala and Mangalore of Karnataka. In some regions habitats of this species have been disturbed due to conversion of the areas for agriculture, industries and the like. (BM, BSI, CAL, CALI, GH, JCB, K, L, M, US).

3. *Amorphophallus mysorensis* Barnes et Fischer, Bull. Misc. Inf. 10: 661, 1939.

Only reported from Billigirirangan hills of Karnataka and as occurring "under shades of bamboos". No collections are available since its first collection and perhaps extinct now. This taxa is very much allied to *A. hohenackeri* and *A. sylvaticus*. (K).

4. *Amorphophallus sylvaticus* (Roxb.) Kunth, Enum. Pl. 3: 34, 1841.

An endemic species of South India and North and East Sri Lanka, usually found among dry lowland bushes. Reported from very limited localities of Kerala, Tamilnadu, Maharashtra and Andhra Pradesh. Now very rare and no recent collections could be seen from many of the former localities. (BLAT, K, MH).

5. *Anaphyllum beddomei* Engler, Pflanzenr. IV, 23C (48): 26, 1911.

Vary rare and much restricted in its distribution from Tirunelveli hills and Courtallam area of Tamilnadu. Usually occurring in evergreen semi-evergreen forests. (BM, CAL, FRC, K, M, MH).

6. *Anaphyllum wightii* Schott, Bonplandia 5(8): 127, 1857.

Occurs only in the evergreen/semi-evergreen forests of Western ghats in Kerala and adjacent districts of Tamilnadu. Its habitat in some regions are

being destroyed by conversion of forests into plantations. (BM, BSI, CAL, CALI, FRC, GH, K, L, M, MH, NY, PCM, UX, Z).

7. *Arisaema attenuatum* Barnes et Fischer, Bull. Misc. Inf. 4: 275. 1936.
Syn.: *A. peltatum* Fischer, Bull. Misc. Inf. 4: 277. 1936.

Reported from higher ranges of Munnar, Naimakad, and Pallivasal in evergreen forests and shady grassy places. Its threatened status has been reported earlier by Henry et al. (1978). (K, L, NY).

8. *Arisaema auriculata* Barnes, Kew Bull. 1: 44. 1946.

Henry et al. (1978) have already reported its threatened status. No collections of the taxon have been made since its first collection. Reported to be growing in large clumps in high rocks on the Nilambur Ghats. (K).

9. *Arisaema psittacus* Barnes in Hooker, Icon. Pl. 5 (Vth series): t. 3405. 1940.

Barnes reported it to be occurring in shola forests. No recent collections since its first collection are known to be made. Threatened nature of this taxon also has already been disclosed by Henry et al. (1978). (K, NY).

10. *Arisaema sarracenioides* Barnes et Fischer in Hooker, Icon. Pl. 4 (Vth series): t. 3307. 1936.

Originally collected from Naimakad gap and Munnar-Devicolam path in evergreen forests. This antique species also is not known to be collected since its first collection. (K, L, NY).

11. *Arisaema translucens* Fischer, Bull. Misc. Inf. 7: 344. 1933

No collections since its first collection from Carrington Tea Estate near Thia shola in Nilgiri hills (Tamilnadu) are known. Barnes reported it to be occurring also in the edges of a shola near Thia shola (K, MH).

12. *Arisaema tylophorum* Fischer, Bull. Misc. Inf. 7: 346. 1933.

Reported from Thia shola, between Naduvattam and Gudalur malai, and Mudinud of Nilghirry hills. No recent collections are known. (K, MH).

13. *Cryptocoryne cognata* Schott, Bonplandia 5: 222. 1857.

Schott described the species based on a specimen collected by Law from 'Concan'. No specimens are available in any of the Indian herbaria. Cook (1980) reported that it is supposed to be extinct as its habitats have been destroyed. (K).

14. *Cryptocoryne consobrina* Schott, Bonplandia 5: 222. 1857.

The rarity of the species is due to the destruction of habitats consequent to construction of dams and laying the streams and canals. The taxon usually grows along streams and river banks. Its distribution is recorded from

Parambikulam and Karappara rivers of Palghat district, Kerala and Aliyar submergible areas in Coimbatore district of Tamilnadu. A recent collection (1981) has been made by the author from a new locality in Malappuram district of Kerala. Cook (1980) suspected this species also to be extinct. (GH, K, L, MH, NY).

15. *Lagenandra undulata* Sastry, Bull. Bot. Surv. India 9: 294-296, fig. 1 -6. 1967.

This lithophytic, small, rhizomatous herb is the only North Indian species of *Lagenandra* and is of very much limited in distribution. Known only from Amjee river banks, in Subansiri district of Arunachal Pradesh. (CAL, reported to be available in ASSAM also).

16. *Pothos armatus* Fischer, Bull. Misc. Inf. 4: 126. 1929.

A rare root climber known to occur in Tamarassery ('Tambracherry') ghats in Wynad district and ghats from Ponmudi to Kallar in Trivandrum district only on the Western ghats. No new locality has been reported later. Destruction of the habitats has resulted in the rarity of this species. (BSI, CALI, K, L, MH, US).

17. *Pothos thomsonianus* Schott, Aroideae 1: 24, t. 51. 1855.

Collected from evergreen forests of Kulathupuzha (Quilon district, Kerala) and Kannikatty (Tirunelveli district, Tamilnadu) only. (BM, CAL, CALI, FRC, GH, K, MH, PCM).

18. *Sauromatum brevipes* (Hook. f.) N. E. Brown, Gard. Chron. 34: 93. 1903.

Distribution of this taxon is known to be limited to Sikkim and Darjeeling areas. (BM, K).

19. *Theriophonum dalzellii* Schott, Aroideae 1: 15. 1855.

A rare species of restricted distribution and known to occur along the western parts of Maharashtra and Karnataka states. Usually seen growing on open areas. (BSI, CAL, CH, JCB, K, PCM).

20. *Theriophonum fischeri* Sivadasan in Sivadasan & Nicolson, Aroideana 4(2): 64-67. 1981.

A recently described species based on Fischer's collections made in 1910. Known to be distributed in Attappady valley in Palghat district (Kerala) Annamalai in Coimbatore district and Kalakkad hills in Tirunelveli district (Tamilnadu) only. A recent attempt to collect specimens from the type locality was in vain. (CAL, FRC, K).

21. *Theriophonoum sivaganganum* (Ramam. et Seb.) Bogner, Bull. Bot. Surv. India 10(2): 244. 1968.

This interesting species was collected in 1774 and 1777 by Koenig and those specimens are now extant at BM and LINN. The specimens at LINN were determined by Linnaeus f. as *Arum tenuifolium*. Later collection was made in 1964 based on which a 'new' genus and species (*Pauella sivagangana* Ramam. et Seb., Bull. Bot. Surv. India 8: 348, 1966) was recognised which was later transferred to the genus *Theriophonum*. Known to occur only in Esani forest in Sivaganga in Ramanathapuram district of Tamilnadu. Henry et al. (1978) have also reported its threatened status. (BM, CAL, LINN, MH).

22. *Typhonium bulbiferum* Dalzell in Hooker, Kew Journ. 4: 113. 1852.

A rare species found in deciduous forests. Distribution known to be restricted to Dhoni hills and Parambikulam forests in Palghat District, Kerala, and 'Concan' (Karnataka?—specific locality uncertain). (BM, CALI, GH, K, M, US).

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*CALI is informally used for Calicut University Herbarium, University of Calicut, 673 635, Kerala. Assignment of an official acronym by Index Herbariorum is pending.

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44

Tribe Isachneae (family Poaceae)-its Endemism and Rarity in India

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The tribe *Isachneae* (fam. Poaceae) is apparently a natural assemblage of grasses having five genera viz., *Isachne* R. Br., *Coelachne* R. Br., *Limnopoa* C. E. Hubb., *Sphaerocaryum* Nees ex Hook. f. and *Heteranthoecia* Stapf. The latter three genera are monotypic, of which *Limnopoa* is endemic to India (only in Kerala), *Heteranthoecia* is confined to tropical Africa and *Sphaerocaryum* to tropical Asia. The genus *Coelachne* comprising *ca.* 10 species, extends in Old World tropics and subtropics. *Isachne* comprising *ca.* 110 species, extends in tropical and subtropical regions of both hemispheres.

In morphological characters the tribe *Isachneae* differs from all other tribes and particularly from its nearest allies namely the tribe Paniceae in structure and articulation of the spikelet. In the tribe Paniceae the glumes are unequal (lower glume is small to very small compared with the upper glume or sometimes it is even absent) and spikelets have an articulation below the glumes, so that the spikelets fall entire along with glumes at maturity. But in the tribe *Isachneae* the glumes are almost subequal and the spikelets are articulate above the glumes, so that the spikelets break up at maturity above the glumes and between the florets. Although glumes are not persistent in most of the species of Isachneae, but they often fall separately at maturity leaving scars on the lowest internode of the rachilla.

The authors have made critical revisionary study of this tribe, and recognised 28 species of *Isachne*, 3 species and 1 variety of *Coelachne* and 1 species each of *Limnopoa* and *Spahaerocaryum* from India. The tribe shows high degree of endemism in India. It is seen that 18 species of *Isachne* and 1 species and 1 variety of *Coelachne* and the genus *Limnopoa* are endemic to India. Of these, most of the species are confined to Western Ghats. Only two species of *Isachne* are endemic to Sikkim and two to Khasi Hills (Meghalaya). Several species of *Isachne* are so restricted that they are hitherto known only from type locality. Field and herbarium studies have revealed that most of these endemic species are very rare and threatened. These species are not well represented in Indian herbaria and some of them are known from type collections only. The exact distribution, representative specimens in Indian herbaria and rarity of all endemic taxa of the tribe Isachneae are discussed below:

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1. *Isachne angladei* Fischer in Kew Bull. 1932: 323, 1932.

This species was known only from the original collections until author (VP) relocated it in 1978 after several decades. It has been found so far only in the type locality.

Distribution

INDIA: Tamil Nadu, endemic to Anaimalai and Palni Hills.

Representative specimens

Tamil Nadu: Madurai Dist.: Shembagnur, 5500 ft. (± 1650 m), *R. Van Malderen* 1283 (Paratype, CAL); Anaimalai, High Wavy Mountain 4000-5000 ft. (1200-1500 m), May 1917, *E. Blatter & Hallberg* 182 (Paratype, CAL); *E. Blatter & Hallberg* 326 (CAL); Anaimalai, *Beddome s.n.* (MH); Silver Cascade, Kodaikanal (± 1800 m), March 5, 1978 *Ved Prakash* 91A, B (CAL).

2. *I. bicolar* Naik et Patunkar in Bull. bot. Surv. Ind. 15: 157, 1973 (1976).

This species has been recently described by Naik & Patunkar (l.c.) from Aurangabad Dist. (Maharashtra). While revising this tribe the authors located one specimen of this species in Blatter herbarium, Bombay, which was lying under *I. elegans* Dalz. The other collection of this species is of author (VP) who collected it from Panchgani in 1979.

Distribution

INDIA: Western Ghats, endemic to Maharashtra.

Representative specimens

Maharashtra: Aurangabad Dist.: Maismal, 600 m, Oct. 8, 1973, *B. W. Patunkar* 1849B-E (Isotypes, Marathwada Univ.); Satara Dist.: Panchgani, Oct. 1918, *Blatter* 5080 (BLAT); First table land Panchgani, 1000m, Oct 10, 1979, *Ved Prakash* 346A-F (CAL).

3. *I. borii* Hemadri in Indian For. 97: 223-235, 1971.

This species is known so far only from its type collections from Pune Dist (Maharashtra).

Distribution

INDIA; Western Ghats, endemic to Maharashtra.

Representative specimens

Maharashtra: Pune Dist.: Dhak Khila, 27 km West of Junar, Sept. 27, 1968, *K. Hemadri* 117968A (Holotype, CAL); *K. Hemadri* 117968 B-I (Isotypes, B-D in BSI; F in K; G in L; H in MO, I in LE); Bushi lake, A, bavne near lonavla, Aug. 20, 1964, *Reddi* 98672 A-E (Paratypes, BSI).

4. *I. bourneorum* Fischer in Kew Bull. 1932: 324, 1932.

This specis commonly grows in Anaimalai, Palni and Nilgiri Hils of Tamil Nadu. It has been collected so far once from Kerala [Kottayam Dist., Umaiya Malai-Devicolam, 1975 m, Nov. 22, 1965, *B. V. Shetty* 2611 (MH)]. The author (VP) collected this species from Coimbatore Dist. of Tamil Nadu [Akamalai. March 11, 1978, *Ved Prakash* 133 (CAL)].

Distribution

INDIA: Endemic to Tamil Nadu and Kerala at ± 1200-2200 m alt.

Representative specimens

The species is represented by several specimens in CAL & MH.

5. *I. clarkei* Hook f. Fl. Brit. Ind: 7: 24, 1896.

The species is rather common in Khasi Hills of Meghalaya & Naga Hills of Nagaland. Only once collected from Sikkim [Lachung Valley, ± 2400 m —3300 m, *J. D. Hooker* s.n. (K)].

Distribution

INDIA: Endemic to Meghalaya, Nagaland & Sikkim at ± 1500-3300 m alt.

Representative specimens

The species is well represented in Shillong herbarium (Assam). The author (VP) collected this species from several localities of Khasi Hills in 1978 (specimens are in CAL).

6. *I. deccanensis* Bor in Kew Bull. 1949: 95, 1949.

This species has not been collected during last five decades and perhaps become a rare species now.

Distribution

INDIA: Endemic to Nilgiri and Palni Hills of Tamil Nadu at 2000-2250 m alt.

Representative specimens

Tamil Nadu: Madurai Dist. Kodaikanal shola, July 17, 1898, *Bourne* 1281 (CAL): Shembagnur, *L. A. Auglade s.n.* (CAL); Silver falls, Pulneys, May 26, 1898, *Bourne* 1281 (CAL); Nilgiri Dist. Pykara, Aug. 1878, *G. King* s.n. (CAL); Nilgiri, Aramby, 7500 ft. (Ootacamund, ± 2250 m), Aug. 1884, *J. S. Gamble* 15290 (DD); Ootacamund, Aug. 20, 1900, *G. A. Barber* 2597 (MH); muni dairy, Ooty, 7300 ft., Sept. 15, 1930, *V. Narainswami* 4380 (MH); Nilgiris, *Perottet* 1351 & 1352 (DD); Loc., *M. S. Ramaswami* s.n. (CAL). The most of the specimens cited above were lying under *I. australis* R. Br. (=*I. globosa* (Thunb.) O. Ktze).

7. *I. dimyloides* Bor in Kew Bull. 1949: 96, 1949.

It is a very rare species and so far known only from its type collection.

Distribution

INDIA: Endemic to Sikkim at ± 1500 m alt.

Representative specimens

Sikkim Terai, Dulkajhar, 5000 ft (± 1500 m), Oct. 16, 1884, *C. B. Clarke* 36764 (Holotype, K; Isotype, CAL).

8. *I. elegans* Dalz. in Dalz. & Gibs. Bombay Fl. 291, 1861.

Several workers wrongly reported this species from various regions of India. For example, Fischer (1934) reported it from Karnataka & Tamil Nadu, Tiwari (1955) from Madhya Pradesh, Panigrahi et al. (1964) from Orissa and Kanodia & Rolla Rao (1962) from Rajasthan. And Saha et al. (1971) published a note on the range of distribution of this species. But a critical examination of material reveals that interestingly this species is actually still endemic to Maharashtra. The specimens from other regions on which new distribution were reported belonged to another species i.e. *I. globosa* (Thunb.) O. Ktze. Singh et al. (1976) reported it from Karnataka but the authors have not been able to locate any such specimens so far. However, it is quite likely to be found all along with Western Ghats from Mahabaleshwar to Coorg.

Distribution

INDIA: Western Ghats, endemic to Maharashtra at ± 600-1000 m alt.

Representative specimens

The species commonly grows in Bombay, Pune, Satara and Thana Dist. of Maharashtra and well represented in Pune herbarium (BSI). The author (VP) collected it from Panchgani, third table land (Satara Dist.) in 1979 (Specimens are in CAL).

9. *I. fisheri* Bor in Kew Bull. 1949: 69, 1949.

It is a very rare grass and is known so far only from the type locality which has been collected only once after the type by B. V. Shetty in 1965.

Distribution

INDIA: Endemic to Kerala (Idukki Dist.) at ± 2500 m alt.

Representative specimens

Kerala: Idukki Dist. Summit of Anaimudi, Travancore, High range, 8840 ft. (± 2650 m), Sept. 1933, *E. Barnes* s.n. (type K); Anaimudi summit, 2575 m, Nov. 19, 1965, *B. V. Shetty* 26533 (MH).

10. *I. gracilis* C. E. Hubb. in Kew Bull. 1927: 77. 1927.

This is a very handsome grass and occur mainly in Maharashtra in deep shade and moist places on rocks and walls.

Distribution

INDIA: Madhya Pradesh, Maharashtra, Karnataka, endemic, at 600-1800 m alt.

Representative specimens

It is represented by several specimens from Maharashtra (BSI) and from Karnataka only by two collections [Bababudan Hills, ±4000 ft (± 1200 m), Oct. 1908, *A. Meebold* 10781 (Holotype, K; Isotype CAL); Abbi falls, Oct. 20, 1963, *A. S.* Rao 94975 (BSI)] and from Madhya Pradesh by one collection [Mahadeo falls, Oct. 17, 1960, *S. D. N. Tiwari* 229 (DD)]. The author (VP) collected this species from Lonavla, Panchgani and Mahabaleshwar (Maharashtra) in 1979 (Specimens in CAL).

11. *I. lisboae* Hook f. Fl. Brit. Ind. 7: 22, 1896.

This species is very local inhabiting apparently only the Panchgani and Mahabaleshwar plateau (Maharashtra).

Distribution

INDIA: Western Ghats, endemic to Maharashtra and Karnataka at ±1000—1500 m alt.

Representative specimens

It is represented by several specimens in CAL, BSI & BLAT. Only once collected from Karnataka [Bababudan Hills, Yr. 1890, *W. A. Talbot* 2330 (CAL).] The author (VP) collected this species from third table land Panchgani (Satara Dist., Maharashtra), growing subgregariously in small area around the water line (specimens in CAL).

12. *I. meeboldii* Fischer in Kew Bull. 1932: 323, 1932.

It is a very rare grass and is represented mainly by type collections. During last 70 years it has been collected only once in 1970 by R. S. Raghavan who identified it as *I. elegans* Dalz.

Distribution

INDIA: Endemic to Karnataka.

Representative specimens

Karnataka: Shimoga Dist.: Shimoga, 2-3000 ft. (600-900 m), Oct. 1908, *A. Meebold* 10747 (Holotype, K; Isotype, CAL); *A. Meebold* 10746 (Paratype, CAL); *A. Meebold* 10745 (Paratype, CAL); N. Kanara Dist.: Halyal, Sept.

1890, *Talbot* 2305 (BALT); Kemmengundi, Sept. 23, 1970, *R. S. Raghavan* 125546 (CAL).

13. *I. mysorensis* Raghavan in Indian For. 97: 304, 1971.

This very dainty and rare species has been recently described by Raghavan (l.c.) from Karnataka and so far known only from the type collection.

Distribution

INDIA: Endemic to Karnataka (Shimoga Dist.).

Representative specimens

Karnataka: Shimoga Dist., Kundaguda, near Agumbe, Aug. 19, 1963, *Sundara Raghavan* 90008 A (Holotype, CAL); *Sundara Raghavan* 90008 B-E (Isotypes, BSI).

14. *I. oreades* (Domin) Bor, Grass Bur. Ceyl. Ind. Pak. 582, 1960.

This is a rare species and is known so far only from the few collections from the type locality. It has been collected by the author (VP) in 1978 after several decades.

Distribution

INDIA: Tamil Nadu, endemic to Nilgiri Hills.

Representative specimens

Tamil Nadu: Nilgiri Hills (Dist.); Goodaloor ghat, 5000 ft. (Gudalur, 1500 m), *Lawson* 6 (K); Nadu Vatum, 6000 ft. (±1800 m), Aug. 15, 1889, *M. A. Lawson* 51 (CAL); Kotagiri, 6500 ft (±1950 m), Aug. 1916, *L. J. Sedgwick* 1770 (CAL); Pykara, near Cinchona Plantations, Feb. 24, 1978, *Ved Prakash* 2 (CAL).

15. *I. scabrosa* Hook f. Fl. Brit. Ind. 7: 23, 1896.

This species has so far been restricted to Khasi Hills of Meghalaya; however, Hara et al. (1978) have recently reported it from Nepal. It is poorly represented in Indian herbaria (CAL, ASSAM, DD). The author (VP) collected this species from Nongstoin, Khasi Hills in 1978 (specimens in CAL).

16. *I. setosa* Fischer in Kew Bull. 1932: 247, 1932.

This is a very rare species which is represented by few collections in Indian herbaria.

Distribution

INDIA: Endemic to South India: Tamil Nadu, Kerala, Karnataka.

Representative specimens

Kerala: Kottayam Dist.: Lockhert gap, Devicolam, 1675 m, Oct. 10, 1963, *K. M. Sebastine* 17487 (CAL); Munnar, Nov. 5, 1961, *C. Saldanah* 8036 (BLAT). Tamil Nadu: Coimbatore Dist.: Kavarkal, Anaimalai, 290 m, July 7, 1978, *M. Chandrabose* 57256 (MH).

17. *I. sikkimensis* Bor in Kew Bull. 1949: 115, 1949.

This too is a rare species and is not well represented in Indian herbaria.

Distribution

INDIA: Endemic to Eastern Himalaya at ±1800-2800 m alt.: Sikkim, West Bengal. Recently reported from Nepal by Hara et al. (1978).

Representative specimens

Sikkim: Penlong, 6500 ft. (±1950 m), July 10, 1945, *N. L. Bor* 934 (DD): Karponang 8500 ft. (±2550 m), Aug. 5, 1948, *N. L. Bor* 781 (DD).

West Bengal: Darjeeling, 6000-7000 ft. (±1800-2100 m), Aug. 1957, *K. C. Roy Choudhury* 2 (CAL); Darjeeling, Sept. 22, 1957, *B. D. Patil* 1266 (CAL).

18. *I. swaminathanii* Ved Prakash & Jain.

This is a new species and is described elsewhere by the authors from Maharashtra.

