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ENDANGERED SPECIES

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Wildland Management Center
The University of Michigan

From the School of Natural Resources

Looking Closely at Minimum Viable Populations

by
Kathleen Rude

Scientists are competing in the sports arena, or so it would seem, by awarding the MVP title to endangered species. However their MVP is based on genetics, not athletics. And what's most valuable about this particular MVP is not an individual player, but a population. It is also one of the most valuable pieces of information to assist scientists in preserving endangered species.

MVP, ecologically speaking, stands for "minimum viable population" - the smallest number of interbreeding individuals that is able to survive indefinitely. Scientists use MVP as a threshold level: any population that remains below its MVP size will eventually go extinct. Therefore, scientists must work to keep populations at or above the MVP level to ensure their survival.

Determining an MVP also provides guidelines for habitat use. Once an MVP is established for a species, scientists can then determine the habitat requirements that are necessary to sustain that population size. However, scientists do not want MVP to be viewed as an optimal population size to attain. Rather, it is a **minimum** size that a population cannot fall below. All species are more secure if they remain above their MVP sizes.

When a population does fall below its MVP, it becomes susceptible to complications resulting from a loss of genetic diversity. Inbreeding and loss of adaptability, the most severe of these genetic complications, endanger the survival of the species. And as a population becomes smaller and more isolated, these threats become more serious.

Inbreeding brings out the worst in a population because it allows for increased occurrences of genetic defects in offspring. When close relatives continually breed with each other, they increase the expression of recessive genes in their young, genes that usually remain suppressed by dominant ones. The danger here is that many recessive genes produce damaging traits that frequently affect reproduction. Fecundity (total number of offspring born), fertility (ability to produce viable gametes or zygotes), and litter size all decline as inbreeding increases. Eventually the species cannot produce enough young to replace individuals that perish and the species itself dies off.

Dr. Soulé discusses agenda during workshops.

Genetic diversity sufficient to offset inbreeding may not be enough to ensure adaptability. The environment changes over time and a population needs to be able to adapt to those changes. A species' adaptability is enhanced by diversity most often provided by larger populations. This magnitude of genetic diversity allows the population to continually adapt and evolve over long time periods.

Thus MVP must take into account both inbreeding and adaptability. Scientists, in making preliminary calculations, have estimated that 50 breeding individuals are the minimum necessary to prevent inbreeding over the short-term and that 500 breeding individuals are the minimum that will ensure adaptability over the long-run. However, these threshold levels are only starting points for assessing MVP's. In actual application, MVP sizes will not be the same for every species. The species life history (e.g. are they migratory, do they breed for life, do they breed more than once in a year or in a life-time), will cause the threshold levels to vary.

Life histories also make calculations of individual MVP's extremely difficult. Scientists are still working on models and equations with variables that can be easily measured in the field. Scientists and managers need this type of workable information before they can determine species-specific MVP's and their habitat re-

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MVP continued

quirements.

Recognizing the need for application of MVP theory to management efforts, the Wildland Management Center along with Dr. Michael Soulé, School of Natural Resources adjunct professor, organized and sponsored the second workshop on Minimum Viable Populations. Fifteen prominent scientists from the US Forest Service, the US Fish & Wildlife Service, and from several universities attended the workshop held October 18 - 20, 1984. They concentrated on revising and expanding the management protocols that were developed at the first MVP workshop held in 1982. Of primary importance to the participants was the need to communicate effectively what scientists have learned to the resource managers in order to implement these findings in the field.

Dr. Soulé, who chaired both workshops, originally planned on producing one working paper from the '84 workshop on the state-of-the-art for minimum viable populations. However, the new approaches to the problem and research needs that participants generated during the session surpassed Dr. Soule's initial goals for the meeting. Together, these participants made major advances in MVP theory and application.

As a result, participants will be writing chapters for a book on minimum viable populations that Dr. Soulé will edit. The book will discuss MVP theory and calculations, management techniques, and policy issues involving MVP. This text will make a significant contribution to the study of MVP.

This workshop, funded by the US Fish & Wildlife Service, the US Forest Service, the National Wildlife Federation and the Griffin Foundation, is the first of several workshops and conferences to be sponsored by the Wildland Management Center. Dr. Soulé will also chair the Center's Second International Conference on Conservation Biology, May 5 - 9, 1985, in Ann Arbor.

Second IUCN Plant Red Data Book in Preparation

The plants section of IUCN's Conservation Monitoring Centre gathers data on threatened plants and their habitats worldwide in order to find out which species and areas are under threat. Data are used to help plan, encourage and support plant conservation projects in the field. So far the CMC database has information on 14,000 plant taxa out of an estimated 25,000 - 30,000 threatened plants worldwide. Unfortunately, as the rate of habitat loss and degradation continues to increase, many species will become extinct even before they are named. Gathering data on individual species has been an important part of CMC's work; however they are far from having a complete list of threatened plant taxa in the world, let alone identifying measures to ensure each one is adequately protected. Clearly there is a need to identify and focus attention on plant-rich sites around the world in need of conservation, as well as individual species.

