

CONSERVATION OF RARE PLANTS—INDIAN SCENE VIS-A-VIS
WORLD SCENE

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Throughout the world, there has been much concern for conservation and protection of endangered animals, particularly mammals and birds. It is only in recent years that rare and endangered plants have been given serious consideration. The recent promulgation of United States Endangered Species Act (1973), U.K. Wild Creatures and Wild Plants Act (1975), development of international conventions on conservation (Wetlands Convention, World Heritage Convention, Endangered Species Convention and South Pacific Convention), and setting up of the Biological Records Centre of the Nature Conservancy, U.K. and Threatened Plants Committee of the International Union for Conservation of Nature and Natural Resources (IUCN) with regional and specialist groups on palms, orchids, cycads, tree ferns, succulents, etc., reflect a timely world-wide awakening on the subject (Lucas and Synge, 1977). The Council of Europe declared 1970 as European Conservation Year and urged member-states to promote and encourage suitable conservation programmes during the year. A symposium entitled "Threatened and Endangered Species of Plants in the Americas and their significance in Ecosystems Today and in the Future" held at the New York Botanical Garden emphasized that a major obstacle to plant conservation is ignorance. Many coun-

tries (such as Mexico) cannot produce inventories of threatened species because they lack national floras (Prance and Elias, 1977). The recent conference held at Kew entitled "The Function of Living Plant Collections in Conservation and Conservation-orientated Research and Public Education" fully explored the potential of the botanic garden in conservation, from problems of propagation and cultivation through problems of documentation to the need for a network of gardens to cover all major plant zones in the world (Simmons *et al.*, 1976). The Wild Life (Protection) Act 1972 has been promulgated in India, but it does not provide lists of protected plants. *Red Data Books* on endangered animals have been prepared for a number of years by the Survival Service Commission of the IUCN. A *Red Data Book*, volume 5, on angiosperms was started by the IUCN in 1970 (Melville, 1970-1971). It has been estimated that out of *ca* 300,000 species of plants of the world, over 20,000 are endangered or vulnerable and threatened with extinction by the year 2000 A.D. Besides the *Red Data Book*, there are now a number of lists, such as the *Smithsonian Report on Endangered and Threatened Plant Species of the United States* (Smithsonian Institution, 1975), *Rare and Endangered Species of Hawaiian Vascular Plants* (Fosberg and Herbst, 1975), *List of*

Rare, Threatened and Endemic Plants for the Countries of Europe (Lucas and Walters, 1976), *Red Book : Native Plant Species to be Protected in the USSR* (Takhtajan, ed., 1975) and accounts from various countries such as U.K., Italy, Peru, U.S.S.R., Switzerland, South Africa, India, Australia and New Zealand. There are also species (like *Microcycas calocoma*, *Stangeria eriopus*, *Fitzroya cupressoides*, *Welwitschia bainesii*, *Engelhardtia pterocarpa*, *Didickea cunninghamii*, *Panax quinquefolium*, *Saussurea lappa*, *Basiloxylon excelsum*, *Thermopsis mongolica*, *Dioscorea deltoidea*, etc.) included in Appendices I and II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* for strict regulation and control of trade. This convention has so far been ratified by 49 countries (Anon., 1976).

Classification of Rare Plants : The IUCN recognized five status categories of rare plants, based principally on (i) present and past distribution, (ii) decline in population numbers through time, (iii) abundance and quality of existing natural habitats, and (iv) biology and potential value of the species. These are defined as follows for the purpose of conservation :

0. *Presumed Extinct* : Taxa completely eliminated from all areas of its range within historic time, e.g. *Franklinia alatamaha* (North America), *Medusagyne oppositifolia* (Seychelles).

1. *Endangered* : Species actually threatened with extinction and whose survival is unlikely without protective measures, e.g. *Lodoicea maldivica* (coco-de-mer; double coconut).

2. *Rare* : Those that are not under immediate threat of extinction but occurring in such small numbers or in such localised or specialised habitats that it could quickly

disappear and, therefore, need watching, e.g. *Artemisia norvegica* (United Kingdom).

3. *Depleted* : Although sufficiently abundant for survival, the species has been heavily depleted and is in decline as a result of natural causes or human activity, e.g. *Gloriosa superba*, *Costus speciosus* (India).

4. *Indeterminate* : Apparently endangered but data insufficient for a reliable assessment, e.g. *Utricularia australis*, *U. intermedia* (Austria).

The word *Threatened* has been used in the conservation context for species which are in one of the three categories, i.e. endangered, rare or depleted.