Distribution

INDIA: Western thats, endemic to Maharashtra at above 600 m alt.

Representative specimens

Maharashtra: Satara Dist.: Mahabaleshwar, 1372 m, Oct. 9, 1979, *Ved Prakash* 337A (Holotype, CAL); *Ved Prakash* 337B-E (Isotypes, CAL); Bombay, Trambe, Sept. 1907, *A. Meebold* 9118 (CAL); Pune Dist., Lonavla, near Valvam dam, Sept. 1964, *B. V. Reddi* 98729 (BSI); Satara Dist., Mahabaleshwar, Oct. 1918, *Talbot* 4545 (BLAT); Mahabaleshwar, Oct. 5, 1957, *G. S. Puri* 25641 & 25642 A, B (BSI); Mahabaleshwar, Oct. 10, 1979, *A. Mehrotra* s.n. (CAL); Thana Dist., Harischandragarh, Sept. 1970, *B. M. Wadhwa* 127804 (BSI).

19. *Coelachne minuta* Bor in J. Bomb. nat. Hist. Soc. 58: 317, 1961.

This is a very rare species and is known only from few collections. Very recently Naik (1980) described *C. ghatica* from Amboli hill station (Maharashtra). Ved Prakash and Kulkarni (1981) reduced it as a synonym under *C. minuta* Bor.

Distribution

INDIA: Western Ghats, endemic to Maharashtra at *Ca.* 650-1375 m alt.

Representative specimens

Maharashtra; Satara Dist., Mahabaleshwar, Sept. 14, 1956, *H. Santapau* 22731 (K); Ratnagiri Dist.: Ramghat Road, Amboli, Aug. 12, 1971, *B. C. Kulkarni* 131615 (BSI, CAL); Amboli hill station, Sept. 13, 1971, *V. N. Naik* 1300 (BSI, Marathwada Univ.).

20. *C. perpusilla* var. *nilagirica* Ved Prakash & Jain

This a new variety and is described elsewhere by the authors.

Distribution

INDIA: So far known only from type collection from Nilgiri (Tamil Nadu).

Representative specimens

Tamil Nadu: Nilgiri Dist., Parthimund, 2300 m, July 11, 1970, *J. L. Ellis* 34627 (Holotype, CAL; Isotype, MH).

21. *Limnopoa meeboldii* (Fischer) C. E. Hubb. in Hook. Ic. Pl. t. 3432, 1943.

This is an extremely rare species which occurs in very small area of Kerala in tanks and forming thick mass of tangled stems on the surface of water. It was known only from the original collection made by A. Meebold in 1910 until Dr. Cook relocated it in 1973 and 1979. Dr. Cook (in litt.) stated, "A single population of this rather strange aquatic grass was found at Chottanikara, *Ca.* 14 Km S. E. of Ernakulam (Cohin), Kerala. I first found this population in 1973, in 1979 it was unchanged. The population contains several hundred plants and occupies an area of about 100 × 300 m in vast flood plane that is otherwise uniform. An intense search was made surrounding the population but no additional plants were found".

Distribution

INDIA: Endemic to Trichur & Ernakulam Dist., Kerala.

Representative specimens

Kerala: Cochin, Trichur Dist., Chalakudi, Nov. 1910 *A. Meebold* 12520 (Holotype, K., Isotype, CAL); Ernakulam Dist., Chottanikara, *Ca*, 14 Km S.E. of Ernakulam, Nov. 15, 1979, *C. D. K. Cook* 1988 (CAL, Z).

Discussion

From the above observation it is evident that the Peninsular region of India, especially part of the Western Ghats, can be regarded as the area of endemism, speciation and of high relative concentration of the tribe *Isachneae*. Authors observations also corroborate Turrill's (1964) view that generally Peninsular regions are a close second to islands in having favourable condition for endemism. Some of these species have been discovered only recently (e.g.

Isachne bicolor, I. borii, I. mysorensis, and *I. swaminathanii*) and whether they will remain endemic or their range will extend can be judged only after few decades. But in the case of others, such as *I. elegans, I. lisboae, I. clarkei, I. oreades, I. gracilis, I. fischeri, I. setosa* etc. it can certainly be said that they have remained endemic for long periods ranging from 3 to 12 decades.

Most of the botanically interesting areas of the world are relatively rich in endemics. It is estimated that several thousand species of higher plants are endemic to India and comparable conditions exist in few other regions of the world. Endemic taxa are of special interest to the taxonomists. They make botanical regions foristically unique. They may be very rare and often endangered.

In India, several natural and unnatural factors like deforestation, excessive exploitation and indiscriminate collection are resulting in threat to many plant species (Jain & Sastry, 1980). In the word of Jain (1980)* "if endemic species are annihilated from our country it will mean they will be annihilated from the world, will be lost to science, will be struck of the rolls of biological resources of this earth".

Thus, for the purpose of conservation of diversity and germplasm of our plant resources, Jain (1980)* rightly emphasised that in our conservative efforts we should first give priority to endemics. Steps are necessary for their conservation to ensure their survival and spread in the country. It is hoped that this note will draw attention not only to these species but also other such endemic and rare taxa of our country which need to be intensively searched in the field.

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*Agharkar memorial lecture, delivered in Maharashtra Association for the cultivation of Science, Pune—4, India.

45

Rare Bamboos of India

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Introduction

India is endowed with a large number of bamboo species and perhaps the world's largest reserves of bamboos exist in this country. Out of a total of nearly 100 known species (excluding the herbaceous bambusoid grasses), *ca* 100 have already been described or recorded from India and there are probably many more that are not yet known to science. Several species have also been introduced from other countries and at present the total number of known taxa both wild and cultivated in India is *ca* 113. Of these, more than 50% occur in Eastern India—Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and West Bengal. Other areas rich in bamboos are the Andamans, Bastar region of Madhya Pradesh and Western Ghats, while quite a few species are found in other parts of India both in the hills as well as in the plains (Varmah & Bahadur, 1980 a, b).

The 19 principal genera of bamboos (out of *ca* 50 in the world) occurring in India are *Arundinaria, Bambusa, Cephalostachyum, Chimonobambusa, Dendrocalamus, Dinochloa, Gigantochloa, Indocalamus, Melocanna, Neohouszaua, Ochlandra, Oxytananthera, Pseudostachyum, Schizostachyum, Semiarundinaria, Sinobambusa, Teinostachyum* and *Thamnocalamus*. Besides, 3 exotic genera—*Guadua* (since merged with *Bambusa*), *Pseudosasa* and *Thyrsostachys* are found in cultivation. This list should be considered only tentative as may prove to be synonymous while few more may be available (Varmah & Bahadur, 1980 a, b).

Region-wise position is that : 16 genra and 58 species of bamboos are found in Eastern Himalaya and other parts of eastern India (*Arundinaria* 9, *Bambusa* 12, *Cephalostachyum* 5, *Chimonobambusa* 6, *Dendrocalamus* 7, *Dinochloa* 2, *Gigantochloa* 2, *Melocanna* 1, *Neohouzeaua* 2, *Oxytanathera* 2, *Phyllostachys* 2, *Pseudostachyum* 1, *Semiarundinaria* 1, *Sinobambusa* 1, *Teinostachyum* 1, *Thamnocalamus* 4); 5, genera and 14 species in Western Himalaya including foot-hills (*Bambusa* 4, *Chimonobambusa* 2, *Dendrocalamus* 4, *Phyllostachys* 2, *Thamnocalamus* 2) 4 genera and 8 species in the Indo-Gangetic plain: (*Bambusa* 4, *Cephalostachyum* 1, *Dendrocalamus* 2, *Oxytenanthera* 1): 8 genera and 24 species in Peninsular India : (*Bambusa* 3, *Cephalostachyum* 1, *Chimonobambusa* 1, *Dendrocalamus* 1, *Indocalamus* 3, *Ochlandra* 9, *Oxytenanthera* 5, *Teinostachyum* 1): and 6 genera and 7 species in the

Andaman and Nicobar Islands : (*Bambusa* 2, *Cephalostachyum* 1, *Dendrocalamus* 1, *Dinochloa* 1, *Oxytenanthera* 1, *Schizostachyum)* (Bahadur, 1979; Varmah & Bahadur, 1980 a).

On a conservative estimate the forest area under bamboos in India (including plantations) is 9·57 m. ha which is *ca* 12·8% of the total forest area of 75 m ha, ie. 22·8% of the total land area (328·8 m ha). The estimated annual output of bamboos (air-dried) from the above area is 3·23 m. tons which represents one-fifth of the country's total wood production and is utilised for a variety of purposes ranging from most conventional to highly sophisticated uses. More than half of this production (*ca* 2 m. tons) is consumed by the paper and rayon industries alone. Bamboos, therefore, constitute one of the most important renewable natural plant resources of India (Bahadur, 1974; Varmah & Bahadur, 1980 a, b).

Rare bamboo taxa :

In India, bamboos occur widely as an understorey in many types of forests in almost all the states excepting Kashmir valley. They form rich belts of vegetation in well drained parts of tropical and sub-tropical habitats going up to 3700 m of altitude in the Himalayas (Varmah & Bahadur, 1980 a, b). While the majority of the Indian bamboos are widely and abundantly distributed, *ca* 26 species/varieties, or roughly 25% taxa, could be classified as rare *(Arundinaria* 2, *Bambusa* 3, *Cephalostachyum* 1, *Chimonobambusa* 2, *Dendrocalamus* 4, *Dinochloa* 1, *Gigantochloa* 1, *Indocalamus* 1, *Ochlandra* 5, *Oxytenanthera* 1, *Phyllostachys* 2, *Schizostachyum* 1, *Semiarundinaria* 1, *Sinobambusa* 1). Barring a few intermediate types, these rare/endemic bamboos fall into 3 categories: (1) those restricted to a very few localities or a single locality but found in fairly large numbers, (2) those found in small numbers but occuring in several areas and (3) those occurring very few individuals over a small geographic range. Most of the information given below is drawn from the material preserved in in Dehra Dun Herbarium (DD), which has one of the finest collections of bamboos in Asia.

1. Indian bamboos which are restricted to very few localities or a single locality but are found in fairly large numbers :

(i) *Arundinaria mannii* Gamble

This is a slender, graceful, tufted, climbing, wiry bamboo. It is known only by its type collection of 1889 by Gustav Mann from a place called Amkasur about 8 km from Jarain, Jaintia Hills, Meghalaya and is locally called *beneng*. Mann observed that this bamboo was much used in building huts (Gamble, 1896) and therefore, although endemic to Jaintia Hills it appears to have been fairly common there. Nevertheless, it needs study and protection.

(ii) *Arundinaria rolloana* Gamble

This is a shrubby bamboo with distant culms and very broad leaves. It is known by just two collections, obviously syntypes, one by James Rollo and the

other by Gopal Banerjee, both collected in 1889, from Zullah valley in Naga Hills between 1525 and 2300 m. It is called *jipvo* by the Nagas. Not much is known about this rare bamboo. It needs special attention.

(iii) *Bambusa atra* Lindl.

This reed-like, large-leaved shrub is described in our Floras as *B. lineata* Munro; sometimes it is also called *B. amahussana* Lindl. Unlike most other bamboos it is a constant flowering species and the culms which produce flowers do not die. In other words it behaves like any other ordinary plant. Since flowers are always available in this species it has come into prominence lately, as it could be conveniently used for hybridisation with other *Bambusa* spp. when they come to flower. In wild, this important species is found in the Malayan Archepelago and the Mollucas, extending northwards to the Andamans. As far as India is concerned this bamboo is rare and is found only in marshy areas of Rutland Island of the Andamans. Although it is already in cultivation at Calcutta and Dehra Dun, its conservation needs to be encouraged.

(iv) *Dinochloa maclellandii* (Munro) Kurz

This species was first described as *Bambusa maclellandii* by Munro in (1868) and later transferred to the genus *Dinochloa* by Kurz in 1873. From the literature it appears that there are two elements involved under this complex. Gamble (1896) mentioned that it was a climbing as well as an erect bamboo with zig-zag culms. On examination it has been found that the two types (scandent and erect) have nothing common and that they represent two distinct taxa. The climbing one, which is represented in our live collections at Debra Dun and has recently produced flowers and fruits, has in fact been identified as *Melocalamus compactiflorus* (Kurz) Benth. In all probability therefore, what Munro Kurz and Gamble meant by *D. maclellandii* was the erect type with zig-zag culms. Due to the above confusion the native home of the real *D. maclellandii* is not certain but it could be either Chittagong or Burma. Enquiries made recently from both the places revealed that this taxon has not been seen there in recent times. It is therefore, evident that it is a threatend species. Fortunately we have this zig-zag bamboo growing at the Indian Botanic Garden, Howrah, and from there it has recently been introduced at FRI, Dehra Dun. Its cultivation at other places in India is most desirable.

(v) *Indocalamus walkerianus* (Munro) Nakai

This frequently flowering, shrubby bamboo looks very handsome because of its purple panicles and large, thick leaves with cartilaginous edges. It is found in Sri Lanka and also in Pulney Hills in South India. In India it is localised only at one place and needs to be protected.

(vi) *Ochlandra beddomei* Gamble

Very little is known about this pretty species first collected by Colonal R. H. Beddome in Wynaad, South India and described by Gamble in 1896. It is known only by a few collections from the type locality and from Western slopes of the Nilgiris below Sispara between 200 and 1350 m. According to Brandis

(1906) it grows gregariously but as it has been collected only once or twice it should be given proper attention.

(vii) *Ochlandra ebracteata* Raizada & Chatterjee

This shrubby, reed-like bamboo was described in 1963; and it is close to *O. travancorica* Benth. It is confined to hilly districts of Kerala occurring along streams and in the valleys. It is reputed as a raw material for paper and for a long time has been used for this purpose under the name *O. rheedei* Benth. ex Gamble (Raizada & Chatterjee, 1963). It is also used for basket and mat making. As this bamboo is not common in the area and at the same time is being extracted from the forests, chiefly by the Punalur Paper Mills, it is becoming rare day by day and needs to be protected.

(viii) *Ochlandra setigara* Gamble

This is a small, erect or straggling reed-like bamboo found on the western slopes of the Nilgiri Hills in ravines above Gudalur at *ca* 900 m. It appears that it has been collected only twice since Gamble's time and therefore it is certainly rare. It should be conserved.

(ix) *Ochlandra sivagiriana* Camus

This annually flowering, shrubby bamboo which to some extent resembles *O. rheedei* Benth. ex Gamble is found in Sivagiri and Pulney Hills between 1200 and 2400 m. It is used locally for making baskets and mats. It has been collected only two or three times and deserves to be considered as a rare Indian bamboo.

(x) *Ochlandra talbotii* Brandis

This graceful, reed-like bamboo grows in dense clumps in North Canara along the banks of river. It is locally called *hooda* and is used for various purposes. Due to large scale extraction it has become rather uncommon in the area of its occurrence and needs to be protected.

(xi) *Phyllostachys assamica* Gamble ex Brandis

This is a caespitose, graceful, thin, yellow bamboo which was earlier confused with the Chinese/Japanese *P. bambusoides* Sieb. & Zucc. It is found in patches in Arunachal Pradesh at *ca* 2400 m and is locally called *deo* or *bih*. It has been collected recently after a lapse of more than 50 years and appears to be rare. It should be considered as a threatened species along with *P. bambusoides*, which is cultivated in the area, it is used for making walking sticks.

2. Indian bamboos which are found in small numbers but occur in several suitable areas :

(i) *Bambusa arundinacea* Retz. var. *gigantea* Bahadur

B. arundinacea, the thorny bamboo of India, which is one of the commonest bamboos in the plains, is a complex species with a lot of variation. One of its elements is a tall, handsome, large-culmed variety infrequently found in patches in the valleys of the Circars and other places of South India. This rare taxon is planted at FRI, Dehra Dun and looks very large and different from the typical

B. arundinacea. Very few collections of this variety have been made from the wild and therefore efforts should be made to conserve it.

(ii) *Chimonobambusa densifolia* (Munro) Nakai

This is probably the smallest Indian bamboo (15-90 x 0·8 cm) which is occassionally found in patches in South India and Sri Lanka. It is better known from Sri Lanka rather than from India, it has been collected only once or twice in India and therefore deserves to be considered as rare.

(iii) *Chimonobambusa jaunsarensis* (Gamble) Bahadur & Naithani

This graceful, reed-like bamboo arising singly from a long creeping rhizome (not forming definite clumps) is found sporadically in North-West and Central Himalaya between 1800 and 3300 m. This handsome species which is largely used for making mats and baskets by the hill people in Garhwal and Kumaon is becoming scarce gradually. In order to conserve this rare and endangered species, Bahadur and Naithani (1978) have already suggested that it should be reared in botanic gardens in the Himalaya e.g. Lloyd Botanic Garden, Darjeeling and the newly established experimental garden of the B.S.I. at Pauri.

(iv) *Dendrocalamus strictus* (Roxb.) Nees var. *argentea* McClure ex Bahadur *ined.*

Several varieties of the commonest Indian bamboo, *D. strictus*, which is often called the Male Bamboo because of the strength of its culms, have been based on the extremes of variation within the species. One of these varients is silvery white in colour which McClure (1966) suggested should be kept as a separate variety (var. *argentea*). This rare taxon is occasionally found intermixed with the typical *D. strictus* in plantations and deserves to be given attention.

(v) *Oxytenanthera bourdillonii* Gamble

This is a moderate-sized, straggling bamboo with long internodes forming open clumps. It grows only on steep precipitous places and wet rocks between 900 and 1550 m in the Ghats of Kerala. Since this bamboo is endemic to Kerala and is also selective with regard to its habitat, it deserves to be protected.

(vi) *Phyllostachys manni* Gamble

This is a very pretty, caespitose shrub with yellow culms. In wild state it is confined to Naga Hills but is cultivated in Khasi Hills around 1500 m. Perhaps it also occurs in Burma. It is locally called *deo* in Shillong and is used for making walking sticks. Considering the restricted distribution of this bamboo in India it should be given due attention.

(vii) *Semiarundinaria pantlingii* Gamble

This is an erect shrub with thin, hairy or spinous culms (at the nodes). It was described from Bhutan but lateron has also been collected from Sikkim and Arunachal Pradesh. It is generally found in small patches between 3000 and 3350 m. Very few collections of this bamboo have been made and it appears that it is rare.

(viii) *Sinobambusa elegans* (Kurz) Nakai

This is a slender, shrubby bamboo chiefly occurring in the hills of Eastern Burma and extending northwards into the Naga Hills where it is occasionally found between 1525 and 2300 m and is locally called *jilli*. Although it is one

of the principal bamboo species of Burma, as far as India is concerned it is localised in the Naga Hills where it is used for making native huts. The species, therefore, needs to be protected.

3. Indian bamboos which occur as few individuals over a small geographic range

(i) *Bambusa mastersii* Munro

This is a reed-like, climbing bamboo. Very little is known about this species. It has been gathered only once by Masters from Dibrugarh. The Assamese name is *benti baus*. Since this bamboo is known only by its type collection serious attention should be paid towards it conservation.

(ii) *Cephalostachyum capitatum* Munro var. *decomposita* Gamble

This semiscandent bamboo with yellow culms has been collected only twice from Sikkim where it is called *gubis*. It is different from the typical *C. capitatum* which is characterised by having capitate flowers and is common in the hills of North-East India, in possessing paniculate flowers. The culms are used for making bows and arrows and also for baskets. Since this taxon is endemic to Sikkim and is also economically exploited, it needs to be conserved.

(iii) *Dendrocalamus hookeri* Munro var. *parishii* (Munro) Blatter

This is an imperfectly known bamboo which has been collected only once by Lieut. Parish from Himachal Pradesh. Curiously enough the flowers and fruits of this bamboo have been well-described but the culms, culm-sheaths and leaves are unknown. Initially described as a distinct species (*S. parishii* Munro), it has been rightly given a varietal rank (Blatter, 1929). It is extremely rare. The exact locality where this grows is apparently unknown. Efforts should be made to trace and conserve it.

(iv) *Dendrocalamus sahnii* Naithani & Bahadur

This is a thin bamboo with pale-green culms which has been discovered recently from Subansiri district of Arunachal Pradesh. This new species is localised at one particular place and in all probability is endemic to the area. It deserves to be conserved.

(v) *Dendrocalamus strictus* (Roxb.) Nees var. *prainiana* Gamble

This is another variant of the commonest Indian bamboo, *D. strictus*, which differs from the typical species in having smaller and fewer flowers with nearly glabrous glumes. It is known only by the type collection made by David Prain from Cocos Island near the Andamans in the last century. Very little is known about this rare taxon which needs to be given proper attention.

(vi) *Gigantochloa takserah* Camus

This is a large, evergreen bamboo with broad culm sheaths and membranous blades. To some extent it resembles *G. macrostachya* Kurz, but differs in having conspicuously ribbed and fimbriate sheaths. It is confined to Garo Hills from where it was collected by Gustav Mann in 1889. It is known only by its type collection.

(vii) *Schizostachyum rogersii* Brandis

This is a middle-sized, tufted bamboo with week culms, overhanging or supported by trees. It occurs in the forests of Andamans and is known only by the type collection made by G. Rogers. Not much is known about this species but obviously it is endemic in the Andamans and needs to be protected.

Conclusion

The bamboos which occur as few individuals over a small range are truely endemic and therefore, highly threatened. Immediate attention should be paid towards their conservation. In view of the fact that bamboos constitute one of the most useful natural plant resources in India resulting in their large scale exploitation and also realising that their flowering, in most cases, is irregular and uncertain making their natural regeneration difficult, it is necessary that these rare taxa are protected. Their *in situ* as well as *ex situ* conservation is desirable in tune with the extent of rarity as brought out above.

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Some Rare Gentians

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Gentians are valued for their ornamental and medicinal properties. They are bitter and are used in medicine as febrifuges, stomachics and tonics. It is interesting to note that not a single species of this family is devoid of the bitter taste. The various beautiful colours of their flowers add to the beauty of temperate, alpine and glacial moraines of both the hemispheres. It is observed that there are some species which have not been collected after their type specimens or in the last fifty to eighty years or they have been collected after a long lapse of time. It is obvious that the rarity of their collection is either because of ecological imbalance or due to their small sizes and alpine to glacial habitat, they have been often overlooked by botanical collectors.