In 1978 IUCN published the Plant Red Data Book which contained case-histories of 250 threatened plants and was the first international account of threatened plants. It brought attention to the fact that plants are threatened as well as animals. The IUCN/WWF Plants Campaign focus is to ensure the survival of most plant species by protecting large areas of plant-rich habitats. Therefore, they are preparing an area-based Red Data Book for plants. It will contain accounts of 100-150 botanical sites considered by IUCN to be indicative of those in greatest need of protection, and where species diversity and/or endemism is particularly high. The book will be published next year during the Plants Campaign to highlight the importance of plant conservation worldwide.

Jane Lamlein, who has been gathering data on threatened plants from Latin America for the IUCN's Threatened Plants Unit, is drafting a list of sites for Latin America and will be submitting the data sheets for this region. She has prepared a draft list of important sites in Latin America which includes areas such as: Lacandon rain forest (Mexico); Rio Platano water-shed (Honduras); Department of Peten (Guatemala); Darien Province (Panama); Atlantic coastal forests of Brazil; Choco, Colombia; Amazonian forest of Ecuador and Peru; and Paria, Venezuela. If anyone would like to review this list or submit any particular sites that meet the criteria, please write Jane at the Smithsonian Institution, Department of Botany, Plant Conservation Unit, NHB-166, Washington, D.C. 20560.

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A forum for information exchange on endangered species from

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Announcing: The Center for Plant Conservation

by
Jane Lamlein

In the United States 3,000 plant species are already threatened or endangered, and perhaps another 3,000 are in serious decline. With less than 10% of the threatened species under protection in cultivation, the Center for Plant Conservation was created in 1984 to develop a national network of programs at botanical gardens and arboreta to conserve and study endangered American plants. The national headquarters of the Center, which is an independent non-profit corporation, is located at the Arnold Arboretum of Harvard University.

The primary objectives of the Center are:

1) To establish a network of programs, involving gardens and arboreata in each region of the country, devoted to the protection, cultivation, and study of U.S. endangered plants.
2) To create an endangered species data bank that will assemble, catalog, and share basic information about the biology and horticulture of these plants.
3) To develop living plant collections at regional gardens, for the purpose of reintroduction, storage and research.
4) To support research and education concerning the biology, conservation, and practical value of endangered species.

To date, the following institutions are regional participants: Arnold Arboretum, Garden in the Woods, Holden Arboretum, Missouri Botanical Garden, University of North Carolina Botanical Garden, Transition Zone Horticultural Institute, State Arboretum of Utah, Rancho Santa Ana Botanical Garden and Waimea Arboretum. These gardens are known for their experience in the cultivation of rare and threatened plants, as well as for their commitment to working cooperatively on the endangered species problem.

The national collection will not be centralized—collections will be maintained at Regional Program facilities around the country in climates similar to those the plants encounter in the wild. Each Regional Program will focus on native species hardy within its respective regional climatic zones, thus helping to ensure cultivation success with a minimum of effort and expense. Each participating botanical garden or arboretum will plan to undertake four general activities in this conservation effort.

1) Selection of target species: The Center's advisory board will develop criteria to determine which species are in need of protection based on available knowledge on endangered species and recommendations from organizations involved in natural habitat management. Standards regarding acquisition, maintenance and documentation will be developed to maintain uniformity.
2) Collection: With the aid of the Center, each Regional Program will identify possible sources of specimens which may include wild populations on protected or unprotected lands, other botanical gardens, or individual collections.
3) Curation: Acquisitions will be maintained for ongoing study and public display. Some species may be represented only by collections maintained in the participating gardens, therefore, efforts will be made to reintroduce them into the wild natural habitats. Curation will also include seed banking or tissue culture storage as a means of preserving the genetic material.
4) Propagation: Many of the plants grown will be under cultivation for the first time. Records regarding cultivation procedures will be made available along with living material for research and horticultural purposes.

The Executive staff, Dr. Frank Thibodeau and Mr. Donald Falk, and the Advisory Council coordinate and direct the program's activities. The Advisory Council representatives are: Dr. Robert DeFilipps (Smithsonian Institution), Dr. Robert Jenkins (The Nature Conservancy), Dr. Thomas Lovejoy (World Wildlife Fund), Mr. Grenville Lucas (Royal Botanic Gardens, Kew), Dr. Bruce MacBryde (Fish & Wildlife Service), Dr. Linda McMahan (TRAFFIC-USA), and Dr. Norton Nickerson (Tufts University). Mr. Jonathan Shaw serves as the representative of the American Association of Botanical Gardens and Arboreta.