At the Biological Records Centre of the Nature Conservancy, U.K., rare plant species are arranged according to their 'threat number' which is calculated from the following criteria : (1) absolute size of the population in Great Britain, (ii) rate of decline, (iii) attractiveness of the species, (iv) accessibility of the site and of the plants on the site, and (v) present conservation status of the site(s). The threat number distinguishes the more endangered species and gives priority for conservation measures (Perring and Walters, 1971).

Causes of Rarity, Endangerment and Extinction : The distribution and abundance or rarity of plant species result from a large number of factors, both natural and man-made. Species have developed, spread, retreated and some have become extinct throughout millions of years of geological history. The development and extinction of species is usually a long, slow, natural process. Man and his associated agents (*viz.* fire, shifting cultivation, grazing and migratory animals, biocides, pollutants, etc.) have, however, accelerated this process. This suggests that there may be naturally endangered as well as artificially endangered species. Some of the

major natural factors that affect plant life are uplift or sinking of land, development of mountain ranges, volcanic eruptions, flooding, development of islands, erosion, glaciation, droughts, expansion of deserts, eutrophication (filling of lakes and ponds), and fire. When species become very old or senescent, such as small populations of relicts from ancient floras (*Metasequoia glyptostroboides*, *Sequoia sempervirens*, *Sequoiadendron giganteum*, *Torreya taxifolia*, *Taxus floridana*, *Elliottia recemosa*, etc.), they may suffer genetic depletion or loss of genetic variability and become unadaptive or develop narrow specialization that results in their rarity and perhaps extinction. Man has changed drastically the surface of the earth as a result of manifold activities. The building of dams and power plants, increased irrigation and agriculture, development of cities, roads, factories, with consequent dumps and pollution are threatening to destroy or modify the natural environment. Plant populations are destroyed by men as the result of commercial exploitation and collection of entire plants, roots and rhizomes, tubers, corms, seeds, fruits or flowers. Plant species and populations are also destroyed indirectly as a result of various other human activities, viz. overgrazing of goats, cattle, sheep and pigs, intentional or accidental introduction of noxious weeds or other competitive species (e.g. *Eichhornia crassipes*, *Xanthium pungens*, *Eupatorium odoratum*, *Mikania micrantha*, *Parthenium hysterophorus*), introduction of plant diseases, insects and other animal pests, use of chemicals, fertilizers, herbicides and other biocides including air, water, and soil pollutants, and the destruction of pollinators such as insects, birds and bats.

Conservation in situ of Rare Plants : Conservation of rare species of plants requires the preservation and protection of the habitats upon which they depend for growth and reproduction. *In situ* perpetuation of sufficient

populations of endangered and threatened plants is required to ensure their survival. There are three key factors involved in *in situ* conservation : (i) prevention of the destruction of populations and their habitats ; (ii) maintenance or enhancement of the population levels and viability ; and (iii) prevention of collection and commercial exploitation. It is, therefore, important that preservation of habitat be recognized as the critical factor in all conservation activities and in legislative acts, etc. Further, the more practical method for conservation involves the mapping of species ranges to determine the centres of endangered species. Rare and endangered species are often narrow endemics occurring in restricted ecological niches. An accurate knowledge about endemic centres of species is, therefore, of considerable value in determining and establishing priorities for preserving the habitat and to protect these plants.

In India, a number of endangered species are used in commercial trade and hence efforts should be concentrated on monitoring of populations to determine trends in their levels and viability. Some of the important plant species threatened to extinction in their natural habitats due to commercial exploitation are : *Rauvolfia serpentina*, *Atropa acuminata*, *Colchicum luteum*, *Commiphora mukul*, *Coptis teeta*, *Dioscorea prazeri*, *D. deltoidea*, *Gentiana kurroo*, *Nardostachys jatamansi*, *Podophyllum hexandrum*, *Rheum nobile*, *R. emodi*, *Saussurea lappa*, Himalayan Aconites, *Juglans regia*, *Meconopsis aculeata*, *M. betonicifolia*, *Diospyros marmorata*, and several species of orchids (e.g. *Vanda caerulea*, *V. teres*, *V. tessellata*, *Paphiopedilum fairrieanum*, *P. villosum*, *P. hirsutissimum*, *P. spicerianum*, *P. venustum*, *Pleione praecox*, *Cymbidium elegans*, *C. longifolium*, *C. lowianum*, *C. giganteum*, *Aërides crispum*, *A. fieldingii*, *A. odoratum*, *A. multiflorum*, *Dendrobium chrysanthum*, *D. densiflorum*, *D. moschatum*, *D.*