In view of the medicinal potential, their rarity, as judged from the study of BSD, DD, CAL, BSIP, NBRI, CDRI-Lucknow and the lists of the specimens, obtained from ASSAM & RRL-Jammu, is highlighted here. To facilitate their further collections, key characters, up-to-date nomenclature, flowering & fruiting time, distribution, ecology and specimens examined (chronologically arranged) are being provided.

1. GENTIANA SAGJINOIDES Burkill in J. & Proc. Asiat. Soc. Bengal *2*(7): 318. 1906.

Annual, tiny 2-3 cm long, decumbently branched herbs. *Leaves* narrowly ovate, acuminate, 5-7 long, 3-4 mm broad. *Flowers* solitary terminal, blue?, 4-6 mm long. *Capsule* obovate, crestate, protrudes at dehiscence.

Fls & Frts : February to June.

Ecology : Alpine rocks; ± 4000-5000 m altitude.

The species has never been collected after its type: Alpine Western Himalaya, Soonderdhunga at Kumaon, 13000-14000 ft (±4000-5000 m), May 1857, *Anderson s.n.* (CAL 300119) (Holo. CAL !).

2. GENTIANA TETRASEPALA Biswas in Hook. f. Ic. Plant. 4: ser. 5. t. 3359. fig. 1-9. 1938.

Annual, small, 1-2 cm long, erect, delicate, glabrous herbs. *Leaves* ovate-elliptic or sublanceolate, subacute, obtuse, subsessile-petiolate, usually 4 mm long, 1-2 mm broad. *Flowers* 4-merous, terminal, solitary-subsolitary, pedicellate. *Calyx* lobes 4, oblong, narrowly rotundate-obtuse or acute.

Fls & Frts: August to November.
Ecology: Alpine regions; rocky slopes; 4000-5000 m altitude.

So far, known only from its type: INDIA: Kumaon, Ralam Valley, 13000-14000 ft (= 4000-5000 m), 26 Aug. 1884, *Duthie* 3166 (Holo—CAL !, I. K).

3. GENTIANA INFELIX Clarke in Hook. f. Fl. Brit. India 4: 111. 1883.

Perennial, 1-2 cm long, leafy herbs. *Leaves* 4-5 mm long, 2-3 mm broad, ovateoblong, subsessile-sessile. *Flowers* infundibuliform, solitary terminal, violet, 0.8-1 cm long, subsessile. *Capsule* oblong.
Fls & Frts: February to June.
Distribution: INDIA: Himachal Pradesh, Uttar Pradesh, Sikkim. TIBET; CHINA.
Ecology: Temperate to alpine himalayas; in patches on rocks; in grasses and among *Potentilla* spp; 2775-4901 m altitude.
Specimens Examined: Himachal Pradesh: Kinnaur: Chini, 2775 m, 3 June 1962, *Nair* 22369 (BSD, CAL).

The rarity of the species can be judged by the fact that except type specimens from Sikkim and Kumaon there is only above specimen from Kinnaur and one from Sikkim at ASSAM herbarium (*Rolla Rao* 900).

4. GENTIANA CRASSULOIDES Bureau et Franch. in J. de Bot. 5: 104. 1891.

Annual, 0·7-3·7 cm long, decumbently branched scabrous herbs. *Leaves* orbicular or reniform, 2-3 mm long, 2-4 mm broad, apiculate. *Flowers* infundibuliform, deep blue, solitary terminal, 0·6-1.1 cm long. *Calyx* lobes orbicular, mucronate. *Capsule* obovate-ellipsoid, crestate.
Fls & Frts : Late August to October.
Distribution: INDIA: Himachal Pradesh, Uttar Pradesh, Sikkim. NEPAL; CHINA; TIBET; BHUTAN.
Ecology: Moraine slopes or among rocky boulders; 3594-4901 m altitude.
Specimens Examined: Uttar Pradesh; Tehri: Above Taulea, 4247-4574 m, 8 Aug. 1883, *Duthie* 450 (DD, CAL); Nila Valley, 4574-4901 m, 16 Aug. 1883, *Duthie* 451 (DD, CAL); Near the Lebung glacier, 4247-4574 m, 3 Aug. 1886, *Duthie* 5788 (CAL); Tehri: Moraine in Nulapa Gadh, Darma, 3594-3920 m, 5 Aug. 1886, *Duthie* 5788 (DD); Kumaon: Parbhu Gori Valley, 12 Aug. 1900, *Inaiyat* 24693 (DD). Himachal Pradesh: Kinnaur: Chitkul slopes of left bank of river, 5207 m, 21 July 1974, *Janardhanan* 53628 (BSD); Lahul: Chetru, 25 July 1977,

The rarity of the species is observed by the fact that from Indian regions after *Inaiyat's* collection in 1900, the species was collected in 1974.

5. LOMATOGONIUM CAERULEUM (Royle) H. Smith ex Burtt in Notes Roy. Bot. Gard. Edinb. 26(3): 285. 1965.
Basionym: *Swertia caerulea* Royle, Ill. t. 67. 1. Aug. 1835.

Perennial, erect, rhizomatous, branched herbs. *Stems* 5·5-30.5 cm tall. *Leaves*

narrowly oblong-elliptic or lanceolate, spathulate, 1·2-4·2 cm long, 0·3-1·2 cm broad. *Flowers* in lax panicles, deep blue, 1·1-2·5 cm across.
Fls & Frts: August to October.
Distribution: INDIA: Jammu & Kashmir, Himachal Pradesh. AFGHANISTAN; PAKISTAN; TIBET.
Ecology: Water courses; moist grassy slopes; 2613-4247 m altitude.
Specimens Examined: Kashmir: *s.loc.*, 1885, Major *Sedgewick s.n.* (CAL); Kilanmarg, 25 Sept. 1890, *Aitchison* 93 (CAL). Himachal Pradesh: Chamba: Pangi, *Douie* 71 (CAL); Sach Pass, Pangi, 3267-3920 m, 10 Sept. 1898, *Lace* 1244 (DD); Kashmir: Rajdiangandhar, Head of Bonarmala, 3594 m, 6 Oct. 1906, *Keshavanand* 1622 (DD); Below Sonapind Pass, Kishanganga Valley, 2613-2940 m, 7 Oct. 1906, *Keshavanand* 593 (DD); Bangas, Rajman forest, Jhelum Valley, 1940-3267 m, Nov. 1907, *Keshavanand* 882, 883 (DD); Kishanganga Valley, Kamri Pass, Burgil Basin, 4247 m, 2 Oct. 1909, *Keshavanand* 1601 (DD).

Thus no collection of the species from Indian region is available after Keshavanand's collection in 1909.

6. Lomatogonium brachyantherum (Clarke) Fernald in Rhodora *21*: 197. 1919. *Basionym: Pleurogyne brachyantherum* Clarke in Hook. f. Fl. Brit. India 4: 20. 1883.

Tiny ± 2 cm long, tender herbs with 3-4 cm long peduncles, bearing solitary terminal, 4-7 mm across, blue flowers. *Cauline Leaves* 1-2 pairs, elliptic-oblong, spathulate, 2-4 mm long, ca 2 mm broad.
Fls & Frts: August to October.
Distribution: INDIA: Jammu & Kashmir (Ladakh), Himachal Pradesh (Spiti). TIBET.
Ecology: Alpine bugyals; 3950-4600 m altitude.
Specimens Examined: Himachal Pradesh: Spiti: Maran Pass, 4500 m, 8 Sept. 1961, *Nair* 16781 (BSD); Kunzum Hills, 3950 m, 9 Sept. 1961, *Nair* 16808 A (BSD). Jammu & Kashmir: Ladakh: Debring, Rupshu, 4600 m, 4 Sept. 1970, *Bhattacharyya* 41005 B (BSD).

Clarke described the species in 1883 from Karakorum but afterwards there are only three collections made by Nair in 1961 and Bhattacharyya in 1970.

7. Jaeschkea canaliculata (Royle ex G. Don) Knobl. in Bot. Centralbl. 60: 387. 1894. *Basionym: Gentiana canaliculata* Royle ex G. Don, Gen. Hist. Dich. Pl. 4: 182. 1837. *Synonym: J. latisepala* Clarke in J. Linn. Soc. 14: 441. 1875.

Annual erect, 8·5-86·5 (-112) cm long herbs. *Leaves* narrowly oblong-elliptic to lanceolate, 1·5·8 (-6·5) cm long, 0·4-1·5 (-1·7) cm broad. *Flowers* 4-merous, blue, in panicles. *Calyx* lobes foliaceous, obovate, spathulate, uncinatus, unequal, 0·5-1·2 cm long, 3-5 mm broad.
Fls & Frts: July to October.
Distribution: INDIA: Jammu & Kashmir, Himachal Pradesh. TIBET: NEPAL.

Ecology: Shady slopes; moist open meadows, near water; 2350-5000 m altitude. *Specimens Examined*: Jammu & Kashmir: *s.loc.* 11 Aug. 1838, *Falconer s.n.* (DD); Sonamarg, 3594 m, 1876, *Clarke* 30825 p, (CAL); Sonamarg. 3594 m, 29 Aug. *Clarke* 30826 F (CAL); Pahlgam, 2777 m, 5 Sept. 1876, *Clarke* 31105 (CAL); Hirpur, Pir-Panjal, 2286 m, 17 Aug. 1891, *Gammie s.n.* (DD); Above Gulmarg, 9 July 1892, *Duthie s.n.* (DD); Above Kaimmul, Liddar Valley, 3420 m, 4 July 1893, *Duthie s.n.* (DD); Liddar Valley, 3267 m, 20 July 1893, *Duthie* 13096 (CAL). Himachal Pradesh: Chamba: Between Alwas & Sach Pass, 3920-4574 m, 29 Aug. 1896, *Gammie* 18414 (DD); Head of the Sural Valley, 3920-4901 m, 19 July 1899, *Harsukh s.n.* (DD); Head of Hudan Valley, 3920-4901 m, 25 July 1899, *Harsukh s.n.* (DD). Jammu & Kashmir: Surgan Basin, Kishanganga Valley, 3267 m, 4 Aug. 1907, *Keshavanand* 800 (DD); Kajnag, Hamal Basin, Jhelum Valley, 2613-3267 m, 5 Sept. 1907, *Keshavanand* 837 (DD); Jhelum Valley, 3267-3594 m, 4 Aug. 1909, *Keshavanand* 1293 (DD); Way to Chandan Wari, 14 Sept. 1960, *Malhotra* 12264 (BSD).

Thus after Keshavanand's collection in 1909 the species was collected in 1960 and afterwards no collection is available in the aforesaid herbaria.

Acknowledgements

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Notes on Endangered species of Scleria in India

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While undertaking the revision of the genus *Scleria* in India it was found that the genus is represented here by 24 species and 4 varieties. The examination of its material deposited in various Indian herbaria and literature has revealed that a few of them are represented by only a few nineteenth century collections. *S. alta* Boeck. and *S. bracteata* var. *assamica* Clarke are, in fact, known only by their type collections. It is an indication that these species could be endangered. However, the correct approach would be a thorough exploration particularly in the type locality and its neighbourhood. The exact collection localities are generally not given in original publication and hence it is usually necessary to consult type sheets for any indication to the collection locality, or trace the route followed by the collectors. This, though ideal is time-consuming. Meanwhile the only alternative to prepare a tentative list of endangered species is to include those species which have not been collected for about 50 years or so. With this view, notes on *S. alta*, *S. bracteata* var. *assamica*, *S. neesii*, *S. psilorrhiza* and *S. sumatrensis* have been given below. Since none of these species are of any economic or ornamental use it can safely be presumed that the rarity of these are due to habitat changes, but this needs confirmation in the field

SCLERIA ALTA Boeck. Linnaea 38: 485. 1874; Clarke in Hook. f. Fl. Brit. Ind. 6: 690. 1894; Kern, Blumea 11: 164. 1961 (in note).

This species was originally described by Boeckeler in 1874 on "*Scleria ciliaris* Herb. Hook. et Thoms. (non Nees). Mont. Khasia Indiae Orient.—Griffith)". Clarke *(l.c.)* reported the species from "N. E. Bengal, Mudhopur, *C. B. Clarke* 7779. Serhampore, *Voigt*. East Bengal, *Lemann, Griffith;* Pundua, *J. D. Hooker* 394". However on scrutiny of the *Scleria* material in different herbaria, only two collections of *S. alta* have been found. The first, probably a duplicate of the type from Mont. Khasia by J. D. Hooker and T. Thomson and the other from Assam without a definite locality by Griffith. There is no record of the species having been recollected subsequently.

Among the Indian species of *Scleria*, *S. alta* can be distinguished by its winged middle leaf sheaths, the very short secondary bracts and the slightly depressed globose cancellate nuts.

Distribution: EAST BENGAL. In INDIA: Assam.

Specimen examined: ASSAM, *Griffith s.n.* (DD). MEGHALAYA. Mont. Khasia, *J. D. Hook. & T. thoms. s.n.* (CAL *acc. no.* 512132).

S. BRACTEATA var. ASSAMICA C. B. Clarke in Hook. f. Fl. Brit. Ind. 6: 694. 1894.

This species is based on a collection of *Masters* from Assam sometimes around 1835. The exact locality is not known. It is represented only by its type sheet at Kew Herbarium. There is no record of the species having been recollected by any botanist.

It is characterised by tessellate, scarcely verrucose nuts, rim of disc with many triangular (sometimes narrow, almost lanceolate) teeth.

Endemic to Assam.

S. NEESII Kunth, Enum. 2: 358. 1837; Clarke in Hook. f. Fl. Brit. Ind. 6: 688. 1894; Fischer in Gamble, Fl. Madras Pres. 3: 1677. 1931; Kern in vanSteenis, Fl. Males. ser. 1.7(3): 741. f. 105. 1974; Nair, Ind. Journ. For. 2: 258. 1979.

This species was described from materials collected from Sri Lanka. However, it was reported from India by Fischer *(l.c.)* from Yeddicarra in Malabar district. On scrutiny of the herbarium and literature it was found that no specimen has been collected again; the specimen cited by Fischer too is neither available at CAL nor at MH. Recently the species has been collected by N. G. Nair from North Nicobar.

The species is recognised by its pubescent inflorescence, the hairy glumes and the not or hardly spiculate nuts and disc reduced to a columnar, triquetrous stipe.

Distribution: S. E. ASIA. In INDIA: Kerala, Nicobar Islands.

Specimen examined: NORTH NICOBAR, Arong, Car Nicobar, *N. G. Nair* 4547 (PBL).

S. PSILORRHIZA C. B. Clarke in Hook. *f.* Fl. Brit. Ind. 6: 691. 1894; Tiwari & Maheshwari, Ind. For. 90(9): 627. 1964; Saxena, Bull. Bot. Surv. Ind. 12: 63. 1970; Sharma & Nag, Ind. For. 100(3): 203-205. 1974; Kern in vanSteenis, Fl. Males. ser. 1.7(3): 735. f. 104. 1974.

This species was described by Clarke from Malaya Peninsula collection of which is represented in the Kew herbarium. Haines collected the species from Chanda (*Haines* 3597) which too is represented at Kew (Sharma & Nag, *l.c.*). Later on Sharma & Nag *(l.c.)* have reported its occurrence in Himachal Pradesh. The identity of the plant is, however, doubtful as the description of the plant does not exactly tally with the text figures. However, on consultation of different herbaria only two specimens have been found and further exploration seems necessary.

According to Kern it is the only Asiatic species having premorse leaves. The species is further characterised by the presence of stolons, the broadly winged sheaths, the narrow spike-like dense panicles and the large ovoid obtuse nuts.

Distribution: S. E. ASIA, N. AUSTRALIA. IN INDIA: Assam, Madhya Pradesh, Maharashtra, Orissa.

Specimen examined: MAHARASHTRA. Bhandara dist., *Anon.* 144074 (BLATT). ORISSA, Near Brahmani village, Rairakhol, *Mooney* 4012 (DD).

S. SUMATRENSIS Retz. Obs. 5: 19. t. 2. 1789; Clarke in Hook. *f.* Fl. Brit. Ind. 6: 693. 1894 *et* in Ill. Cyp. t. 129. f.1-2. 1909; Prain, Bengal Pl. 1903 (2: 853. 1963, repr. ed. Calcutta); Fischer in Gamble, Fl. Madras Pres. 3:1678. 1931; Kern in vanSteenis, Fl. Males. ser. 1.7(3): 736. f. 105. 1974.

A thorough scrutiny of herbarium material reveals that the species is represented by only a few collections of nineteenth and early twentieth century. Further exploration and collection of the species seems necessary.

The species is well characterised by the whorled leaves and the large cyathiform hypogonium attaining $\frac{1}{2}$ to $\frac{3}{4}$ height of the nut.

Distribution: CHINA, S. E ASIA, AUSTRALIA. In INDIA: Assam, Andaman & Nicobar Islands, Bengal, Kerala.

Specimen examined: MIZORAM: South Lushai Hills, *Gage s.n.* (CAL *acc. no.* 512313). NICOBARS: Kamorta, *Kurz s.n.* (CAL *acc. no.* 512318). SOUTH ANDAMANS, *Prain's collector* 23. TENASSERIM & ANDAMANS, *Helfer* 6132 (DD).

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Studies on Endemism and Rarity in the Family Eriocaulaceae in India

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The members of the family Eriocaulaceae are not of much economic importance except perhaps as ornamentals when dried and stained.

After the works of Hooker (1893) and Fyson (1921-1922) no work is available on phytogeography of Indian Eriocaulaceae. However, by virtue of their common occurrence, the family has found a place in almost all the regional floras and check-lists. An attempt is made here to study the endemism and rarity in the family Eriocaulaceae.

For deciding the endemism, the present political boundaries of India have been adopted. The literature on Eriocaulaceae of adjacent countries such as Pakistan, Nepal, Burma, Bangladesh and Sri Lanka have also been consulted for study and comparison. Chatterjee's (1940) phytogeographical regions have been broadly adopted to study the distribution of endemic species within India. North-east India includes Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

For analysis of endemism, several floras and floristic lists of India and adjacent regions have been consulted. For evaluation of endemic status of species, as far as possible, the nomenclature and distribution of species were updated.

The family Eriocaulaceae comprises 13 genera and *ca* 1150 species (Willis, 1973); distributed throughout the tropics and subtropics and a few in temperate regions. The majority are found in the New World. This family exhibits discontinuous distribution because of the absence of its members between South and West Africa, South East Asia and United Kingdom.

The family is represented in India by a single genus *Eriocaulon* L. with 74 species, chiefly distributed in peninsular India. This constitutes approximately 6.43 per cent of the total species of the family. Most of the species are found in swampy localities or seasonally inundated regions and some grow in dry places.

An analysis of endemism reveals that out of 74, 39 species, i.e. 52.50 per cent, are endemic to India; 24 species (32.43 percent) are endemic to Indian subcontinent and remaining 11 species (i.e. 14.86 percent) are widespread. The distribution of endemics and wides in various phytogeographical regions is shown in Table 1.

Out of 39 endemic species 14 (i.e. 35.89 percent) are rare in occurrence in their respective areas. These species along with distribution and their categories of Red Data Book are listed in Appendix I.

Conclusion

An analysis of the distribution of the family Eriocaulaceae reveals that 52.70 percent of species are endemic to India. These species are mainly confined to three phytogeographical regions viz., 1. Peninsular India 2. North-east India and 3. the Himalayas.

It is evident from the Table 1 that out of 24 species endemic to Indian sub-continent, five are endemic to Peninsular India and Sri Lanka which is higher than any other region. This perhaps, indicates the similarities between the floras of Peninsular India and Sri Lanka.

Similarly out of eleven widely distributed species, six species occur in Indo-Malaysian region alone, indicating the probable phytogeographical affinity between the floras of India and Malaysia.

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Table 1. *Distribution of the family Eriocaulaceae in various phytogeographical regions.*

Phytogeographical Regions		Total number of endemic/ wide species	Percentage of total Eriocaulaceae (74 species)
(A) *Endemic to India as a whole*		39	52·70
(i) Endemic to Peninsular India	32		
(ii) Endemic to Indus Plain	1		
(iii) Endemic to Gangetic Plain	1		
(iv) Endemic to Western Himalaya	2		
(v) Endemic to North-east India	3		
(B) *Endemic to Indian sub-continent*		24	32·43
(i) Endemic to Peninsular India and Sri Lanka	5		
(ii) Endemic to North-east India & Bangladesh/Burma	4		
(iii) Endemic to whole Himalayas	4		
(iv) Endemic to Andaman & Nicobar island and Burma	1		
(v) Endemic to whole Indian sub-continent	10		
(C) *Wides*		11	14·86
(i) Indo-Chinese	1		
(ii) Indo-Malaysian	6		
(iii) Indo-Australian	1		
(iv) Sino-Japanese	1		
(v) African-Asiatic	1		
(vi) Cosmopolitan	1		

APPENDIX—I

LIST OF RARE AND ENDEMIC SPECIES

Sl.No.	*Name of the species*	*Distribution*	*Categories*
1.	*Eriocaulon barba-caprae* Fyson	Meghalaya	Perhaps Extinct
2.	*E. barbeyanum* Ruhl.	Karnataka	,, ,,
3.	*E. bombayanum* Ruhl.	Maharashtra, Gujarat	Rare
4.	*E. europeplon* Koern.	Maharashtra, Gujarat	Endangered
5.	*E. fluitans* Griff.	Assam	Insufficiently known
6.	*E. gamblei* Fischer	Tamil Nadu	Rare
7.	*E. geoffreyi* Fyson	Tamil Nadu	Rare
8.	*E. gregatum* Koern	Meghalaya	Rare
9.	*E. mysorense* Fyson	Karnataka	Rare
10.	*E. pectinatum* Ruhl.	Tamil Nadu	Endangered
11.	*E. pseudo-quinquangulare* Ruhl.	Uttar Pradesh	Insufficiently known
12.	*E. pumilio* Hook. f.	Uttar Pradesh Bihar.	Vulnerable
13.	*E. rouxianum* Steud.	Maharashtra	Insufficiently known
14.	*E. thomasi* Fyson	Maharashtra, Karnataka	Rare

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A Few Highly Exploited Species Needing Special Attention of Conservationists

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Some of the plant species which were reported to occur commonly or abundantly about half a centuary or a centuary ago have at present become rare or very rare due to over exploitation and have fallen in the category of endangered species. The glaring examples are *Dioscorea deltoidea* Wall. ex Kunth, and *Rauvolfia serpentina* (L.) Benth. ex Kurz.