The Center for Plant Conservation hopes to become a leading organization for the protection of species diversity. The early development of the Center has been made possible by grants from the Andrew Mellon Foundation, the Atlantic Richfield Foundation, the George Gund Foundation and private contributors. More information is available upon request from: Donald Falk or Frank Thibodeau, Center for Plant Conservation, c/o Arnold Arboretum, Jamaica Plain, MA 02130.

Part II.

The Second Argument for Plant Conservation: Medical Plants

Seventy-five to ninety percent of the world's rural people rely on herbal traditional medicine as their primary health care. The World Health Organization recognizes that it will not be possible, perhaps even desirable, to replace this herbal medicine with western techniques, at least during this century, and are leading a revival of interest in medicinal plants. Since 1978 they have identified 20,000 medicinal plant species, and have shortlisted 200 of them for detailed

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The Arguments: Medical Plants (continued)

study. A UN survey estimated that the total value of world trade in medicinal plants in 1980 was US$550m and identified 400 botanicals — plant drugs — used commercially. So medicinal plants are essential for the health of billions of people and are also big business.

Selection of those found good as food, medicines or stimulants has gradually developed over thousands of years. This has led to the acquisition of a knowledge of their properties. For example the autumn crocus, *Colchicum autumnale,* was used in Arab medicine for treating gout as long ago as the 10th Century A.D. The Indian snakeroot, *Rauvolfia serpentina,* was employed for centuries in India to treat mental disorders and insomnia; today it provides the tranquilizer reserpine.

Much of the traditional use of plants is intricately linked with age-old beliefs, and the physical effects of the plant medicines are often rather difficult to distinguish from the psychological effects of the accompanying rituals. Because these medicines lack any 'pedigree' of clinical evidence under controlled conditions and because many of them have multiple rather than single effects, many western-trained doctors and 'modern'-looking cultures tend to discount traditional medicine.

This attitude is changing, however, both in developing and in the industrialized world. An increasing number of countries rightly place great value on their traditional medicines. Plant drugs form part of the culture and are usually cheap, whereas western prescriptions are very costly. China, India, France, Vietnam, Ghana and Zimbabwe are all attempting some integration of traditional and western methods in their health systems and carry out research to find new medicinal uses for plant chemicals.

In Africa 95% of the traditional drugs come from plants and in the Ayurvedic system in India, 75% of the 2000 drugs are based on plants. Most plant drugs are still gathered from the wild; over-collection has made many very scarce. *Dioscorea* has become heavily degraded genetically in the Himalayan region. Chinese ginseng *Panax ginseng* is now an endangered species in its native China. The very popularity of medicinal plants can lead to this extinction, particularly where they are not cultivated.

Destruction of vegetation makes the threat all the more acute. Recent studies sponsored by WWF have recorded over 1000 useful plants in the rain forests of South America; of these the latex of *Croton lechleri* is used in Peru to treat stomach cancer and elsewhere the bark and stem of *Jacaranda caucana* are used against leukemia; three different tribes use *Anthurium tessmanii* as an oral contraceptive. Loss of habitat also threatens the extinction of many species whose medicinal properties we will never know. One could provide a cure for cancer, another for heart disease.

Tribal societies and cultures are themselves disappearing and with them goes their plant lore. This is more knowing which plants are useful: many medicinal plants are only active against disease when gathered at particular times of the year, or at specific stages in the life cycle. Only local users are likely to know this. Many populations of useful plants are so scattered that only local users can gather enough for clinical trials. Conventional botany recognizes the existence of 'biological species', outwardly identical but genetically (and often biochemically) quite different. For example, the many wild maize species in Amazonia include a group of 5 apparently identical species, one of which is a deadly poison, two are food plants, one is an abortefacient and the other a hallucinogen. Only local knowledge could warn about this situation.

This tribal knowledge is important not just for the tribal people themselves, but for the wider world. A splendid example is Curare, from the Brazilian vine *Chondrodendron tomentosum:* it was originally used as a hunting poison, but it contains tubocurarine which is now essential in surgery as relaxant.

It is often forgotten that 40% of the world's drugs come from wild sources or are synthesised from wild derivatives. Their total commercial value is said to be US$40 billion a year. Many western drugs have their origins in compounds found in plants used in folk medicine. For example aspirin (salycilic acid) was first discovered in willow bark. Although it is now made synthetically, it would not have been discovered without the chemical blueprint from willow bark.

Some plant drugs used in western medicine are recent discoveries. An example comes from Madagascan periwinkle, *Catharanthus roseus,* which yields vincristine and vinblastine, drugs widely used in treating leukemia and lymph gland cancer. Total sales are worth US$100m a year.

Almost every plant species that has been studied appears to produce its own unique mixture of chemicals. Many are toxic or repellent, enabling the immobile plant to avoid being eaten by animal predators. Some are harmless to man, but others are extremely toxic. In this way plants may be seen as chemical factories of almost limitless potential, much of it, perhaps most of it, still waiting to be discovered. This is surely one of the most potent arguments for making sure the plants survive.

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