aphyllum, *D. nobile*, *Phaius tankervilleae*, *Rhynchostylis retusa*, *Renanthera imschootiana*, and *Cypripedium cordigerum*, etc. (Maheshwari, 1970). There is at present a large trade in the sale of endangered and threatened species, many of which are collected from the wild. Thus, various orchids, lilies, palms, cycads, tree ferns, insectivorous plants such as *Nepenthes* suffer the greatest threat. Efforts should, therefore, be made to end the craze for rarity by discouraging dealers from advertising the rarity of their stocks. Instead, the emphasis on advertising should be directed to conservation of species grown from seed and not collected from the wild. Dealers and the public should be encouraged to leave endangered flowers undisturbed or only to photograph them carefully *in situ*. It is also important to make readily available to the public illustrations of endangered but commercially exploited species, as has been done in Europe, particularly for rare and endangered alpine plants.

Conservation *ex situ* of Rare Plants : There is at present much discussion on the role of botanic gardens in the conservation of world's flora. Some of this discussion is concentrated on the function of botanic gardens as repositories of vanishing and threatened plants. For such preservation, the important prerequisites are : (i) to recognize which species are seriously threatened with extinction, (ii) to acquire sufficient knowledge of their habitat requirements and conditions for propagation to be able to satisfy these within the confines of a botanic garden or green house, and (iii) to bring these endangered plants into effective cultivation in good time. Further, by instructing potential cultivators, botanic gardens can relieve the pressure on those wild species which are threatened by being too much sought after by commercial collectors, through their cultivation in nurseries instead of decimation

of the wild populations. A number of species have already been rescued under cultivation. The Maidenhair Tree, *Ginkgo biloba*, is a familiar example, for it would have been known only as a fossil if it had not been preserved in Chinese temple gardens until discovered by Western horticulturists. *Metasequoia glyptostroboides*, the Dawn Redwood, was known as a fossil before its last stand of live trees was discovered in China. Now, it is so successful in cultivation that its future seems assured (Steere, 1978). The Flamboyant, *Delonix regia*, is reduced to a *single* truly native colony in one limestone gorge in its native home, Madagascar! but quite widely cultivated as a flowering tree throughout the tropics. A number of other species have been saved by cultivation during the present century, e.g. *Camellia granthamiana*, *Tecomnanthe speciosa*, *Streblorrhiza speciosa*, *Hibiscus insularis*, *Hibiscadelphus giffardianus*, *Amherstia nobilis*, etc.

The proper maintenance and storage of collection of threatened plant taxa is a major problem. In the majority of cases, the choice lies between keeping a collection of living plants or maintain a seed bank. It is possible that in future, *in vitro* cultures will play a significant part as a means of conservation. It is sometimes suggested that collections of annuals and short-lived perennials are best maintained as seeds in a seed bank, and that long-lived species such as trees and shrubs are better kept as collections of living plants. There is a certain possibility in this approach, as by and large the seeds of herbaceous species present few storage problems whereas those of trees and shrubs present many. The orchid, *Paphiopedilum fairrieianum*, too rare to be safely collected from the wild, is readily stored in a refrigerated seed bank at the Royal Botanic Gardens, Kew (Thompson, 1975). However, it is generally felt that cultivation or artificial propagation, even in the

best botanic gardens is not an acceptable alternative to *in situ* conservation of species in natural habitats. Artificial propagation is a last resort and should be done always with the ultimate objectives of reestablishing the species in its natural habitat.

Need for Conservation Strategies : The task of plant-resource conservation is gigantic. A detailed knowledge about the endangered, threatened and recently extinct plant species and communities is urgently needed. The following collection data need to be recorded and documented, while collecting and preserving rare and endangered species :

(i) *Collection of plant material* (Besides routine data including collector's name, field number and the date of collection; voucher specimens, photograph, living plants, seeds and size of population, *i.e.* total number of plants—mature, flowering and seedling); (ii) *Identification* (family, genus, species, subspecies, variety, etc.); (iii) *Location* (Locality map, latitude and longitude, country, state, district, village or tehsil, site); (iv) *Ecology* (altitude, aspect, habitat condition, topography, plant community, effective reproduction—vegetative or by seed, special features).