From the revision of *Dioscorea* by Prain & Burkill (Ann. Royal Bot. Gard. Cal. 14:28. 1936), it is evident that *Dioscorea deltoidea* was in the past abundantly found in N.W. Himalaya. After a lapse of *ca* 4 decades this species has become rare and has fallen in the category of endangered plants.

In 1959, Sulochana in the critical revision of *Rauvolfia* (J. Indian Bot. Soc. 38:580 Stated "Along the West coast strip from Konkan Southwards to Thadikkarankonam in South Travancore-the area critically surveyed by me-plentiful occurrence of *Rauvolfia serpentina* is more or less continuous". Atp resent i.e. after a lapse of 2 decades this plant has become rare in most of the accessible areas of the above region. The above mentioned two species have been included in the publication "Threatened Plants of India" by Jain & Sastry, 1980.

In view of the facts explained above it is necessary that the field botanists should focus attention of the appropriate authorities on even the common species which are being over-exploited and should urge them to take appropriate measures for the optimum exploitation and saving the natural population. In this context 2 species of *Aquilaria*, 4 species of *Berberis* and *Gloriosa superba* are discussed below.

Aquilaria

*A. agallocha** is a large evergreen tree 15-25 m high and 1·5-2·5 m in girth. It is distributed in India (Eastern Himalaya), Bhutan, Burma, Bangladesh and Malaysia. Usually the wood is light, pale and unscented but the 'Agar' is found

*The plants going under the name *A. agallocha* from India belong to two distinct species viz. *A. malaccensis* Lamk. (syn. *A. agallocha* Roxb.) and *A. khasiana* Hallier (1922) *A. khasiana* occurs in Bhutan and Khasia Hills. *A. malaccensis* occurs in Eastern India, Burma, Bangladesh and Malaysia.

in the irregular patches of dark wood which is obtained from the interior of old trees. The dark wood is the result of fungal infection. The dark wood which contains a high amount of oleoresin is mostly obtained from 30—50 years old trees.

The uses of 'Agar' are well known. Agar is mainly exported to Arab Countries, China and Europe. During 1975-76, 127436 Kg of Agar wood valued at Rs. 845565/- was exported after meeting the domestic consumption. This is the official figure which does not take into account the suspected large scale illicit trade. As the demand for 'Agar' is very great and it fetches a handsome return, firms based in Bombay which export Agar are actively engaged in the exploitation of *Aequilaria agallocha* from the Eastern Himalaya through local contractors. They employ labour force, especially Nepalis, to spot out the trees in the interrior of the forests as the species has become very rare in the accessible areas. Often, the inexpreienced labourers cut the trees indiscriminately without ensuring their 'Agar' potential whereas the local tribals can easily spot out the 'Agar' bearing trees. Therefore, the species has become very rare. Discussion with the Forest Officers of Arunachal Pradesh revealed that it is not easy to locate an Agar tree in accessible areas. During our survey of Arunachal Pradesh (Kameng, Siang & Subansiri) we could find only very few plants. However, the Forest Officers who were working in Arunachal Pradesh for a long period informed us that this species was not rare about two decades ago.

There is, therefore, an urgent need for conserving this very valuable species. It is suggested that the Government should immediately ban the extraction through contractors and private traders. The extraction and trade should be done by the Government Agency. This will help in curbing the illicit exploitation which is the major cause for the fast depletion of the natural population of this species.

Berberis spp.

The ganus *Berberis* L. is well known in ancient Indian Medicine. The famous medicinal product 'Rasaut' or 'Rasavanti' or 'Rasanjan' is commonly extracted from the root barks, roots and lower stem-wood of *B. glaucocarpa* Stapf (*B. aristata* sensu Hook. f & Thoms. *p.p.*), *B. aristata* DC., *B. lycium* Royle and *B. chitria* Lindl.

B. asiatica is an evergreen erect throny shrub usually 1.2-1.8 m high and found in the dry outer Himalaya and also in Assam between 600 & 2700 m. *B. lycium* is an erect shrub usually 1.2-3 m high occuring from Kashmir to Garhwal in the North Western Himalaya between 760 & 2400 m. *B. chitria*, a shrub 2-3.5 m high with reddish or dark reddish brown branchas and mostly 3-partite spines, is commonly found in Kumaon, Dehra Dun to Mussoorie and Jaunsar. *B. glaucocarpa*, a shrub 2.0-3.5 m high with usually solitary spines, is

found mostly in Tehri Garhwal, Simla and Jaunsar between 900 & 2700 m. In general, these species are not easily distinguishable.

As *Berberis* spp. are highly medicinal, large scale exploitation of their roots and stems is going on in the Garhwal region especially in the neighbourhood of Mussooric and Chakrata. This is obvious from the fact that every month, except in the monsoon season, many truck-loads of *Berberis* roots and stems are being supplied for outside market from these areas.

As the total alkaloid content of root is quite high (*ca* 4%) when compared to that of stem (*ca* 2%) people uproot the whole plant in order to get the maximum quantity of roots. Therefore, the depletion of the natural population is faster. According to the present rate of exploitation there is no doubt that the above mentioned *Berberis* spp. are likely to become rare within the next 10 to 20 years.

As the above mentioned species of *Berberis* are common in the Himalayan belt, there is no likely-hood of their becoming endangered if proper check on their exploitation is exercised by the authorities. We suggest that a Range or a forest Division should be taken as a unit for giving extraction permits. The permit should be limited to a maximum of two years for a unit and for the subsequent five years period, extraction should be banned in the same unit. This five years period is good enough for the regeneration of the natural population to the original level. In this way, these valuable medicinal plants can be utilised to the maximum without a threat to the natural population and therefore there is hardly any need for raising their plantations.

Gloriosa superba L.

This branched herbaceous climber with beautiful flowers was in the past commonly found throughout India in plains and low jungles up to an altitude of *ca* 2000 m. However, it is getting depleted day by day. The annual aerial shoot reaches a height of 10 m. The perennial tuberous rhizome is up to 30 cm long and 1.5 cm in diam. The tips of the ovate-lanceolate leaves are modified into spirally twisted tendrils. Flowers are greenish yellow in the beginning and finally they become scarlet or crimson. Capsule is *ca* 5 cm long with many rounded seeds.

From time immemorial the tuberous rhizome was being used in Indian medicine. It is reported to be a tonic, stomachic and anthelmintic. The drug is also used for a variety of other medicinal purposes such as Colic, Chronic Ulcers, Piles, etc. Around 1940, colchicine was extracted from the tubers of this species for the first time. It is reported to yield 0·3% of Colchicine (dry weight). As Colchicine is used in plant breeding work and in medicine, this species has gained much more importance in pharmaceutical industry during the last 4 decades resulting in indiscriminate exploitation of its natural population. Due to the removal of tubers, the whole plant is destroyed and as such wild populations are getting depleted fast. During the last five years there was a great demand for the rhizomes and many persons have approached us to

either supply the tubers or to locate wild populations. From our field experience we record here that due to high exploitation of tuberous rhizomes this plant has become rare in and around Dehra Dun and in the plains of Kanyakumari District. However, this was certainly not the case before because Kanjilal (For. Fl. Chak. D. Dun Saharan. For Div. Ed. 3. 525. 1928) and Babu (Herb. Fl. D. Dun 519. 1977) mentioned it as common. Babu did intensive exploration of Dehra Dun up to 1966. Therefore, it is obvious that this species was common in Dehra Dun at least up to 1966. The same is the case with many other areas.

The present position is that this species is still common only in those areas of our country wherever exploitation has not yet started. If the present rate of demand for rhizomes continues, the pressure of exploitation from the interior forest areas will increase as soon as the availability from the easily accessible a areas diminishes. Therefore, we suggest that a proper check should be enforced on the exploitation of the wild population of this species and the industries who are the major users should be urged to raise their own plantations.

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Distribution of Wild Relatives and Related Rare Species of Economic Plants in India

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The importance of wild species in crop improvement studies has been much realised in recent years (Hawkes, 1977), and the plant breeders and germplasm collectors have looked thoughtfully into the centres of diversity of crop plants for supplementing such genetic variability of economic plants. The Indian centre in this context is equally rich in the floristic wealth of wild relatives and related species of agri-horticultural importance. Of about 250 such species distributed in different agro-ecological, phyto-geographical regions of India, about 60, are either rare (being mostly endemic taxa) or are endangered due to over-exploitation in their native habitats. Majority of such taxa occur in the north-eastern region, the western Himalayas, the western ghats and the eastern ghats. In this paper, a region-wise assessment of such species is presented, with grouping of taxa, as far as possible, based on the prevalent cause(s) generating threat. Further, for better awareness of the breeders, a list of such species according to the economic plant categories—cereals, millets, legumes, fruit and vegetables, oilseed, etc., is also given (Appendix I).

1. Threatened species in north-eastern region.

Much of the north-eastern tract holding genetic diversity of wild relatives and related taxa of crop plants, is subject to immense biotic interference, particularly shifting cultivation. In the secondary forests—mixed evergreen, moist deciduous vegetation belts and the ecotonal zones, sporadic distribution of several potentially useful taxa occurs. Such threatened plant wealth can be broadly grouped as follows:

(a) Species threatened due to large scale forest clearings, burning etc./ shifting cultivation, destruction of original habitats.
Citrus indica, C. assamensis, C. ichangensis, C. latipes, Musa cheesmanii, M. flaviflora, M. itinerans, M. velutina, M. sikkimensis, Prunus, jenkinsii, P. acuminata, Rubus lineatus.

(b) Species of restricted distribution, more localized: equally subject to biotic/bioedaphic pressure as in (a).
Camellia drupifera, C. lutescens, Docynia, hookeriana, Musa nagensium, Neolufia sikkimensis, Rauvolfia sp. *(R. chinensis,* related to *R. serpentina) Trichosanthes khasiana, T. majuscula, T. ovata, T. tomentosa, Zingiber intermedium.*

(c) Overexploited species :

Coptis teeta, Dioscorea prazeri, Piper peepuloides Shella area, Shillong plateau); ornamentals like *Lilium macklinae; Vanda coerulea* and several other orchids, *Rhododendron* and others species (Jain and Sastry, 1980).

(d) Native cultigens and related types :
Endemic crops of Khasi hills mainly—*Sophlong* (*Moghania vestita*, a root legume), and *raishan, Digitaria cruciata* var. *esculenta* a minor millet (Singh and Arora, 1972, 1973) and the variability in soft-shelled forms in *Coix lacryma-jobi* var. *mayuen* (Arora, 1977), mainly concentrated in the Garo and Khasi hills, and sporadically in Nagaland. *Coix* is replaced by maize and very few ethnic groups grow this crop now.

II. Threatened species in the Western Himalayas.

Most such taxa in the western Himalayas occur in temperate forests or in alpine grassy meadows/scrubs. Particularly, the medicinal plant species here are being indiscriminately collected from natural habitats.

(a) Overexploited species :
Aconitum chasmanthum, Atropa acuminata, Colchicum luteum, Dioscorea deltoidea, Gentiana kurroo, Nardostachys jatamansi, Podophyllum hexandrum, and agriculturally useful taxa like *Allium rubellum*, and to a lesser degree—*Bunium persicum* and *Cicer microphyllum*.

(b) Species of relatively sparse distribution :
Prunus salicina, P. tomentosa and *Pyrus kumaoni* in temperate forests; *Erianthus macratherus, Linum perenne* and *Malus baccata* var. *himalaica*, in the alpine zone.

(c) Native cultigens and related types :
This group comprises Kuth *(Saussurea lappa)*, the popularity of which is receding now, and the sparsely grown *Inula racemosa* (Arora et al, 1980)—both taxa are of industrial utility. A minor millet sparsely grown in Kashmir—*Digitaria sanguinalis* subsp. *aegyptiaca* var. *frumentacea*, genetically very veriable is also important.

III. Threatened species in the Western Ghats.

Most of these (endemic) taxa are of sparse distribution, narrow endemics localized to few pockets of the Western Ghats. Only a few species fall under the overexploited category. Largely, these species are undergrowth components of the biotic/bio-edaphic habitats, occurring in distrubed grass-mixed vegetation, forest openings or in ecotonal zones bordering semi-evergreen or mixed, seasonal forests.

(a) Species of sparse distribution, relatively rare :
Canavalia stocksii, Dolichos bracteatus, Vigna radiata, V. vexillata var. *stocksii, Seasamum laciniatum*.

(b) Species of comparatively wider distribution :

(i) *Overexploited:*

Vigna grandis, V. capensis, V. mungo var. *sylvestris; Rauvolfia serpentina* (threatened).

(ii) *Others:*

Atylosia grandiflora, A. nivea, Dioscorea wightii.

IV. Threatened species in the Eastern Ghats & adjoining eastern peninsular belt.

The taxa dealt with here also occur in the disturbed habitats, excepting certain agro-ecological sites viz., *Oryza* spp.

(a) Species of rare distribution, localized occurrence : *Cajanus cajanifolia* (Maesen,1 980 --*Baillladilla* hills, Orissa).

(b) Species of relatively wider distribution as compared to (a) above (siill confined to this region only) :

Dolichos lablab—lignosus variability, wild forms, *Luffa umbellata, Oryza* spp. (*O. malampuzhaensis, O. jeyporensis*—true status doubtful), *Sesamum prostratum, Solanum melongena* var. *insana.*

(c) Native/primitive cultigens :

This group is under threat because of spread of high yielding improved varieties.

Solanum melongena var. *potangi* (Petongi, Koraput, Orissa), *Luffa hermaphrodita*

V. Other such species

Other species of relatively sparse distribution are:

Abelmoschus tuberculatus, Curcuma amarissima, Eriobotrya angustissima, Lathyrus altaicus, Musa simiarum, Piper schmidtii.

Apart from these species, mention may be made here of a few inadvertant introductions, adaptable to north-eastern region now, and sparsely distributed, and reportes for the first time from India (Arora and Singh 1975; Arora and Hardas, 1977)—*Cucurbita ficifolia, Solanum integrifolium* and *S. gilo.*

We have dealt above with endemic/rare taxa and other such species of relatively threatened types, but a passing reference may be made to the threat imposed by high yielding varieties in areas of traditional agriculture, largely dominated by various ethnic groups, which still hold rich variability of native landraces and primitive forms, e.g. in north-eastern region, central and eastern peninsular belts. Such genetic wealth of non-descript types, equally deserves attention for collection and detailed study for its potential utility and preservation of desirable genotypes, now under threat.

Acknowledgements

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APPENDIX—1

Wild relatives and related endemic/rare species (Including endemic cultigens) and over-exploited types arranged according to economic plants categories.

Cereals, millets:

Coix lacryma-jobi var. *mayuen, Digitaria cruciata* var. *esculenta, Digitaria sanguinalis* subsp. *aegyptiaca* var. *frumentacea, Oryza malampuzhaensis.*

Legumes:

Atylosia cajanifolia, Atylosia grandiflora, Atylosia nivea, Canavalia stocksi , Cicer microphyllum, Dolichos bracteatus, Dolichos purpureus Lathyrus altaicus, Vigna mungo var. *sylvestris, Vigna radiata, Phaseolus setulosus forms; Vigna grandis, Vigna vexillata* var. *stocksii* under *Vigna capensis.*

Fruit-tree types:

Citrus assamensis, Citrus ichangensis, Citrus indica Citrus latipes, Docynia hookeriana, Malus baccata var. *himalaica, Musa cheesmanii, Musa glauca, Musa flaviflora, Musa itinerans, Musa nagensium, Musa sikkimensis, Musa simiarum, Musa velutina, Prunus acuminata, Prunus jenkinsii, Prunus tomentosa, Pyrus kumaoni, Rubus lineatus.*

Vegetable types:

Abelmoschus tuberculatus, Allium rubellum, Cucurbita ficifolia, Cur uma amarissima, Luffa hermaphrodita, Luffa umbellata, Moghania vestita Neoluffa sikkimensis, Solanum gilo, Solanum integrifolium, Solanum melongena var. *insana, S. melongena* var. *potangi, Trich santhes khasiana, Trichosanthes majuscula, Trichosanthes ovata, Trichosanthes tomentosa, Zingiber intermedium.*

Oilseed types:

Sesamum laciniatum and related type *Sesamum prostratum.*

Medicinal types :

Aconitum chasmenthum, Atropa acuminata- Coptis teeta, Dioscorea deltoidea, Dioscorea prazeri, Dioscorea wightii, Gentiana kurro, Inula racemosa, Nardostachys grandiflora, Podophyllum hexandrum, Rauvolfia serpentina, Saussurea lappa.

Others:

Bunium persicum, Camellia drupifera, Camellia lutescens, Lilium macklinae, Linum perenne.

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Rare and Endemic Taxa in the Botanical Garden and Arboreta of the Forest Research Institute, Dehra Dun

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Introduction

Forests in India have been over-exploited to the various demands of the growing population and in this process the distribution and populations of several plant species have been reduced to such an extent that if their removal is not restricted some of them may face extinction in course of time. The Botanical Gardens have an important role to conserve and multiply the rare taxa. The Botanical Garden of the Forest Research Institute, Dehra Dun is doing a useful service in this direction by growing some rare/endemic Indian taxa, some more important of these are briefly discussed below:--

RARE/ENDEMIC INDIAN TAXA IN THE BOTANICAL GARDEN AND ARBORETA OF FRI

Asplenium nidus L.

Known as the Bird Nest Fern, it ranges from India to Polynesia. It owes its name (*nidus*--nest) to the arrangement of its fronds which are undivided and combined into a dense rosette-the 'nest'. The rosette forms a funnel in which water and humus can collect; the roots grow into the funnel and obtain nourishment there (Boedijn, 1965). It is growing well in the conservatory of the Botanical Garden.

Bambusa arundinacea Retz. var. *gigantea* Bahadur *ined.*

This rare bamboo is found in patches in valleys of the Circars and other places of Southern India. It is handsome and much taller than the typical *B. arundinacea*. It is doing well in Sector E of Botanical Garden.

Bambusa atra Lindl.

This read-like bamboo is found in the Andamans in marshy coast forests (Rutland Island) and also in Malaya. It is a constant flowering bamboo. Unlike other bamboo species where the culms produce flowers and die after flowering its stems do not die, rather they remain healthy and green even after flowering, Vermah & Bahadur, 1980). It is growing in the nursery area of the Botanical Garden and also in the Arboretum No. 3.

Butea buteiformis (Voigt) Grierson & Long (Syn. *Butea minor* Ham.)

This leguminous shrub with long sarmentose branches is found in parts of eastern India. The beautiful red, about 5 cm long, flowers appear during Aug.-Oct. on long panicled racemes; the fruits ripen in Nov.-Dec. It is growing well in Sector D of Botanical Garden.

Cyathea gigantea (Wall. ex Hook.) Holtt.

This giant tree-fern is of botanical interest; it is distributed in hilly regions of eastern and southern India but is nowhere abundant. It is exploited for starch by the local people and the trunk is used for growing epiphytic orchids (Jain & Sastry, 1980). It is growing well in the Green House of Botanical Garden under moist condition. The sori ripen in May-June.

Dendrobium densiflorum Wall. ex Lindl.

This is an epiphytic orchid with bright-coloured and sweet-scented flowers which appear in April-May. It is grown for ornamental purposes. It is distributed in the forests of Sikkim, Arunachal Pradesh and Khasi Hills but is not common. It is in demand in the florist industry. It is growing well in Green House of Botanical Garden.

Entada pursaetha DC. ssp. *sinohimalensis* Grierson & Long.

This large, woody, fast-growing, leguminous climber is found in Nepal, Sikkim, Darjeeling, Assam Manipur, Sylhet (Bangladesh) and China (Grierson & Long, 1979). It flowers in April-May and produces gigantic pods of botanical interest during Dec.-March. It is becoming rare due to large scale cleaning of forests. It has been grown in Sector A of Botanical Garden.

Ficus krishnae DC.

This medium-sized tree is conspicuous on account of the leaf-base forming a cup or cone-shapped structure. It is possibly a mutant of *F. bengalensis* L. and is only found in cultivation. A 46 years old tree grown in Sector C of Botanical Garden has attained a height of 14 m with 2.6 m girth.

Gleditsia assamica Bor

This is a large leguminous tree of eastern India. A 42 years old tree grown near the conservatory in Botanical Garden has attained a height of 24 m with 2.65 m girth. The flowers appear in April-May. The pods are up to 40×3 cm, flat, leathery and dark brown (Bor, 1941). They ripen during Jan.-April.

Gloriosa superba L.

The Malabar Glory Lily is a herbaceous climber with perennial, fleshy, tuberous rhizome. It flowers in great profusion during rainy season. Flowers are showy, large, greenish at first, later becoming yellow and finally scarlet or crimson. The tubers are poisonous but are used in medicinal.

Paphiopedilum fairieanum (Lindl.) Pfitz.

The Lady's Slipper Orchid with large attractive greenish or creamy reddish and purple-veined flowers is endemic to Kameng area of Arunachal Pradesh and adjoining Bhutan. It is of vary rare occurrence and is threatened due to habitat destruction and indiscriminate collections for trade (Jain & Sastry, 1980). It flowers during Oct.-Jan. It is growing well in Green House of Botanical Garden.

Paphiopedilum villosum (Lindl.) Pfitz.

This is another Lady's Slipper. It has large, ornamental, purplish-brown flowers. It is found in Mizoram (Lushai Hills). It is extremely rare and threatened due to indiscriminate collections from the wild (Jain & Sastry, 1980). It flowers during Jan.-Feb. This orchid is growing well in Green House of Botanical Garden.

Uvaria hamiltonii Hook. f. & Th.

This straggling shrub of the family Annonaceae is found in the Himalaya, Assam and the Andamans. Solitary, thick, large, reddish-orange flowers appear in May-July. Only a few fruits ripen in Oct.-Nov. It is growing well in Sector 8 of Botanical Garden.

Vanda coerulea Griff.

The Blue-Vanda of Asia is perhaps the most beautiful of all the Vandas. This epiphytic orchid is distributed in Khasi, Jaintia and Naga Hills; recently it has been reported from Tirap district of Arunachal Pradesh also (Jain & Sastry, 1980). Flowers appear during Oct.-Dec. It is much exploited from the wild for ornamental purposes and now is very scarce. It is growing well in Green House of Botanical Garden.

Conclusion

The FRI Botanical Garden and Arboreta are doing a useful service in the acclimatization and conservation of rare or endemic Indian taxa. The other Botanical Gardens in the Country, no doubt, are also engaged in similar work. It will be useful if the seed-and plant-exchange of rare/endemic taxa among the different Botanical Gardens, having matching/favourable climatic conditions, is done to promote their *ex-situ* acclimatization and conservation.

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Threatened Plants of India—Some Considerations on Native Genetic Resources

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Introduction

India is very rich in its endemic flora (61.5%; Chatterjee, 1940) and floristically unique and interesting. It is also a centre of diversity and a seat of domestication for several economic plants. These native genetic resources broadly comprise of domesticated/semi-domesticated/protected cultigens, their wild prototypes and related taxa. About 250 such species occur, of which around 60 are relatively of rare occurrence being endemic/rare taxa or other species endangered or threatend due to over-exploitation. For most of such taxa, while their area of cultivation, distributional range/spread, is shrinking in native habitats, their potentialities and desirable attributes are as yet not fully known and exploited. Furthermore, for some, even the taxonomic and eco-geographical details are lacking. Most of these are also of great concern in elucidating phylogenetic position and in solving crop-evolutionary relationships. A case study of such taxa/native genetic resources is presented here.

The rarity concept vis-a-vis endangered taxa

The concept of rarity of a species is considered more on a local or national basis in the present treatment. The sparse/limited distribution of a taxon indicates its relative rareness while its sporadic, limited occurrence but wider distribution indicates whether or not, it is a narrow endemic. This obviously is subject to change based on existing findings. Van Balgooy (1971) has quoted major reductions for the Philippines while working for *Flora Malesiana* e.g. *Ficus*-144 species with 116 endemic, now reduced to 87 species with endemic, while a more critical study of newer areas presents increase in the number of endemic taxa. Richardson (1978) for Mascarenes Islands points out (for example) to 15 endemic species of *Diospyros* against the previously designated 8. Recent explorations carried out by the Botanical Survey of India, also point out to wider distribution of some hitherto narrow endemics—*Aconitum deinorrhizum, Anoectochilus sikkimensis, Didiciea cunninghamii, Ormosia glauca,* and new record of endemic types like *Rhododendron arizelum* and *R. santapaui* (Jain and Sastry, 1980) indicating their rare distribution.

Endemic/rare cultigens

Endemic crops are those that originated in a limited area and did not spread appreciably, while those with a definable centre and limited spread fall under the category of semi-endemics (Harlan, 1975). In the regions of floristic/ genetic diversity (in traditional agricultural belts) newer cultigens are quite often the result of folk domestication. In the initial stage such taxa are narrow endemics and may or may not attain a wider distribution. There is danger of their being wiped out by large scale expansion of high yielding cultivars, and the impact of modern agriculture. Such examples occur in Meghalaya, where the Khasi (tribal) growers have domesticated *Moghania vestita*, a tuberous legume crop (tubers eaten raw) and *Digitaria cruciata* var. *esculenta*—a minor millet, used locally for grain and fodder (Singh and Arora, 1972 & 1973).

Inula racemosa from Lahul, Western Himalayas, is a semi-domesticated cultigen (Arora et al., 1980). At present, very narrow variability exists in this, and this is under threat, since more prominence is given to the traditionally grown *Kuth (Saussaurea lappa)*, another endemic cultigen, of wider cultivation in this region. Equally endangered is the situation with regard to the cultivated forms of job's-tears. *Coix lacryma-jobi* is an obsolete cultiver now, and its soft-shelled forms- (var. *mayuen*) are grown sporadically in north-eastern hills, a region of veriability for this crop (Arora, 1977). With the introduction and spread of maize, area under *Coix* has considerably shrunk and now such threatened genetic wealth of soft-shelled forms, in mainly concentrated in a few pockets of Khasi and Garo hills (Meghalaya) and sporadically in Nagaland.

Docynia hookeriana is a protected type with restricted distribution in the Khasi hills, Meghalaya, while an allied taxon *D. indica* is of comparatively wider distribution. Both taxa are however confined to the north-eastern hills. Better fruit-types occur and the prevalent variability is threatened since the mixed evergreen forests, where this occurs, are subject to much clearing under the *jhum* or shifting cultivation system, thus depleting the sporadic populations of such useful taxa. Similar threat is posed to indigenous wealth of *Citrus*, endemic cultigens like *C. ichangensis* (Nagaland), *C. assamensis* shella range, Meghalaya), *C. latipes* (Shillong plateau) and *C. indica* (Garo hills, Meghalaya, parts of Assam, Nagaland). Other such examples are: *Houttuynia cordata, Phytolacca acinosa, Malus baccata* var. *himalaica, Rhodomyrtus parviflora, Prunus jenkinsii* and *Myrica esculenta.*

To a different category of rare/endangered/endemic wealth, belong the primitive cultivars of our native crops like brinjal *(Solanum melongena)*. *S. melongena* var. *putangi*—a small round fruited thorny undershrub occurs in the neighbourhood of Koraput tract in Orissa. This prototype of brinjal is a semi-domesticate and almost akin to *S. incanum*, a closely related wild type to brinjal (Bhaduri, 1951). Such germplasm with promising attributes is of value to plant breeders and crop-evolutionary scientists. Equally important in this context is the variability occurring in *S. melongena* var. *insana*, sporadically found in disturbed habitats in West Bengal, Orissa and Bihar.

Overexploited wild plant wealth

Several medicinal plants and botanical curiosities like *Nepenthes khasiana*, *Balanophora dioica*, and quite a few ornamentals fall in this category (Jain and Sastry, 1980).

Among the overexploited and thereby threatened resources of medicinal plants, noteworthy examples are of *Rauvolfia serpentina; Dioscorea deltoidea*, *Aconitum deinorrhizum*, *Colchicum luteum*, *Atropa acuminata* and *Gentiana kurroo* (W. Himalayas); *Coptis teeta* (Arunachal Pradesh); *Dioscorea prazeri* (E. Himalayas) and *Nardostachys grandiflora* (Alpine Himalayas—eastern/western).

Though the range of distribution of several of these taxa i.e. *Rauvolfia serpentina* is wider, in natural habitats where such species occur, they are subject to over-exploitation. Natural populations in *Rauvolfia* have considerably shrunk in the Western Ghats since the past few decades, because of large scale root collection (apart from seeds) and uprooting of plants from natural sites.

Mass scale exploitation of *Piper peepuloides* sporadically distributed in north-eastern hills, where in certain areas, it is intensively collected from the natural habitat (Shella area, Cherrapunji) has resulted in imbalance in natural populations of the male and female bushes. Clearing of forest undergrowth has equally hampered the natural regeneration.

Equally alarming is the situation posed by indiscriminate collecting of orchids and other wild ornamentals for direct introduction or breeding purposes; orchids with restricted distribution like *Cypripedium elegans* (Sikkim) *Paphiopedilum fairieanum* (Kameng, Arunachal Pradesh), *P. hirsutissimum* (Khasi hills, Meghalaya) *P. villosum* (Lushai hills, Mizoram) and *P. druryi* (southern hills, Western Ghats); and others with comparatively wider distribution though localized to north-eastern hill region i.e. *Arundina graminifolia* and *Vanda coerulea*. The Manipur lily or Sirohi lily *(Lilium macklinae)* is exploited from its native habitat (undergrowth in mixed sub-tempterate forest) in the hill ranges of Ukhrol (Manipur).

Wild relatives of crop plants of localized occurrence

Several of the wild related species of cultivated taxa occur in localized pockets. These may occupy primary, relatively undisturbed habitats of climatic climax formations or occur in secondary habitats, cleared sites and openings in seasonal or humid tropical to temperate habitats. Some examples may be sited: *Canavalia stocksii* (Konkan, Western Ghats), *Atylosia cajanifolia* Bailladilla hills, Orissa-Maesen, 1980), *Neoluffa sikkimensis* (Sikkim), *Dioscorea wightii* (Tirunelvelli hills), *Abelmoschus tuberculatus* (Saharanpur & adjoining northern plains extending westwards), *Vigna vexilata* var. *stocksii* (Konkan, W. Ghats, sporadic, scarce), *Sesamum prostratum* (Southern (coast)-sandy hills belt), *Solanum melongena* var. *insana* (Eastern peninsular tract, sporadic). Comparatively wider

distribution occurs in *Cucumis hardwickii* (Western Himalayas) and in *Vigna mungo* var. *sylvestris* (Northern parts, W. Ghats).

Types developed by Breeders

The importance of wild taxa in plant breeding and related studies has been much emphasized (Hawkes, 1977). This category includes types that are chiefly the result of efforts pooled in by breeders, through crossibility studies etc., to utilize the wild or primitive germplasm or else to provide insight into the interrelationship among taxa, with a crop evolutionary bias.

Abelmoschus tuberculatus is related to the cultivated okra *(A. esculentus)* and has contributed on genome with 29 chromosomes to this cultigen (Joshi and Hardas, 1953). It is a symptomless carrier of yellow-vein-mosaic-virus (Pal et al. 1952). Newer germplasm (taxa) are created quite often i.e. cross of *Sesamum indicum* (n=/13) with *S. prostratum* (n=/16), provided a stable amphi-diploid with n=/29, named as *S. indicatum*. This could be crossed back to *S. indicum* and useful characters of resistance and higher yield and oil content could be transfered (Ramanujam and Joshi, 1951). Such breeders creations occur in several more wild and cultivated (e.g. *Brassica, Atylosia, Cajanus, Vigna, Abelmoschus, Saccharum*) taxa. Identity of such specific materials often poses problems as taxonomic rules might not have been critically applied. Even otherwise, the original material might not have been preserved and with time might have changed its authenticity.

Rare primitive flowering plants

The Eastern Himalayan Flora includes some such rare examples e.g. *Magnolia pterocarpa* (Sikkim, Assam and Arunachal Pradesh hills, n =/19). It is pointed out that such taxa have been derived by the hybridization of genera with n=/7 met in Laurales) and n=/12 (occurring in primitive families Schizandraceae and Winteraceae). This tree is considered as the most ancient species of living flowering plants and is of considerable botanical/phylogenetic interest (Janaki Ammal, 1958, 1960).

Genetically distinct flora of specialized environments

Outside the humid-tropical region, under the effect of glaciation, diploids have the faculty of changing their genetic composition by the duplication of chromosomes. In *Camellia, Magnolia* and *Rhododendron* polyploid forms occur in the Himalayas (Janaki Ammal, 1958, 1980). Forms with very high chromosome number occur in the northeast in *Narenga* and *Erianthus*/*Saccharum* and several gigantic forms have been reported.

Active speciation in the *Buddleias* of Eastern Himalayas has resulted in high polyploids with chromosome number ranging from 2n=/71 to 2n =/307 (Janaki

Ammal, 1958). True identity of such (experimental) materials might be difficult later unless the origional material has been maintained/preserved.

Genetic erosion and the landraces

In regions of variability occur many landraces, under traditional agriculture. All components of the population are here, adapted to local eco-climatic conditions, cultural practices and diseases and pests e.g. as in tribal tracts of north-eastern and peninsular region of India. Under the effect of high yielding varieties, such indigenous types possessing valuable atributes-disease resistance, adaptability, quality traits etc., are getting lost. Genetic erosion has set in and this native variability is greatly threatened now. Its collection is being pursued by the National Bureau of Plant Genetic Resources, on priority basis (Arora and Koppar, 1980). Natural hybrids may also occur and would need care as separate entities. Equally scarce is the variability prevelent in localized forms in several perennial types/fruit crops e.g. polyembryonic forms in mango (e.g. colour) in the malabar tract.

A passing reference may be made to certain inadvertant introductions since distant past, and held presently by some primitive tribal communities. Such plants reported recently for the first time in India e.g. *Cucurbita ficifolia, Solanum gilo,* and *S. integrifolium* (Arora & Singh, 1973; Arora & Hardas, 1977) and more or less confined in their distribution are also of great concern. Their limited variability needs preservation, lest it gets lost. Equally important is the variability occurring in this region in Manipur, of the small-seeded diploid forms in Soybean.

Conclusions

With the speeding up of activities in plant exploration and collection, as more unexplored and under-explored pockets of floristic diversity are tapped, more rare plants will be added to our existing list and newer distribution patterns would emerge for several of the known endemics. In contrast to this, native species diversity would face threat in the wake of genetic erosion due to modification of habitats, change in farming system, over-exploitation for industrial use, incidence of diseases/pests, biological inadequacy, other natural or man made factors including natural hazards. In a more scientific approach to safeguard this diversity under *in situ* (gene sanctuaries, biosphere reserves), or *ex situ* conservation (repositories) and in Botanical gardens/arboreta, it would be necessary to provide complete passport data/field notes (taxonomic, distributional, ecological, with usefulness) with mapping charts etc. so that this is helpful to the environmental conservationist.

Under *in situ* preservation, wild relatives of *Musa, Citrus, Mangifera, Prunus, Pyrus, Malus, Camellia, Eurya, Saccharum,* and others—*Rhododendron,* orchids etc., would survive as naturally occurring populations where evolution

can proceed normally. (a gene sanctuary for *Citrus* is proposed in Garo hills, Meghalaya, by the National Bureau of Plant Genetic Resources). The wide diversity in bamboo species e.g. *Phyllostachys bambusoides*, with localized distribution also need protection, as it is being wiped out under shifting cultivation practices. Preservation of certain botanically interesting/other endemic taxa of trees like *Magnolia pterocarpa*, *Pterocarpus santalinus*, bushes like *Salix gamblei* and *Rhododendron nivale* and other species in Botanical gardens deserves attention. It is equally necessary in this context that breeders and other evoluationary botanists developing newer materials through experimental studies must also preserve their original material along with properly identified (typified) specimen(s) in the herbarium. Invariably authenticity of such taxa becomes questionable for neither the live collections nor the designated material (stored as seed) may be available. The taxonomists role in the conservation of genetic diversity must be fully realised (Hawkes, 1978). And as would be evident, along with the traditional taxonomic framework, population concept/variation pattern would be much involved. Data are to be collected on taxonomic/geographic isolation of a taxon, its relative diversification, potential to expand and get adapted to physical/physiological (ecological) conditions.

Hegnaeur (1975) states 'it will never be possible to forecast the potential value of a taxon to different branches of science or to future plant utilization'. In this context, preservation of plant genetic resources of unknown promise including threatened types for posterity would need priority. Protection efforts should be such so as to bring threatened plants in the out of danger category by adopting effective conservation measures. The role of National Committee on the Man and Biosphere (MAB) and the National Committee on Environmental Planning and Coordination (NCEPC) and the co-ordinated efforts of several institutions helping the above Committees in formulating plans for conservation of natural habitats, and of other bodies like the Chipko movement, would go a long way to hasten these activities. Much useful information in this direction has recently been published particularly by the Botanical Survey of India (Jain and Sastry, 1980; Jain, 1981) which is carrying out a Project on remains to be done on the management and maintenance aspect, and particularly in case of perennial tree species, on regeneration aspects (other than through seed) to preserve the native, unique flora and the plant genetic wealth.

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Rare and Endangered Liverworts of India

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Contributions on Bryophytes of India (mostly reviewed by Udar, 1976, 1980) indicate that the floristic studies in liverworts have not received adequate attention. Only a small fraction of diverse population is known to us and a majority still await proper study.

In the present state of our knowledge approximately 728 taxa of liverworts are known from this country (see Kashyap, 1929; 1932; Pande, 1936; 1958; Pande & Bharadwaj, 1952; Udar, 1976; Kachroo, 1969; 1970, 1973; Kachroo *et al.* 1977; Srivastava, 1979; Srivastava & Udar, 1979). Out of the total taxa known so far over 8% (61 species embracing 30 genera) are definite endemics.

The natural home of liverworts, with luxuriant vegetation in Indian subcontinent, includes the vast Himalayas, eastern and western coasts of peninsular India and the hill ranges of central and eastern parts of the country, many places of which also make good tourist spots attracting a large number of people all the year round. The liverworts growing in these areas are subjected to considerable stress due to developmental activities inevitably destroying the habitat of many species causing a threat to their survival. Even in remote areas, where there is little or no influx of tourists, some of the taxa evidently show considerable decrease in their population tending to be extremely rare, probably due to natural or biotic disturbances in their microclimate and narrow ecological niches.

Several growth patterns and distribution have been observed from cumulative collection experience of liverwort taxa during a period of over three decades from different parts of the country. This may be exemplified by a consideration of some of our rare and phylogenetically important plants. *Aitchisoniella, Sewardiella* and *Stephensoniella*- the three monotypic and endemic genera described by Kashyap are confined in the North West Himalayas and are gradually disappearing from their well known localities. They perenate by means of tubers and the spores do not seem to play any significant role in the reproduction.

Aitchisoniella Kash. was initially collected from only one locality (Mussoorie) from exposed and comparatively dry slopes facing east along with *Riccia* sp. with which it resembles in the external morphology of the thallus (Kashyap, 1914), and subsequently from other localities also such as Simla, Kulu, Dulchi-pass in the western Himalayas (Kashyap, 1929). Since then it was collected only once in four decades from Nainital [Mukteshwar, Paharpani (see Kanwal, 1977).

Stephensoniella Kash. was also initially collected and described from Mussoorie (Kashyap, 1914, 1914a). The plants are either found singly growing hidden among grass and moss or, aggregated forming large patches on bare rocks in more or less exposed places in Nainital, Mussoorie, Simla, Kulu, Dulchi-pass etc. (between 6000-7000 ft.). This plant is remarkable that it propagates by means of tubers in nature as evidenced by the fact that each thallus has a tuberous base which proliferates distally to form a new thallus. The population of *Stephensoniella* is significantly depleting in Nainital from some of its well known localities. The plants, although known to occur in other parts of the Himalayas, do not seem to have been collected.

Sewardiella Kash. was collected and described from Mussoorie and Simla (5000-7000 ft.) growing in large patches on moist rocks, sometimes singly associated with moss and grass (Kashyap 1915; 1929). In the young condition the plant has a striking resemblance with the prothallus of a fern : *Gymnogramme leptophylla* with which this plant often grows in association. As there is a single locality in Mussoorie where *Sewardiella* occurs, it is extremely vulnerable and on way to be dangerously rare.

Monoselenium Griff. is also a monotypic genus described in 1849 from Assam (Griffith, 1849). Since the first report of this taxon it was only once collected after about eight decades from the Presidency Garden at Manipur (Kashyap, 1923), although it occurs in Japan, Hawaii (Hattori, 1952; Inoue, 1966), Ryukhyu (Horikawa, 1934: as *Dumortieropsis* Horik.—a later synonym of *Monoselenium:* see Hattori, 1944), Formosa and China.

Similarly *Takakia ceratophylla* (Mitt.) Grolle was described from Lachen: Sikkim (Grolle, 1963) on the basis of plants collected by Hooker much before a century and a half (see Mitten, 1861: as *Lepidozia ceratophylla* Mitt.) and was never found again in Sikkim, although it has been collected recently from the neighbouring Himalayas of East Nepal where it grows around Kipuphu on rock alt. 4550 m. and also in crevices of cliff [alt. 4520 m. (Hattori, 1975)]. The present distribution of this plant is extended to Alaska, Aleutian Islands, Amchitka Island and Aleut point. It grows on moist soil on bank of stream in full shade and also on moist soil of ditch at top of bluff, about 69 m (Hattori *et al.* 1968). The antheridia and the sporophyte are not known in this genus.

At the time of discovery of *Takakia* Hattori and Inoue (1958) remarked that "the genus *Takakia* possessing several primitive characters may be considered as a relict plant representing an isolated offshoot (branch) from among the probable ancestors of modern bryophytes." According to Hattori et al. (1974; "Lack of sporophytes and male plants in *Takkakia* suggests that speciation occurred in both species probably from a *T. ceratophylla* like ancestor before or during Tertiary when the male plants of both ancestral species existed. After that for some reasons, in both species the male plants became extinct and asexual reproduction remained or was even gradually reinforced." They further remarked that "these species might have had wide geographical ranges before or during Tertiary, but due to the Quaternary glaciations and other

unfavourable climatic events, their ranges now have been reduced to limited places where suitable habitats occur, principally in isolated regions." The occurrence of both the species in the same area (East Nepal) led Hottori *et al.* to postulate the Eastern Himalayas to be the centre of distribution of *Takakia*.

Haplomitrium and *Calobryum*, allied to *Takakia*, have restricted distribution in India in the eastern Himalayas and it is the only territory in the World where a maximum of six taxa of Calobryales are located (see Kumar, 1974 & Udar 1980). *Calobryum indicum* Udar *et* Chandra, *C. dentatum* Kumar *et* Udar, *Haplomitrium grollei* Kumar *et* Udar and *H. kashyapii* Udar *et* Kumar are endemic to India and are confined in Darjeeling and neighbouring areas. *Haplomitrium hookeri* (Smith) Nees is rare in Darjeeling as it was never collected again from the same locality since its first Asiatic report (Udar and Chandra, 1965). This species also occurs in the Western Himalayas (at Deoban, 2885 m. Vyas Shikhar) and earlier known from North America, Europe and Spitsbergen (see Udar & Singh, 1977). *Calobryum blumii* Nees - a taxon earlier known from Java, Sumatra and New Guinea was reported from Assam (Jowai Jarrain road) by Udar *et al* (1968) and has not been collected again even though repeated efforts have been made.

Similarly a number of endemic and other taxa (listed below) from the Indian subcontinent are becoming rare posing a threat to their survival.

TAXA ENDEMIC TO INDIA

1. *Calobryum indicum* Udar *et* Chandra (Haplomitriaceae)-Confined to eastern Himalayas, (Darjeeling). Grows on moist soil-covered rocks with the association of other leafy liverworts. Rare.
2. *C. dentatum* Kumar *et* Udar (Haplomitriaceae)-Confined to eastern Himalayas (Darjeeling). Grows on moist soil-covered rocks.
3. *Haplomitrium grollei* Kumar *et* Udar (Haplomitriaceae)-Confined to eastern Himalayas (Teesta valley road, Darjeeling). Grows on moist soil covered rocks. Rare.
4. *H. kashyapii* Udar *et* Kumar (Haplomitriaceae)-Confined to eastern Himalayas (Darjeeling). Grows on soil-covered moist rocks.
5. *Trichocolea indica* Udar *et* Singh (Trichocoleaceae)-Confined to eastern Himalayas (Tongloo, Ghoom, Darjeeling). Grows epiphytic on bark of angiospermous trees, also as a cover on associated mosses, or on moist and shaded rocks.
6. *T. indica* Udar *et* Singh (Trichocoleaceae)-Confined to Darjeeling (eastern Hamalayas). Grows epiphytic and also on moist and shaded rocks.
7. *Noloscyphus pandei* Udar *et* A. Kumar (Jungermanniaceae)-Confined to eastern Himalayas (Kurseong, Gangtok, and Shillong) and Wellington, Grows on moist soil-covered rocks in pure populations.
8. *N. darjeelingensis* Udar *et* A. Kumar (Jungermanniaceae)-Restricted in eastern Himalayas (Darjeeling). Grows on moist soil-covered rocks forming Pure populations.