The rich heritage of plant life and the magnificent diversity of plant resources is being lost, as forests and natural areas are cleared for urban and agricultural development or denuded by fire or disease. Each species, subspecies and variety of plant represents a unique type of biological germ plasm or gene pool with special characteristics and values. The preservation of plant genetic resources is, therefore, of prime importance. This would mean that survey, exploration, collection, documentation and conservation of genetic resources is to be taken up on a *priority* basis. Several cultivars and their wild and semi-wild relatives which themselves have been products of thousands of years of

evolution, have disappeared during the last few decades due to urbanization, technological developments and major advances in crop production. In many cases, primitive cultivars have been lost, supplanted by modern high-yielding strains resulting in a situation in which future plant breeders will be left with a rather narrow genetic base. The following conservation programmes for plant life in the Indian region are suggested :

(i) Plant resource surveys and collection of plant genetic resources with appropriate programme for exploration and documentation; (ii) Preparation of resource inventories at regional, state and district level of wild and existing culture collections, and quantitative estimations of critical plant populations; (iii) Conservation of rare or valuable plants in the region by designation of a series of flora reserves and ecosystem reserves; (iv) Conservation of rare and endangered species in living collections (botanic gardens and arboreta) and gene banks comprising seed collections or tissue cultures; (v) Establishment of a network of biosphere reserves for conservation of the diversity and integrity of natural ecosystems, for the teaching of conservation and for prosecution of ecological and environmental research, particularly baseline studies.

There are local regulations and State Acts in some parts of our country which forbid the removal or picking of showy and beautiful flowers such as orchids, but unless there is a body of public opinion behind it, the laws will not prevent the disappearance of such plants. It is, therefore, only by educating the masses from the earliest years at school that positive results may in time be obtained. Conservation of rare and endangered species in the Indian flora is a matter of immediate concern and needs to be put on

a sound footing. Effective conservation of plant species, communities and areas need increasing inputs from various disciplines like

taxonomy, floristics, ecology and chorology, and from the professions like law, administration and environmental planning (Fig. 1).

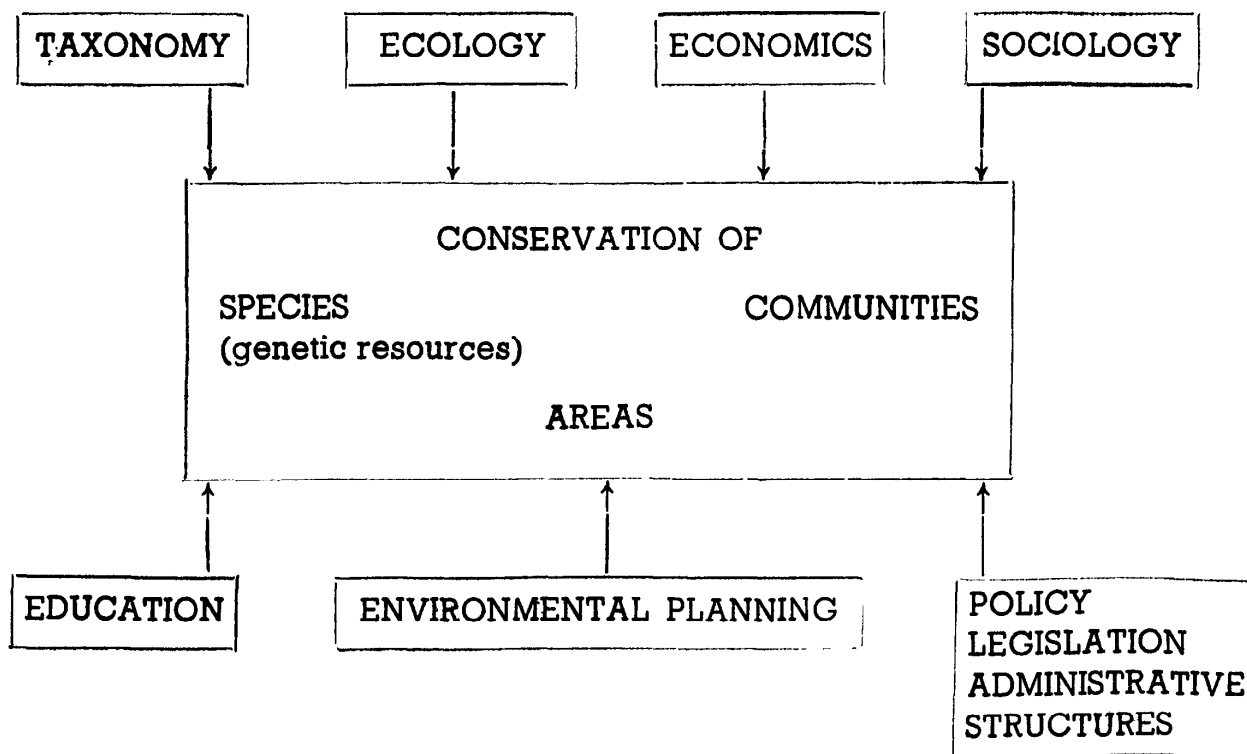


Fig. 1. Showing multidisciplinary approach in conservation of species, communities and natural areas.

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