9. *Cephalozia darjeelingensis* Udar *et* Kumar (Cephaloziaceae)-Restricted in eastern Himalayas (Darjeeling). Grows in small tufts on moist soil-covered rocks.
10. *C. pandei* Udar *et* Kumar (Cephaloziaceae)-Restricted in eastern Himalayas (Darjeeling). Grows on moist soil.
11. *C. kashyapii* (Udar *et* Kumar) Udar (Cephaloziaceae)-Restricted in eastern Himalayas (Darjeeling). Grows on moist shaded rocks.
12. *Cephaloziella indica* Udar *et* A. Kumar (Cephaloziellaceae)-Restricted in eastern Himalayas (Kalimpong). Grows on soil-covered moist rocks.
13. *C. magna* Udar *et* Nath (Cephaloziellaceae)-Restricted in western Himalayas (Sheetlakhet, Almora). Grows on moist soil-covered rocks.
14. *Leptocolea himalayensis* Pande *et* Misra (Lejeuneaceae)-Restricted in the western Himalayas (Bageshwar and Almora) Grows either epiphytic or on moist rocks. Not found since its original discovery in 1941. Extremely rare.
15. *Cololejeunea indica* Pande *et* Misra (Lejeunceaceae)-Restricted in eastern Himalayas (Mungpoo, Darjeeling). Grows epiphyllous.
Restricted in eastern Himalayas (Sikkim and Darjeeling).
17. *Jubula hattorii* Udar *et* Nath (Frullaniaceae)-Restricted in eastern Himalayas (Darjeeling, Tonglu). Grows in moist places, epiphytic.
18. *Frullania hattorianthus* Udar *et* Nath (Frullaniaceae)-Restricted in eastern Himalayas (Darjeeling). Grows epiphytic.
19. *Fossombronia indica* St. (Fossombroniaceae)-Restricted in Karnataka (Mangalore). Extremely rare; almost completely disappeared as never collected since 1917 (Known so far from type locality).
20. *F. foreaui* Udar *et* Srivastava (Fossombroniaceae)-Restricted in Palni hills (Kodaikanal). Grows on moist soil.
21. *F. kashyapii* Srivastava *et* Udar (Fossombroniaceae)-Restricted in western Himalayas (Rohtang Pass, Kulu valley). Grows on exposed rocks.
22. *F. himalayensis* Kash. (Fossombroniaceae)—Distributed in western Himalayas and south India. Grows on moist ground in small patches.
23. *Petalophyllum indicum* Kash. (Fossombroniaceae)—Distributed in Punjab (near Chandigarh) and also in the western ghats. Grows on moist clayey soil.
24. *Sewardiella tuberifera* Kash. (Fossombroniaceae)—Restricted in the western Himalayas (now found only in Mussoorie). Grows on moist and shaded rocks. Rare.
25. *Riccardia santapaui* Udar *et* Srivastava (Aneuraceae) —Restricted in Madhya Pradesh (Chhindwara district). Grows in a very moist situation on rocks.
26. *R. perssonii* Srivastava *et* Udar (Aneuraceae) —Restricted in Palni hills (Kodaikanal). Grows under a very moist and shaded situation.
27. *R. villosa* St. (Aneuraceae) —Restricted in eastern Himalayas (Darjeeling and Tonglu). Grows epiphytic. Only once collected in 1941 since its original discovery (1917). Extremely rare.

28. *R. sikkimensis* St. (Aneuraceae)--Restricted in western and eastern Himalayas (Darjeeling, Khasi-Jayantia hills, Shillong, Manebhanjan). Rare.
29. *R. cardotii* St. (Aneuraceae) -Restricted in eastern Himalayas (Sikkim). Known only from its type locality. Never collected since its original discovery in 1917. Extremely rare- almost completely disappeared.
30. *Pallavicinia himalayensis* Schiffn. (Palaviciniaceae)--Restricted in eastern Himalayas (Kurseong & Sikkim). Grows at moist and shady places.
31. *Metzgeria crispula* Herz. (Metzgeriaceae)--Ristricted in eastern Himalayas (Sikkim). Extremely rare as it has never been found since its original discovery in 1939.
32. *M. indica* Udar *et* Srivastava (Metzgeriaceae)--Restricted in Nilgiri & Palni hills (South India). Grows epiphytic or on moist or dry rocks.
33. *M. nilgiriensis* Srivastava *et* Udar (Metzgeriaceae)--Distributed in Nilgiri hills, Palni hills (south India), and eastern India. Grows epiphytic.
34. *M. lutescens* St. (Metzgeriaceae)--Restricted in western ghats. Extremely rare as never found since its original discovery (1917).
35. *M. pandei* Srivastava *et* Udar (Metzgeriaceae)--Ristricted in Palni hills (Kondaikanal). Grows epiphytic. Rare.
36. *M. madagassa* St. (Metzgeriaceae)---Restricted in eastern Himalayas (Kurseong and Sikkim). Extremely rare as never found since its original discovery (1900).
37. *M. himalayensis* Kash. (Metzgeriaceae)--Distributed in western Himalayas (Kulu, Dalhousie, Mussoorie), Palni hills (Kodaikanal), Assam, Mount Abu and Mahabaleshwar. Grows epiphytic.
38. *M. assamica* Srivastava (Metzgeriaceae) -Restricted in Meghalaya. Grows epiphytic.
39. *Stephensoniella brevipedunculata* Kash. (Exormothecaceae)--Restricted in western Himalayas (Nainital, Mussoorie etc). Grows on moist soil or rocks. Rare.
40. *Aitchisoniella himalayensis* Kash. (Targioniaceae) Restricted in western Himalayas (Nainital, Mussoorie etc). Grows on muddy exposed rock. Extremely rare.
41. *Exormotheca tuberifera* Kash. (Exormothecaceae) -Restricted in western Himalayas (Garhwal, Mussoorie). Grows on moist soil or shaded rocks. Extremely rare.
42. *Athalamia pusilla* (St.) Kash. (Sauteriaceae)--Distributed in western Himalayas (Kumaon hills, Kulu, etc.) and south India. Grows on moist soil or shaded rocks. Extremely rare.
43. *Athalamia pinguis* Falc. (Sauteriaceae)---Restricted in western Himalayas (Kulu, Simla, Mussoorie). Rare.
44. *Mannia foreani* Udar *et* Chandra (Rebouliaceae) --Restricted in Palni hills (Kodaikanal) and Nilgiri hills (Beruliar). Grows on slopes and rocks in exposed habitat. Rare.

45. *Mannia perssonii* Udar *et* Chandra (Rebouliaceae)—Restricted in western Himalayas (Gangotri). Grows on slopes and rocks in exposed or shady habitats. Rare.
46. *Cyathodium denticulatum* Udar *et* Srivastava (Targioniaceae)—Restricted in eastern Himalayas (Darjeeling). Grows in moist and shady places.
47. *C. indicum* Udar *et* Singh (Targioniaceae)—Restricted in western Himalayas (Nainital). Grows on moist and shady rocks.
48. *C. tuberculatum* Udar *et* Singh (Targioniaceae)—Restricted in eastern Himalayas (Darjeeling). Grows on moist soil-covered rocks.
49. *Riccia reticulata* Udar (Ricciaceae)—Restricted in Pilani (Rajasthan). Rare.
50. *R. aravalliensis* Pande *et* Udar (Ricciaceae)—Ristricted in Rajasthan (Mt. Abu). Grows exposed on soil covered rocks.
51. *R. pandei* Udar (Ricciaceae)—Restricted in Garhwal Himalayas (Kandolia). Grows on moist walls.
52. *R. melanospora* Kash. (Ricciaceae)—Distributed in Hoshiarpur and Nilgiri hills (Ootacamund), Lucknow and western Himalayas (Kashmir). Grows exposed or under xerophytic conditions, usually on gravel foot paths and also on red soil.
53. *R. grollei* Udar (Ricciaceae)—Restricted in Nilgiri hills (Runneymede, Rajasthan & Madhya Pradesh. Grows on red soil.
54. *R. abuensis* Bapna (Ricciaceae)—Restricted in Mount Abu (Rajasthan).
55. *R. jodpurensis* Bapna (Ricciaceae) —Restricted in Jodhpur.
56. *Asterella angusta* (St.) Kachroo (Rebouliaceae)—Distributed in western Himalayas, eastern Himalayas, Khasia hills, Madhya Pradesh and Rajastham, Uttar Pradesh. Grows on plains as well as on hills on exposed soil.
57. *A. mysorensis* (Kash. mss) Kachroo *et* Bapna (Rebouliaceae)—Restricted in south India (Mysore). Grows in fairly exposed habitat.
58. *Asterella reticulata* (Kash.) Kachroo (Rebouliaceae)—Restricted in eastern and western Himalayas. Grows on exposed or shaded soil covered rocks.
59. *Cryptomitrium himalayensis* Kash. (Rebouliaceae)—Restricted in western Himalayas (Nainital etc.) Grows on moist slopy rocks.
60. *Plagiochasma pauriana* Udar *et* Chandra (Rebouliaceae)—Restricted in Garhwal Himalayas (Pauri Garhwal). Grows on moist rocks.
61. *Sauchia spongiosa* (Kash.) Hattori *et* Shim. (Sauteriaceae) —Restricted in western Himalayas.

RARE TAXA WITH NARROW ECOLOGICAL RANGE AND RESTRICTED DISTRIBUTION IN INDIA.

1. *Takakia ceratophylla* (Mitt.) Grolle (Takakiaceae)—Extremely rare in India (Sikkim). Earliest report based on a collection made over a century and a half ago. Currently distributed in East Nepal: on rock, alt. (4550 m) in crevices of cliff (alt. 4520 m); Alaska, Aleutian Islands: Amchitka

Island, Aleut point: on moist soil on bank of stream in full shade and also on moist soil of ditch at top of bluff (about 69 m.).

2. *Calobryum blumii* Nees (Haplomitriaceae) --Distributed in Assam (Jowai-Jarrain road), Java, Sumatra and New Guinea grows in moist and shady forests and steep clay banks. Not found in India since 1968.
3. *Haplomitrium hookeri* (Smith) Nees (Haplomitriaceae) --Distributed in Darjeeling, (eastern Himalayas), Deoban, (Western Himalayas), North America, Europe and Spitsbergen. Grows in a moist and shaded habitat.
4. *Anthelia julacea* (L.) Dum. (Antheliaceae) --Extremely rare in India. Distributed in the Western Himalayas, Nepal, Europe, America and Asia.
5. *Ptilidium ciliare* (L.) Nees (Ptilidiaceae) --Extremely rare in India. Distributed in the Eastern Himalayas (Darjeeling), Nepal, circumboreal, barely into the northern most limit of the deciduous forest as a relict, rarely in Argentina (Tierra del Fuego), New Zealand, Europe, America, Asia, Japan and Alaska.
6. *Isotachis indica* Mitt. (Balantiopsidaceae) Rare in India. Distributed in the Eastern Himalayas (Khasia mountains) and Nepal.
7. *Schiffneria levieri* Schiffn. (Cephaloziaceae) -Rare in India. Distributed in Darjeeling, Eastern Himalayas.
8. *Blasia pusilla* L. (Blasiaceae)--Distributed in Kulu, Manali, Nagar, Karaon, Garhwal, Gangotri Road, Europe, America, Japan, Pakistan, Taiwan and Siberia.
9. *Calycularia crispula* Mitt. (Pelliaceae) -Rare in India. Distributed in Garhwal, Gaurikund, Kumaon, Gangolight, Dalhousie, Sandakphu-Khajiar road (about 7000 ft.), Mungpoo (Darjeeling), Tonglu, Korea and Japan. Fertile plants with mature sporophytes collected in India after more than two decades. The spores rarely germinate under artificial conditions. Grows in a shady and moist habitat. Sporophytic plants found apparently under snow cover –a condition presumably essential for the development of sporophytes in this plant.
10. *Metzeria conjugata* Lindb. (Metzgeriaceae) --Extremely rare in India. Distributed in Western Himalayas, Burma, Java, Celebes, Taiwan, New Zealand, Japan, America Chile, Europe, Ireland, Caucasus, Africa, Brazil, Mozambique. Never found since its original discovery from India.
11. *M. furcata* (L.) Dum. (Metzgeriaceae) Extremely rare in India. Distributed in Western Himalayas, South India, Europe, North & South America, Australia, Tasmania, New Zealand, Caucasus, Africa, China, Formosa & Japan. Never collected since its original discovery from India.
12. *M. longitexta* St. (Metzgeriaceae)---Extremely rare in India. Distributed in Eastern Himalayas, Sikkim) and Insula Dominica. Never found since its original discovery from India.
13. *Monoselenium tenerum* Griff. (Monoseleniaceae) --Extremely rare in India. Only once collected after about 8 decades from Presidency Garden,

Manipur since its original publication in 1949 from Assam. It is distributed in China, Japan, Hawaii, Ryukyu and India.

14. *Conocephalum supradecompositum* (Lindb) St. (Marchantiaceae)—Extremely rare in India. Only once collected in 1941 from Darjeeling. Distributed in India, subtropical regions of Japan and the Province of Shensi in China.
15. *Wiesnerella denudata* (Mitt.) St. (Marchantiaceae)—Distributed in the Western Himalayas (Dalhousie-Khajiar road), Dulchi-Pass Kumaon and Darjeeling Himalayas, Nepal, Sumatra, Java, Formosa, Korea, Japan and Hawaii, Gross in shade under moist conditions.
16. *Lunularia cruciata* (Scop.) Nees (Marchantiaceae) -- Fertile plants extremely rare in India, vegetative plants very common. Distributed in the eastern and western Himalayas, Nilgiri hills (Ootacamund: in a moist gorge). Distributed in India, Japan North America, Europe, Abyssinia, South Africa, Queensland, Australia and New Zealand.
17. *Preissia quadrata* (Scop.) Nees (Marchantiaceae)--Distributed in the Western Himalayas: Pangi, Lahul, Baralacha Pass, Keylang, Kashmir (collected only once since 1929 from Sonmarg, Kashmir), Nepal, Europe, Japan, Siberia and North America. Grows on moist and shaded rocks.
18. *Sauteria alpina* Nees (Sauteriaceae)--Distributed in Western Himalayas (at higher altitude: Valley of Flowers), Japan, Europe, Siberia, Norway and North America. Grows on moist and exposed or shaded rocks.
19. *Exormotheca ceylonesis* Meij. (Exormothecaceae)--Distributed in Nilgiri Hills & Sri Lanka Grows on moist and shaded rocks.
20. *Ricciocarpus natans* Corda (Ricciaceae)—Distributed in Kashmir (Dal-lake where it occurs floating on water or rooted on mud), Manipur, South America, Europe, China, Indo-China, New Zealand and Australia.
21. *Riella affinis* Howe *et* Underwood (—*R. vishwanathai* Pande *et al*) Riellaceae) --Distributed in India (U.P. and Gujarat), Tafira, Gran Canaria, Stanford California and Cape Province, South Africa. Grows under submerged conditions in Lake-Latif-Shah near Varanasi and also in Gujarat. It is no more found in the former locality.
22. *Apotreubia nana* (Hatt. & Inoue) Hattori & Mizut. (Treubiceae)—Extremely rare in India. Distributed in eastern Himalayas, Japan, British Columbia (Canada). Grows in association with several mosses on damp, humus-covered rocks.
23. *Geocalyx graveolens* (Schrad.) Nees (Geocalycaceae)—Distributed in India, confined to higher altitude (alpine zone) in the western Himalayas (Valley of flowers), Europe, Siberia, Japan and North America. Grows on soil covered rocks or over decaying forest litter in moist habitat.
24. *Delavayella serrata* var. *purpurea* Chen. (Jungermanniaceae)—Extremely rare in India. Distributed in Western Himalayas (Girgaon, Almora), Grows epiphytic.

It is essential that the taxa enumerated above may be repeatedly searched in their type localities for correct assessment. Similarly other liverwort species, which have been recorded earlier from a particular locality, should be looked for carefully in their original home before putting them under the category of rare or threatened taxa. The main causes of depletion of some liverworts including over collecting, growth of tourism, mountain climbing and other leisure activities of the area, are damaging or destroying the habitats of many species (see Richards, 1979). Forest cutting poses a major threat for the epiphytic communities. The industrial and agricultural developments also tend to destroy the habitat. Due to genetic depletion some species which become very old or senescent, become disabled to adapt to a new environment leading to their extremely restricted distribution e.g. *Takakia ceratophylla*, *Calobryum indicum*, *C. dentatum*, *Haplomitrium grollei* and *H. kashyapii*. Also, natural phenomenon such as land upheavals, volcanic erruptions, glaciation, protracted periods of drought, forest fires etc. lead towards extinction of plants.

It is suggested that action should be taken towards the conservation and preservation of the rare and threatened taxa of liverworts on the same lines as suggested by Jain and Sastry (1980) for higher plants. Like Orchid sanctuaries located at various places in the eastern Himalayas, sanctuary of liverworts may also be developed at appropriate places.

It may also be stated that the National Committee on Environmental Planning and Coordination and the National Committee on Man and Biosphere responsible for the protection of habitats having natural vegetation should identify some areas on the hills, where these plants grow, for conservation and preservation as 'Biosphere Reserves'.

The plants listed above need urgent attention towards their preservation and conservation, as several of them are getting depleted day by day.

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Threatened Bryophytes of Nainital

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During the last five years an alarming depletion of certain liverworts, specially those which untill a few years ago, were very well represented in the local flora, such as *Athalamia pinguis* Falc., *Conocephalum conicum* (L.) Dum., *Cryptomitrium himalayense* Kash., *Dumortiera hirsuta* (Sw.) R. Bl. et Nees., *Reboulia hemispherica* (L.) Raddi, *Stephensoniella brevipedunculata* Kash. and *Wiesnerella denudata* (Mitt.) Steph. amongst the Marchantiales and *Fossombronia himalayensis* Kash. and *Sewardiella tuberifera* Kash. amongst the Jungermanniales. Out of these, *Stephensoniella brevipedunculata* and *Sewardiella tuberifera* happen to be monotypic, endemic genera. The former, (*family Exormothecaceae, Suborder Marchantiinae, order Marchantiales, subclass Marchantiae) first described by Kashyap (1914) has a very restricted distribution in the Western Himalayas. It was described as very common in Kumaun, Mussoorie, Simla, Kulu etc. at an altitude of 1800-2100 m. (Kashyap, 1929; Mehra & Mehra, 1939). It was recorded as common in Nainital too, occurring on the joints of old walls as well as on more or less shady places in large, almost pure patches or growing singly among grass and mosses. Once quite common all along the walls on the Mall road, (personal communication, Dr. Ram Udar) it has almost disappeared now. One may find some isolated patches in the crevices of walls on the Mall but the luxuriance of yester-years is undoubtedly gone.

Based on field observations, this liverwort has to be labelled today as quite rare in Nainital, in contrast to Kanwal's record of 'common' in his listing of 'Marchantiales of district Nainital', published in 1977. He had observed this species in association with *Plagiochasma appendiculatum* L. et L. and *Asterella angusta* (St.) Kachroo. Our observations however, indicate that *Stephensoniella* is persisting at present only in certain protected microhabitats, its original habitats being gradually destroyed by overcollection, landslides and drastic topographic changes due to fast increasing urbanization. One must bear in mind that recovery of a bryophyte population is a slow process. Destruction of original habitats by any of the above mentioned causes has resulted in changed successional patterns, the sites becoming more favourable for the growth of other invading groups of plants and making the conditions unfavourable for the existence of this delicate, porous, thalloid liverwort. On one calcareous boulder, it has been observed that *Stephensoniella* is just confined to a very small

*The classification followed is that of Schuster (1966).

patch—the whole area being colonized by mosses like *Anoectangium* and *Barbula* and ferns like *Asplenium* and *Cheilanthes* and even these in turn (in the process of succession) are being replaced by angiosperms like *Platystemma violoides* and *Taraxacum officinale*. In this case, the original ledge has been out away to widen the road, thus reducing considerably the original spread of the liverwort. Whatever area remains is now being colonized by mosses and other higher plants.

Throughout Nainital, the walls are subjected to white-washing and painting in the month of March, followed by scraping in September. This obviously results in the destruction of the original bryo-flora in a two-fold way. The heavy scraping tends to erase the luxuriant expansion of the thallose and leafy liverworts. The cementing, white-washing and painting of the wall surfaces results in an entirely new sequence of invading bryophytes. This has been specially observed on the Mall. Where previously there were species of *Asterella* or *Stephensoniella* or *Targionia* as primary colonizers, the new bryophytic community is composed of species of *Plagiochasma* together with mosses such as *Barbula* and *Bryum*. Infact liverworts are being replaced by mosses. The still surviving *Stephensoniella* can only be seen at some places in the wall-crevices but receeding each year. Here one is reminded of Schusters' (1966) remark that "because of their size, liverworts and Anthocerotae are in general unable to compete favourably with higher plants. They are restricted to temporary habitats or to niches where higher plants cannot undergo ecesis (such as on bare rock walls or cliffs) or where conditions are so extreme as to restrict the growth of the higher plants. Hepaticae. .are therefore pioneer species, which together with lichens, invade bare sites and prepare such habitats for the eventual succession of higher plants, i.e. they form a matrix in which higher plants can undergo ecesis". Once competition sets in, hepatics will naturally be pushed out in the "economy of nature" because of their 'intrinsic inability, compete with other species (higher plants and ferns) in more favourable habitats.

Increased vehicular traffic on the Mall road may also be one of the causes of the disappearance of *Stephensoniella* the fuel fumes acting as a phytotoxicant. Bryophytes are now known to be reliable 'indicators' of atmospheric pollution. Although a thorough study is needed to arrive at any definite conclusion, yet one is reminded of Gilbert's (1968) reference of New Castle Upon Tyne—an industrial area in North East England as a 'bryophyte desert' due to the toxic effects of Sulphur di-oxide fumes.

Sewardiella tuberifera Kash., (family Fossombroniaceae, suborder Codoniinae, order Metzgeriales, subclass Jungermanninae) another monotypic, endemic Indian genus, confined to the Western Himalayas (Mussoorie, Simla, Nainital) was quite common in Nainital as observed by Pande, Srivastava and Misra (1955) but today the picture appears to be as grim as that of *Stephensoniella*. It has disappeared from the localities cited by Pande et al (1955) due to changed topography but survives in certain other areas, growing on rotting wood in

association with mosses like *Entodon* and *Eurphynchium*. One known site of *Sewardiella* near Himalaya Hotel in Tallital has perished recently by the coming up of a residential building.

Besides these two monotypic endemic genera, there are several others showing signs of depletion.

Athalamia pinguis Falc. (family Cleveaceae, suborder Marchantiinae, order Marchantiales, subclass Marchantiae) has a known distribution in Western Himalayas. It was very common in Nainital on all exposed slopes as well as on muddy walls and rocks in shady and moist places but at present it certainly, does not enjoy that very 'Status', if not rare, because of the construction of new roads and their supporting walls.

Conocephalum conicum (L.) Dum., (family Conocephalaceae, suborder Marchantiinae) mainly distributed in the Kumaun and the outer Himalayas, up to Kashmir in the West and Middle Himalayas in India, (Kashyap, 1929) is a ubiquitous species (N. China, Japan, Siberia, Korea, Alaska, Canary Islands, Caucasus, Madeira, Azores, North America, Ireland, Europe & Algeria). At present it is confined to a single locality in Nainital at Dhobighat (near Snow View) in a cool, shady, humid area, receiving extra moisture the whole year round from drainage channels and wet flushes. This locality can still be aptly termed as a 'bryophytic paradise'. The various hepatics viz., *Conocephalum conicum, Dumortiera hirsuta, Marchantia nepalensis* and **Wiesnerella denudata* together with species of *Pellia (P. endivaefolia* (Dicks.) Dum., *Porella, Metzgeria* and variety upon variety of mosses and ferns grew here in so much abundance and luxuriance that the students and botanists could not resist the temptation to gather them in the past. The locality still harbours plenty of bryophytes but the reckless collection has undoubtedly reduced the extent of areas in which mosses upon mosses of *Conocephalum* or *Dumortiera* or *Marchantia* once flourished. With each passing year, I see the areas diminishing. Very little *Marchantia* can be seen growing in Dhobighat today and we have not collected any *Wiesnerella* either. Here indiscriminate collection seems to have played havoc with the bryophytic vegetation. Even the local M.Sc. students flock to this area each year and bring back large patches of *Conocephalum* or *Dumortiera* and often bulk of that collected material is wasted. Without any thought for the recovery of the liverwort populations, the students mercilessly lay bare the hillside and rocks of their precious bryophytic cover. Each year I see this 'massacre' and everytime, Scott and Stones' (1976) appeal flashes through my mind: "small specimens are ample for most purposes and collectors. .. must not forget the need to preserve their heritage unimpaired. Whether for serious research, for exchange, or merely for horticulture, indiscriminate or wasteful collection is unethical, immoral, and altogether to be deplored."

Incidentally, Dhobighat is the only known station for *Conocephalum conicum* in Nainital on loose, red, Kankar soil. Besides, overcollection, other operational

*reported by Kanwal (1977); not seen by me.

factors in the gradual reduction of '*Conocephalum* areas' in this locality are natural disturbances as landslides and rolling down of top debris, thus causing upheaval of soil. The kachcha path from Dhobighat leads to Kainchi and meets the Almora Road. The road is yet unmetalled but each year it is broadened and the area is subjected to biotic disturbances, enough to unbalance the bryophytic communities and their substrates. At present the moss *Atrichum* (*A. obtusulum*) can be seen coming up in between the *Conocephalum* patches, as a characteristic invader of the disturbed soil.

Cryptomitrium himalayense Kash. (family Grimaldiaceae, suborder Marchantiinae) reported from the Himalayas only (Western Himalayas and Sikkim) has a very delicate thallus and grows on very moist places under the dense shade of trees or in caves or moist hollows. Very common in Nainital untill recently, this Himalayan species is also suffering at present the effects or urbanization. Sites after Sites have vanished in the last few years. The whole area where 'Vishal' Cinema hall and Tallital tourist complex has been constructed was rich in *Cryptomitrium*. Near the bus stand, there were huge boulders forming cave-like hollows under the dense shade of trees where this liverwort grew in extra-ordinary richness; but those very boulders were hammered and cut to appropriate sized stone pieces for the construction of supporting walls.

Dumortiera hirsuta (Sw.) Reinw., Blume and Nees (family Marchantiaceae, suborder Marchantiinae)—a markedly, hygrophilous species, well represented in India in the Western Himalayas, Sikkim, Khasia Hills, Madhya Pradesh and South India and also in Japan, North America, Europe, New Zealand, Hawaii, grows in very humid, dark and shady places on stones, rocks and sometimes under running water. As mentioned earlier, this liverwort has been subjected to overcollection hazards at its best known station, Dhobighat. It has also vanished from another site, Gufa Mahadev, where much beautification (!) has been done by white-washing and painting the calcareous, overhanging rocks. At this site I had observed a rich, lush-green *Dumortiera-Marchantia-Pellia* community on the side walls and floor of irrorating rocks, receiving constant sprays of water in 1976 but nothing of it remains today.

Reboulia hemispherica (L.) Raddi., (family Grimaldiaceae, suborder Marchantiinae) has a known distribution in India in the Western Himalayas, South India and Khasia Hills. It is also very well distributed in other parts of the world. (Taiwan, Japan, Korea, Java, New Zealand, Australia, Britain, North and South America, China, Tahiti, Caucasus, Europe, Africa). This robust liverwort prefers an open space and rocky substrate (moist but not extra moisture).

Overcollection, coupled with disturbances to the habitat-both man-made and natural have been instrumental for bringing down the number of *Reboulia* sites in Nainital. In sharp contrast, *Reboulia* can be seen growing in all its glory at Mukteshwar and Pangot where there is less urbanization and the areas are least disturbed by man's activities.

Wiesneralla denudata (Mitt.) Steph. (family Marchantiaceae,) reported from Kumaun, Dalhousie, Java, Hawaii, Japan, Taiwan and Korea prefers very moist rocks and grows actually under water. In recent years, Kanwal (1977) had reported this liverwort from Nainital on "black, muddy and moist soil near a stream associated with *Conocephalum conicum, Dumortiera hirsuta, Marchantia nepalensis* and *pellia*". He has not mentioned his *Wiesnerella* sites of Nainital except Dhobighat. Unfortunately we could neither collect *Wiesneralla* at Dhobighat nor anywhere else in Nainital.

Fossombronia himalayensis (family Fossombroniaceae, suborder Codoniinae, Order Metzgeriales, subclass Jungermanniae) originally described by Kashyap (1915) from Western Himalayas is also reported from other parts of India as Sikkim, Khasia Hills, Rajasthan, Madhya Pradesh, Western Ghats and South India. It grows on moist rocks or among grass, moss and Cyanophyceae. Although reported from Nainital (Pande, Mahabale, Raje & Srivastava, 1954), we could not collect this foliose form untill recently. (Collected by S. D. Tewari from Dhobighat in a moist, shady hollow, associated with species of *Chiloscyphus & Plagiochila*).*

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Rare and Endemic Lichens in the Western Ghats, South Western India

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Introduction

According to Hooker (1906) "The Flora of British India is more than that of any other country of equal area in the Eastern hemisphere, if not the globe. This is due to its geographical extension, embracing so many degrees of latitude, temperate and tropical; to its surface rising from the level of the sea to heights above the limits of the vegetation; to its climates varying from torrid to arctic and from almost aridity to a maximum humidity and to the immigration of plants from widely different bordering countries, notably Chinese and Malayan on the east and south, of Oriental, European and African on the west and of the Tibetan and Siberian in the north" Though, higher vascular plants are primarily considered in this view point, Cryptogams and especially lichenized fungi or Lichens are not exception. Not unlike the higher vascular plants, the lichen flora distributionally shows strong correlation with the climatic conditions and arboreal elements of the flora of any particular regions.

True that our present knowledge of the lichen flora of India is inadequate. Nevertheless, as we have been working on the lichen flora of the Western Ghats from the last couple of years, it is proposed to present before you some of the salient features of the lichen flora of the Western Ghats with special reference to the rare and endemic lichen taxa.

The Western Ghats cover a distance of approximately 1600 kms from Tapti valley to Cape Comorin and consist of a series of hill ranges running north-south along the west coast of India. The hill ranges are more or less continuous with a major discontinuity in the Palghat gap separating the Nilgiri range from the Anamalai. The elevation is not high throughout; at places the hills are as low as 200 m. From climatic point of view, tropical regime with rains from May-June to October or little later with peak in July typifies the Western Ghats in South India. Most of the vegetation and forests in South West India are relegated to hills; the plains and flat grounds having been put under plough since centuries.

Optimum conditions for rich and profuse growth of lichens in variety and development exist in the high hills of the south west India. The vegetation type is generally designated as the high level Shola (montane forest). The foliose

and fruticose lichens of the genera *Parmelia, Heterodermia, Collema, Leptogium, Lobaria, Sticta, Physcia, Dermatocarpon, Ramalina, Usnea, Cladonia, Stereocaulon* and the crustose forms of the families Pyrenulaceae, Graphidaceae, Thelotremataceae, Lecideaceae and Lecanoraceae predominate in these high hill ranges.

The deciduous tropical and subtropical forests existing on the eastern spurs and low hill ranges of the Western Ghats have comparatively poor lichen growth in drier regions but at moist shady places foliose lichens of the genera *Physcia, Pyxine, Dirinaria Heterodermia, Parmelia, Leptogium* are found associated with the crustose lichen genera of the families Lecanoraceae, Lecideaceae, Buelliaceae, Arthoniaceae, Cryptotheciaceae etc.

Out of the over 1500 species of lichens known so far (Awasthi, 1965; Ajay Singh, 1980) from Indian subcontinent, over 50% belong to crustose forms. A great majority of the crustose forms are corticolous, pyrenocarpus, Graphidaceous and Thelotremataceous lichens. Over 50% of the approximately 800 species of lichens known so far from the Western Ghats belong to the genera: *Graphis* (30 species), *Graphina* (35 species), *Phaeographis* (15 spp.), *Phaeographina* (13 spp.), *Thelotrema* (22 spp.), *Ocellularia* (23 spp.), *Phaeotrema* (5 spp.), *Leptotrema* (12 spp.), *Anthracothecium* (25 spp.), *Pyrenula* (20 spp.), *Arthothelium* (20 spp.), *Cryptothecia* (15 spp.), *Parmelia* (90 spp.), *Heterodermia* (20 spp.), *Leptogium* (16 spp.).

It is difficult to go into the details of distribution of all the species that occur in the Western Ghats, but an account of the distribution and nature of occurrence of some species of the Graphidaceous, Thelotremataceous and some pyrenocarpus and Parmelioid lichen genera is presented in the following paragraphs.

Some of the lichen species occurring in the Western Ghats have fairly widespread distribution on the global level. These plants pleuri-regional species or 'wides' have very wide distribution in Europe, Asia, Africa, America etc; On the other hand some species have limited distribution in India and adjoining regions (countries) while still some species have very small range or limited range of distribution in the Western Ghats. These plants of limited distribution are more important as they give character and colour to the flora in an area.

I : *Pleuri-regional species or 'wides':*

List of lichen taxa having distribution in the Western Ghats/other parts of Indian subcontinent/Asia-Europe-Africa-America-Australia (Mah-Maharashtra; Karn-Karnataka; T.N.-Tamil Nadu; Kerl-Kerala).

1. *Parmelia australiensis*

   Karn, T. N., Kerl/NE India, Himachal Pradesh; SE Asia, Europe, Africa Australia, America

2. *Parmelia caperata*

   T.N./NE India, Himachal Pradesh, Nepal; SE Asia, Europe, Africa, Australia, New Zealand, America

3. *Parmelia crinita*
   Karn, T.N./NE India, Himachal Pradesh, Ceylon; SE Asia, Europe, Africa, S. Australia, N. America
4. *Parmelia cristifera*
   Karn, T.N., Kerala/SE India, Orissa; NE Asia, Africa, New Zealand, Central America
5. *Parmelia dialatata*
   T.N., Kerl./Himachal Pradesh, Ceylon/SE Asia, Africa, Australia, Central America
6. *Parmelia reticulata*
   T.N., Kerl/NE India, Himachal Pradesh, Nepal; SE Asia, Europe, Africa, Australia, New Zealand, N America
7. *Parmelia tinctorum*
   Mah, Karn, T.N., Kerl/NE India, Himachal Pradesh, Uttar Pradesh; Asia, Africa, Australia, New Zealand, America
8. *Parmelia horrescens*
   T.N./SE Asia, Europe, S. Africa, Australia, S. America
9. *Thelotrema lepadinum*
   pantemperate species; occurs as a montane species in the tropics T.N., NE India/SE Asia, Europe, America, Africa, Australia

II. List of Lichen taxa having restricted distrubiton

A. Western Ghats, other parts of Indian subcontinent/South East Asia

1. *Parmelia denegans*
   T.N., Ceylon/Sabah
2. *Parmelia expallida*
   Karn, NE India/Thailand, Taiwan
3. *Parmelia exsecta*
   T.N., NE India, Ceylon, Nepal/Japan, Taiwan
4. *Parmelia meizospora*
   Mah, Kerl, Ceylon, Nepal/Japan, Taiwan
5. *Parmelia nilgherrensis*
   T.N., Kerl, NE India, Himachal Pradesh, Ceylon, Nepal/Thailand, China
6. *Parmelia orientalis*
   T.N., Nepal/Philippines
7. *Parmelia setschwanensis*
   NE India, Nepal/China
8. *Parmelia xantholepis*
   T.N., NE India, Nepal/Java, Thailand, Philippines
9. *Parmelia crenata*
   Maha, Karn, T.N., Kerl/Japan
10. *Parmelia planatilobata*
    Karn/Malaya

11. *Ocellularia groenhartii*
    Karn, Kerl/Java
12. *Ocellularia glaucophaena*
    Kerl/Borneo
13. *Thelotrema arecae*
    Karn/Siam
14. *Thelotrema asiaticum*
    Kerl/Siam

It is well known that the endemic plants determine whether the country or region has a typical or characteristic flora or not. The probable reason for the occurrence of large number of these 'isolated' taxa having limited range of distribution might be the existence of—Himalayan ranges in the northern most side, Indo gangetic plain having alluvial warm soil in the northern side, Bay of Bengal, Indian Ocean and Arabian Sea on both the lateral sides -- barriers against migration of plants from other countries. Some of the known endemic lichen taxa of the Western Ghats are listed below: *Parlia bulbochaeta, Parmelia dodapetta, Parmelia simplicior, Parmelia kamatii, Parmelia coorgiana, Parmelia thryptica, Parmelia indica, Parmelia masonhalei, Parmelia vartakii, Phaeotr ma norstic-ticum, Thelotrema indicum, Thelotrema keralense, Thelotrema poeltii, Leptotrema jamesii, Phaeographina halei, Graphis patwardhanii, Graphina panhalensis, Graphina agharkarii, Phaeographis albolabiata Arthothelium verruculosus, Arthothelium, albescens, Arthothelium awasthii, Arthothelium nigrodiscum, Cryptothecia anamalaiensis, Cryptothecia nilghiriensis, Cryptothecia culbersonae, Bacidia nigra, Heppsora indica, Leptogium indicum, Porina palniensis, Cryptothecia subnidulans, Pertusaria concinna, Pertusaria dehiscens* var. *depresior, Pertusaria punctata, Pertusaria subochracea, Usnea flexilis, Usnea spinosula, Usnea stigmata, Usnea subsordida, Usnea vulneraria, Stirtonia monocarpa* etc.

The frequency of occurrence of some species in different areas of the Western Ghats varies remarkably. Besides, there is much smaller but yet significant number of species which exhibit marked distributional tendencies even within the ranges of the Western Ghats. This is apparently because of the climatic factors especially precipitation and length of total dry period. Such rare species existing in the Western Ghats are listed below: 1. *Parmelia bulbochaeta* Hale, *Parmelia dodapetta, Parmelia thryptica, Parmelia abstusa, Parmelia microblasta, Parmelia planatilobata, Parmelia sydnensis, Ocellularia alborosella, Phaeotrema platycarpum, Leptotrema santense, Phaeographina halei,* etc.

The studies on several lichen genera especially microlichens from the Western Ghats are incomplete. Number of Lichen taxa having wide distribution, limited distribution, endemic and rare nature in the Western Ghats would be much more on completion of these investigations.

Nevertheless, the most important observation that has emerged from our last 8 years study is that the Western Ghats still have many magnificent habitats for lichens, rare lichen species and many tropical, subtropical and temperate species in comparision with the rest of India. The primary broad leaved-tropical

rain forests existing in South Canara, Anamalai hills still retain finer assemblage of epiphytic, lignicolous and foliicolous lichens often with excellent representation of the Old World Tropical species and even endemic elements that are not known elsewhere in India.

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Occurrence and Distribution of Some Rare ferns in India

ANUKUL DATTA, *Botanical Survey of India, Howrah.*

During the course of some studies on the pteridophytic flora of India, the author collected interesting data on the distribution of certain rare/threatened species, the details of which are described in this paper. Efforts should be made to locate these rare species in other areas and introduce them in Botanic Gardens so that these threatened species may be saved from possible extinction.

1. ELAPHOGLOSSUM NILGIRICUM Krajina ex Sledge in Bull. Brit. Mus. Nat. Hist. 4(2): 94. 1967. (Family: Elaphoglossaceae).

Rhizome short-creeping, clothed with palea; palea narrowly lanceolate or linear, pectinate-dentate, chestnut-brown, margin black, shiny. Stipe short, rusty-coloured, clothed with ovate or broadly ovate palea, margin with setiform teeth. Fronds fertile and sterile, of same shape and size, but fertile frond often contracted, sometimes not, texture flaccid, tufted, shortly stipitate, 5-35 cm long. Lamina narrowly oblong, 2 cm broad, copiously scaly, apex obtuse, gradually attenuate at base; both the surfaces densely covered with velvety ciliated scales, but in lower surface scales more densely crowded; margin with fimbriate setiform teeth.

Sori on fertile fronds, exindusiate.

Epiphytic fern on mossy tree trunk in the vicinity of river bank.

Beddome (1863-64) in his 'Ferns of Southern India' first reported the occurrence of this fern in the Nilgiris, described it as *Elaphoglossum squamosum* and gave a drawing of its habit in his work which is the holotype of the species. He collected *E. nilgiricum* Krajina ex Sledge (his *E. squamosum*) from Sisparah Ghat, Nilgiris, twice—one in 1860 from an elevation of 1500 m and in second time from the same locality in November, 1883 from an elevation of 1800 m. In the same year, earlier in June, Gamble collected it from Pykara Falls (1,800 m) of the Nilgiri district. Also in the same year, in May, Levinge collected the fern from Paramteethkhol near Anaimoodi, Travancore from an elevation of 2100 m.

E. nilgiricum Krajina ex Sledge is reported to be endemic to Nilgiri Hills. Its distribution elsewhere in South India has not been reported till date except Fischer (1921) who, however, reported its occurrence in Anaimalai Hills of Coimbatore district. But the specimen is not available for varification.

In recent years, during many explorations in various parts of South India, no report of its collections, however, has been made. This species was collected

on two occasions from the forest on Kunthipuza River in Silent Valley by J. N. Vohra and R. K. Ghosh during exploration of Silent Valley in 1980.

Specimens studied :

Pykara Falls, '6000 ft.' Nilgiris, *J. S. Gamble* 19009, June, 1883; Paramteeth-khol, near Anaimoodi, Travancore, '7000 ft.' *H. C. Levinge s.n.*, May 7, 1883; Kunthipuza River bed at Silent Valley dam site, *J. N. Vohra & R. K. Ghosh* 56303 April 21, 1980; same locality, *J. N. Vohra & R. K. Ghosh* 56350, April 23, 1980.

2. DRYOATHYRIUM BORYANUM (Willd.) Ching in Bull. Fan. Mem. Inst. Biol. 9: 81. 1941 Pl. 30, fig. 1; Sledge in Bull. Brit. Mus. Nat. Hist. 2(11): 282-83. 1962. (Family : Athyriaceae).

Rhizome stout, clothed with narrow brown scales. Stipe upto 1 m long, sparsely scaly. Fronds large, broadly ovate, deeply tripinnatifid, rhachis channelled above with filiform scales; pinnae petiolate, pinnules sessile, segments with rounded apices and serrate margins, under surface glabrous but upper surface spiny.

Sori with indusia, round or reniform.

This species is distributed both in north and south India and has been variously named by earlier authors. While Beddome (1863-64, 1883, 1892) described it from south India as *Lastrea divisa* (Hook.) Bedd., *Phegopteris kingii* Bedd. and *Lastrea boryana* (Willd.) T. Moore, Clarke (1880) described it from north India as *Polypodium subtripinnatum* Clarke.

Today, the species is one of the common ferns of north India and is reported as occurring in the Himalayan belt from north-western to eastern Himalaya. But after Beddome's report of the species from south India very few collections appear to have been made (Bhavanandan, 1968; Subramanyam et al., 1961).

During recent floristic surveys of various parts of south India conducted by scientists of Botanical Survey of India, this species has not been reported at all.

The present collection of the species in Mulla-Periyar catchment area in Kerala can, therefore, be attributed to a rediscovery of the species in south India after a long gap.

Specimens studied:

Mlapara Estate, 15 Km north-east of Thanikuddi, Periyar catchment area, Kerala, *A. Datta* 56439, February 9, 1981.

3. BLECHNUM PATERSONII (R. Br.) Mett. in Fil. Hort. Lips. 64. 1856. (Family: Blechnaceae).

Rhizome short-creeping, up to 10 cm or more long, densely clad in dark brown, ovate to subulate-attenuate paleae. Stipe stout, blackish, 10-25 cm long, scaly below. Fronds are of diverse forms on the same plant i.e. in part sterile and in part fertile, 12-30 X 3-4 cm, coriaceous, dark green above, paler below, costa prominent in young ones.

Sori covering all but costa.

This is one of the very rare ferns of India and in fact, there appears to be no record of its further collection after over a century. In Calcutta Herbarium (CAL) there are only 3 specimens available which were collected more than a century ago (1859) by T. Thomson from Sikkim Himalaya and later identified by C. B. Clarke. Its occurrence in the Nilgiris and Anaimalai Hills of south India, however, was reported earlier by Baker (1868), Beddome (1863-64; 1883, 1892), Christensen (1906), Hooker and Baker (1846) and Lyell (1870) but now the species is also extremely rare in south India. This is evident from the contemporary explorations of south India flora by different authors. In the recent works on Indian *Blechnum* also, there is no mention of this species (Nayar and Kaur, 1971; Nayar and Devi, 1964; Nayar et al. 1966).

Specimens studied :

Sikkim, '5000 ft.' *T. Thomson s.n.* April 12, 1859.

4. ANOGRAMMA LEPTOPHYLLA (L.) Link in Fil. Sp. 237. 1841; Pichi Sermolli in Webbia 21(1): 496-505 1966. (Family: Hemionitidaceae).

Small annual fern with tufted mass of fibrous roots. Stipe tufted, glossy brown, upto 10 cm long. Fronds small, 5-10 X 2.5-4 cm, delicate, membraneous, ovate to deltoid, all fertile, reniform or variously pinnate; pinnae spathulate to obovate, entire or serrulate.

Sori oblong, simple or forked.

This species is reported to have been formerly occurring in south India. Kunze (1851) and Schmid (1857) recorded its occurrence in the Nilgiris and Beddome (1863) cited places of its occurrence as Nilgiris -Mahabaleswar- - Sattara Fort Walls (Bombay Presidency) and stated that he had seen specimens collected from rocky cliffs between "Ootacamund and Kotagherry". Hooker and Baker (1866) also mentioned Nilgiris as the only place of distribution of this species in India. Lyell (1870) mentioned the same places of its distribution noted by Beddome.

But in subsequent years, this species appeared to be very rare (Birdwood, 1886, 1887, 1896; Abraham et al., 1962). There is no report of its occurrence in the Pulney (Bir and Vasudeva, 1971) or Anaimalai Hills (Fischer, 1921) or in Western Ghats and other parts of south India in general.

The only collection of this species in CAL is of Gamble's collection from Ootacamund, Nilgiris, made in September, 1886, about a century ago.

Specimens studied:

Ootacamund, Nilgiris, 2100 m, *J. S. Gamble* 18164, September, 1886.

5. WOODSIA ALPINA (Bolton) S. F. Gray in Nat. Arr. Brit. Pl. 2: 17. 1821. (Family : Woodsiaceae).

Small to medium sized ferns of cliffs and mountains. Rhizome with persistent stipe bases, short, horizontal, 0.4-3.6 cm long with light brown scales. Stipe

reddish brown to dark purple, 0.6-7.7 cm long, dull or shiny. Fronds tufted, subpinnatifid, hairy below; lamina oblong to linear, chartaceous or coriaceous when dry, pinnae round to ovate, larger pinnae ovate to triangular, tips of pinnae obtuse, 1-4 segmented, 3-4 lobed, crenulate

Sori discrete to seemingly coenosoral, medial, indusium composed of ciliated plate-like lobes.

This polymorphic fern, widely distributed in the Old and the New World, had been recorded by Clarke (1880) as occurring in Kashmir and Sind Valley. Hope (1900-01) gave detailed distributional account of the species in north-western Himalaya and cited Levinge's and Duthie's collection of the species from various places of high altitudes ranging from 2250 to 4800 m in Kashmir, Sind Valley, Sonamarg and Liddar Valley.

However, in recent years the distribution of this species in the specific habitats in north-western Himalaya as mentioned by the previous authors, has shrinkened. Though earlier, Stewart (1945) found the species commonly occurring in the valleys of Kashmir but in later explorations, he (1951) observed that the species had become rare in the state. Rao (1960a, b) has not collected any specimen of this species. Wali and Tiku (1964) surveyed Lolab Valley of Kashmir but did not collect any specimen of the species. Brown (1964) in his monograph of the genus *Woodsia*, cited only one specimen of the species from India (Simla Valley, Punjab) collected by Levinge (?).

It is thus apparent that this species is found to be rare in India.

Specimens studied:

Above Kainmul, Liddar Valley, 12000 ft., Kashmir, *J. F. Duthie* 13148, July 21, 1893.

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Rare and Interesting Pteridophytes of India—II

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Introduction

Much of work on rare and threatened plants of India at various centres in the Botanical Survey of India mainly pertains to Angiosperms. However, Dixit (1982) made an attempt exclusively and on 19 species of Fern -allies to arouse interest on this group of plants in the country. The present communication, deals with 25 species of Pteridophytes, of which 11 species viz.: *Athyrium parasnathensis* (Clarke) Ching, *Cheilanthes dubia* Hope, *Christiopteriss tricuspis* (Hope) Christ, *Cyathea albosetacea* (Bedd.) Copel., *C. nilgirensis* Holtt., *Dryopteris sikkimensis* (Bedd.) O. Ktze., *Polystichum wattii* (Bedd.) C. Chr., *Selaginella aduncа* A. Br., *S. cataractum* Alston, *Vittaria wattii* Dixit et Nair and *Woodsia andersonii* (Bedd.) Christ are strictly endemic to India; 2 species viz.: *Cyathea crinita* Hook. and *Diplazium travancorium* are reported from South India and Sri Lanka; 5 species viz.: *Athyrium duthei* Bedd., *Cheilanthes dalhousiae* (Hook.) Ching, *Dryopteris gamblei* Hope, *Mecodium levingei* (Clarke) Copel. and *Polystichum atkinsonii* Bedd. are known from India with little more extension of distribution to adjoining regions of Nepal and Bhutan and 7 species viz.: *Antrophyum parvulum* Bl., *Cyathea andersonii* Copel., *C. brunoniana* (Wall. ex Hook.) Clarke et Bak., *Halcosorus bisulcatus* (Hook.) Ching, *Polystichum duthei* (Hope) C. Chr. *Woodsia alpina* (Bolton) Gray and *W. cycloloba* Hand.-Mezt. show more wider range of phytogeographic interest indicating their poor distribution in Indian region as indicated by citation of no specimen or a few specimens from the Indian herbaria.

It has been observed that majority of Tree-ferns (*Cyathea* spp.) are fast disappearing in the country. Many species viz.: *Dryopteris gamblei, D. sikkimensis, Polystichum atkinsonii, Woodsia andersonii, Cyathea nilgirensia* etc. were collected earlier by many workers as represented in the CAL but recent explorations in those areas have failed to locate these species. It is mainly due to natural calamities like land slides, floods, droughts and also due to un-natural disturbances, although somestimes unavoidable, like road buildings, expansion of cultivation area by Jhooming, felling of forests, construction of dams etc. In addition, there are a number of species which are very narrow endemics, and, even a slight disturbance in those areas may create direct threat to survival of such species.

The present study is based on the examination of all available herbarium material housed in the Central National Herbarium, Howrah; Regional Circle

Herbaria of the Botanical Survey of India, Forest Research Institute, Dehra Dun, together with published literature as well as a few specialised tours undertaken by the author in Eastern India

Enumeration

The following enumeration deals with 25 species of rare/threatened and interesting Pteridophytes under each family. The species are arranged alphabetically. Important synonyms if any, present position of the available herbarium material, (even indicating their date of collection wherever available) range of distribution of each species are given. A short note has also been appended indicating the reason for their rarity.

ANTROPHYACEAE

ANTROPHYUM PARVULUM Bl.

No specimen of Indian distribution available in the herbaria of Botanical Survey except two specimens from Malaya housed in CAL. Mehra and Bir (1964) reported its occurrence in Sikkim without citing any specific locality and field number, etc.

India (Sikkim, Meghalaya) Malaya, Java.

The species is rare to vulnerable mainly due to habitat destruction and non expertise collection, since, it is difficult to locate it in the field because of its small size of the plants upto 4 cm high, rooting in rock-crevices.

POLYSTICHUM ATKINSONII Bedd.

KASHMIR: 1885, *Sedgewick s.n.*, Access. no. 7277 (CAL). SIKKIM-12000 ft. 1888, *King s.n.* (CAL). Lachen, 9000 ft. May 1885, *King's Collector s.n.* Access. no. 14458 South Gongri, 9000 ft. 27.6.1892, *Gammie* 205 (CAL). WEST BENGAL : Darjeeling—Sandakhphu,1100 ft., 13.10.1880, *Gamble* 8393 (CAL); 10,000 ft. 13.10.1879, *s.l., s.n.*, Access. no. 14453 (CAL); 16000 ft. 13.10. 1880 *Clarke* 309 (CAL).; Phalut, 11000 ft., 15.10.1880, *Levinge s.n.* (DD).

India (Kashmir, Sikkim, West Bengal : Darjeeling Himalayas) Bhutan.

A few old collections have been examined but no recent collections seen. The species is threatened due to habitat destruction.

POLYSTICUM DUTHEI (Hope) C. Chr. *Aspidium duthei* Hope

UTTAR PRADESH—Kumaon : Lebong Pass, Eastern side, 17000 ft. 6.9.1884. *Duthie* 3708 Plant numbered—I (DD).; 16-17000 ft., 2.8.1886, *Duthie* 6234 (DD). SIKKIM : Ningbel, 14000 ft., 5.8.1910, *Smith* 4108 (CAL).

India (North-West Himalayas, West Bengal-Darjeeling Himalayas, Sikkim) Nepal, China.

Only known from three old collections from the Indian region. No subsequent collection made after the year 1910. It is threatened due to habitat destruction.

POLYSTICHUM WATTII (Bedd.) C. Chr. *Aspidium wattii* Bedd.

MANIPUR—May 1882, *Watt. s.n.* Access. no. 15075 (CAL).

Endemic to India (Manipur).

The species is known from Type number only. No subsequent collection made upto date. It is endangered or even extinct.

ATHYRIACEAE

ATHYRIUM DUTHIE (Bedd.) Bedd. *Asplenium duthei* Bedd.

UTTAR PRADESH- -Tihri-Garhwal -Srikanta ; Lekun Gadh, 12-13000 ft. 11.8.1883, *Duthie* 392 (DD); Kumaon : near Raman glacier, 12000-13000 ft. 9.9.1885, *Duthie* 5165 (DD); Near Raman Glacier, 12-13000 ft. 26.8.1884, *Duthie* 3667 (DD).

SIKKIM, 7.8.1877, *King's Collector* 4464 (CAL): Goomthang, 13000 ft. July 1878, *King's Collector s.n.* Access. no. 11550 (CAL); Changu, 12-13000 ft. 1890, *Smith* 3157 (CAL); Chola, 13000 ft., 20.7.1910, *Smith* 3610 (CAL). Sikkim, June 1955, *Rao* 1007 (CAL).

Only known from a few old collections and a recent collection in the year 1955 only. It is extremely rare due to habitat destruction.

ATHYRIUM PARASNATHENSIS (Clarke) Ching *A. filix-foemina* var. 7. *parasnathensis* Clarke

No specimen available in Indian herbaria.

Endemic to India (Bihar—Parasnath hills)

DIPLAZIUM TRAVANCORIUM Bedd.

Peninsula Indiae Orientalis, *Herb Wight* 3143 (CAL); KERALA—Calicut: Wynad, *Beddome s.n.*, Access. no. 59559 (MH).

India (Kerala), Sri Lanka.

The species is known by only two old collections.

CHEILANTHACEAE

CHEILANTHES DALHOUSIAE (Hook.) Ching *Cheilanthes farinosa* var. *dalhousiae* Hook.

HIMACHAL PRADESH Dalhousie 29.9.1874, *Clarke* 23262D (CAL); Chamoli Bhuma, 3300 m, 4.10.1963, *Bhattacharya* 30980 (BSD).

India (North-West Himalayas, Sikkim) Nepal.

There are number of old collections available in the herbaria but only a few recent collections have been seen. No collection after the year 1963 has been made.

CHEILANTHES DUBIA Hope

UTTAR PRADESH—Mussoorie, 4200 ft., 11.9.1952, *Fleming Jr.* 1082 (DD).

Endemic to India (North–West Himalayas)

CYATHEACEAE

CYATHEA ALBOSETACEA (Bedd.) Copel. *Alsophila setacea* Bedd.

NICOBAR ISLANDS—Great Nicobar: Ganges harbour, 16.4.1903, *Rogers s.n.*, Access. no. 1291 (CAL).; Mingkut-Nancouri, 8 m, 2.4.1959, *Thothathri* 9360 (MH); Katchal Islands, 19.8.1975, *Chakraborty* 2525; (PBL); Kamrota Islands, 22.5.1977, *Bhargava* 5033 (PBL); Great-Nicobar Islands, 19.8.1975, *Balakrishnan* 2959 (PBL); 25.7.1976, *Balakrishnan* 3998 (PBL).

It is a case of narrow endemism, since the species is endemic to Nicobar Islands only.

CYATHEA ANDERSONII Copel.

SIKKIM, 1879, *G. king s.n.* (CAL); Rungbee, 4.1.1886, *Gammie, s.n.* Access. no. 1155 (CAL); Singtam, 2500 ft. 9.10.1883, *Levinge s.n.* Access. no. 1166 (CAL); WEST BENGAL : Darjeeling, 6000 ft. Nov. 1879, *Gamble* 7402 (CAL); Kalimpong, 4400 ft., 25.4.1961, *s.l.*, 269 (CAL) ASSAM—Dulpha hills, 1874, *Lister s.n.*, Access. no. 1172 (CAL). ARUNACHAL PRADESH—Siang: Tuting, 29.11.1958, *Rao* 17372 (ASSAM); Subansiri: Palin-Radang village, 17.5.1966, *Sastry* 14883 (ASSAM); Kameng: Bicham, 23.11.1970 (ASSAM).

India (Sikkim, West Bengal: Darjeeling Himalayas, Assam, Meghalaya, Arunachal Pradesh) Bhutan, China.

The species is fast disappearing due to land slides and other habitat destructions in the area.

CYATHEA BRUNONIANA (Wall. ex Hook.) Clarke et Bank. *Alsophila brunoniana* Wall. ex Hook.

WEST BENGAL : Darjeeling Himalayas, 30.10.1879, *Levinge s.n.*, (DD); Karseong, 5000 ft, Aug. 1880, *Gamble* 8334 (DD); MEGHALAYA: Khasya ± 1333m. Feb. 1887, *Gustav Mann s.n.*, Access. no. 87839 (MH): J. D. Hook. & Thompson Herb., Access. no. 87840 (MH). MANIPUR: Near Ching Sow ± 1666 m, Jan. 1882, *Watt.* 5194 (MH).

India (Sikkim, West Bengal: Mountaineous regions of Darjeeling, Assam, Meghalaya, Nagaland, Manipur) Burma, Bangladesh, Vietnam.

No recent collections examined. It is threatened due to fast disappering habitat and exploitation of tree ferns for various purposes.

CYATHEA CRINITA (Hook.) Copel. *Alsophila crinita* Hook.

TAMILNADU : Madurai : Pulneys, 1890, *Beddome s.n.*, Access. no. 58918 (MH); Nilgiris—Sisparaghat ± 1666 m, Feb. 1889, *Gamble* 20609 (MH); Pumber Shola, Pulneys, 6500 ft. 23.4.1883, *Levinge s.n.* (CAL); Nilgiris, June 1859, *Beddome s.n.* (CAL). KERALA—Kottayam : Rajmallay-Devicolam, 2025 m, 21.4.1966, *Shetty* 27353 (MH); Travancore: Devicolam, 6000 ft., *Meebold* 13526 (CAL).

India (Tamil Nadu, Kerala) Sri Lanka.

The species could not be collected after the year 1966. It is threatened due to habitat destruction.

CYATHEA NILGIRENSIS Holtt.

Endemic to India (Mountains of Southern India)

Many old specimens examined but recent collections are very few. The species is fast disappearing due to habitat destruction.

DRYOPTERIDACEAE

DRYOPTERIS GAMBLEI (Hope) C. Chr. *Nephrodium gamblei* Hope

UTTAR PRADESH—Tihri—Garhwal, 5400 ft., April 1881, *Mackinnon s.n.*

India (Meghalaya, West Bengal—Darjeeling, Uttar Pradesh) Bhutan.

It is known from singular old collection. The species is threatened due to habitat destruction.

DRYOPTERIS SIKKIMENSIS (Bedd.) O. Kize. *Polystichum sikkimensis* Bedd.

SIKKIM : Tsomyo, 12,000 ft., 6.8.1945, *Bor's collector* 552 (DD); Mon Lepcha, 11-12000 ft., 27.10.1857, *J. Thompson s.n.*, Access. nos. 17059 to 17069 (CAL); Oct. 1883, *Levinge s.n.*, Access. nos. 15088, 15089 (CAL); Jongri, 12000 ft., 15.10.1875, *Clarke* 25828, 25960 B; Chola range; Laghet, 10,000 ft., 24.9.1892, *Gammie* 1295 (CAL); *Jaffray s.n.*, Access. no. 17054 (CAL).

Endemic to India (Sikkim).

HYMENOPHYLLACEAE

MECODIUM LEVINGEI (Clarke) Copel. *Hymenophyllum levingei* Clarke

SIKKIM 7000 ft., 1875, *Clarke* 25395 B (CAL); Lacheng, 12000 ft., Nov. 1882, *s.l. s.n.*, Access. no. 2434 (CAL); 2436 (CAL); Ehong Kong, 5000 ft., May, 1885, *King's Collector s.n.*, Access. no. 2435 (CAL).

India (Sikkim) Bhutan.

POLYPODIACEAE

CHRISTIOPTERIS TRICUSPIS (Hook.) Christ *Gymnopteris tricuspia* Hook.

SIKKIM—Goke, Oct. 1879, *s.l. s.n.* Barren frond (CAL); Birohi to Binch Kingpong, 2500 ft., 1.10.1862, *s.l.* 1531, Fertile frond only (CAL); Kaging, 30.6.1880, *Levinge s.n.*, Access. no. 25634, complete specimen possessing fertile and vegetative frond (CAL).

Endemic to India (Sikkim).

The species is known by only three old collections. It is a case of narrow endemism.

HOLCOSORUS BISULCATUS, (Hook.) Ching *Grammitis bisulcata* Hook.

ARUNACHAL PRADESH—Siang : Minguing, 18.11.1958, *Rao* 17766, 17766A (ASSAM).

India (Arunachal Pradesh), Borneo.

It is known only by a solitary collection in India. The species is rare due to habitat destruction.

SELAGINELLACEAE

SELAGINELLA ADUNCA A. Br.

UTTAR PRADESH—Kumaon, *Champion* 7803 (DD); Tihri- Garhwal: Saingri, 4500 ft., Sept. 1898, *Gamble*, 27214 (DD, CAL); Churaui, Oct. 1891, *Gammie s.n.* (DD); 1869, *G. King s.n.*, Access. no. 2801 (CAL). Garhwal: Gobra, 6.9.1959, *Rau* 10044 (BSD, CAL); Mussoorie, 1877, *Duthie s.n.*, Access. no. 28010 (CAL); 1869, *G. King s.n.* (CAL). HIMACHAL PRADESH—Simla, 7000 ft., June 1891, *Gamble* 22822 (CAL). North-West Province—*Dalzell s.n.*, Access. no. 29135 (CAL).

No recent collections have been made after the year 1959. It is extremely rare due to habitat destruction.

SELAGINELLA CATARACTRUM Alston

TAMIL NADU—Kodaikanal Hill: Silver Cascade, 14.10.1919, *Jacob* 16095 (MH). KERALA—Peermade, 3500 ft., 10.10. 1968, *Nair* 40148 (CAL).

Endemic to India (Tamil Nadu, Kerala).

It is known by only two collections in India. The species is rare due to habitat destruction. The plants are minute in size and grow among rock-boulders in inaccessible areas.

VITTARIACEAE

VITTARIA WATTII Dixit et Nair

MANIPUR—Sirohifurar, April 1882, *Watt* 6410 (CAL). ARUNACHAL PRADESH Tirap: Raho, 26.8.1956, *Panigrahi* 16820 A, B. (ASSAM).

Endemic to India (Eastern India).

It is a case of narrow endemism.

WOODSIACEAE

WOODSIA ALPINA (Bolton) Gray

KASHMIR Liddar valley: Above Ainsul, 12,000 ft., 21.7.1893, *Duthie* 13148 (CAL).

India (Kashmir), Europe

The species is known by singular old collection. It is threatened to endangered due to habitat destruction.

WOODSIA ANDERSONII (Bedd.) Christ *Gymnogramme andersonii* Bedd.

UTTAR PRADESH—Kumaon : Kali Valley, 12000 ft, 15.9.1884, *Duthie* 3706 (DD, CAL); Heimal, May, 1857, *J. Anderson s.n.*, Access. no. 1731 (CAL); Pindari, 11000 ft., 28.5.1887 *s.l. s.n.* (CAL). SIKKIM : Tauka La, 14000 ft., August 1910, *Smith* 4555 (CAL), *Gammie s.n.*, Access. no. 24161 (CAL).

India (Sikkim, West Bengal—Darjeeling Himalayas, Assam, Meghalaya, Arunachal Pradesh).

The species is known by only five old collections in India.

WOODSIA CYCLOLOBA, Hand.-Mzt.

SIKKIM, *King's Collector s.n.*, Access. no. 24164; Singalaleh range, 13000 ft, 18.6.1892 *Gammie* 143 (CAL); Chumbi-Choori-Cheu, *King's Collector* 78 (CAL); 14000 ft., 1.11.1913, *Ribu & Ramoo* 6380 (CAL); Tanangie, 13000 ft., Oct. 1888, *King's Collector s.n.* Access. no. 24160 (CAL), UTTAR PRADESH: Chamoli—Nanda Devi National Park: Above Ramani Camp on way to Bhujgara, 4000 m, 26.8.1981 *Hajra* 73332 (BSD.).

India (Sikkim, Uttar Pradesh—Chamoli) Nepal, China—Yunnan.

The species has been collected again after the lapse of 68 years from North-West Himalayas—an additional range of distribution not reported earlier. The species is extremely rare due to habitat destruction.

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