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CONSERVING ORCHIDS IN THE EASTERN RAIN FOREST OF MADAGASCAR: AN INTEGRATED APPROACH TO LINKING LOCAL RESIDENTS AND BIOTECHNOLOGY

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ABSTRACT. Having witnessed more than 90% destruction of its forests in just the past few decades, Madagascar is one of the most endangered centers of biodiversity in the world. Widespread destruction by fires clears the land for crop production and results in forest fragmentation. In Madagascar, more than 1000 indigenous orchid species survive as remnant populations in parks, reserves, or private collections. Ranomafana National Park shelters many of the orchid species native to the eastern rain forest region. A project addressing orchid conservation was undertaken through a cooperative agreement among Association Nationale Pour La Gestion Des Aires Protegees (ANGAP), the Madagascar Institute Pour La Conservation Des Environments Tropicaux (MICET), and Omaha's Henry Doorly Zoo. The initial purpose was to provide training in biotechnology for students from the University of Antananarivo, who would use that training to aid orchid conservation in Madagascar. Orchid propagation and acclimatization training was provided at the zoo in 2000 and 2003. A second part of the project was to conduct an orchid survey in Ranomafana National Park, which was undertaken in 2000. The project's overall purpose was to involve Malagasy residents in the field survey and technology transfers, which subsequently led to involvement by park guides and regional forestry personnel at Ranomafana.

Key words: biotechnology, conservation, residents, technology transfers

INTRODUCTION

Madagascar is one of the most biologically diverse centers of flora and fauna on earth. The country's current system of 22 parks and reserves protects ca. 18% of the remaining natural areas. Many of those areas, however, do not get the full protection needed to sustain ecosystems in their natural state. Species endemism is estimated to be 80%, and the percentage is even higher for the ca. 1000 indigenous orchid species.

Fires are set to clear forested areas for crop production to feed a rapidly growing population, a population living in deep poverty. Forest destruction is not a matter of wanton disregard for the environment; rather, as Russell Mittermeier states in the foreword to *The Eighth Continent* by Peter Tyson (2000), it is a matter of bare survival. Once the soil's nutrients are exhausted, fields are often abandoned, and torrential rains eventually erode large sections of land, washing the red soil down the hillsides. Local residents depend on the remnant forested areas to supply food, fuel, and medicines that are an integral part of their cultural traditions. In some areas zebu cattle are allowed to roam the parks, altering the plant communities that populate the forest. Orchids face this increasingly human-modified environment, along with the devastating effects of cyclones that cut large swathes of destruction through the forest, where the loss of even one old-growth tree can bring down dozens of orchids with it. Ranomafana National Park is located along the north-south escarpment that was once a rain forest running the entire length of the island. Today the Park stands out as a spectacular 43,000-ha island of diversity that constitutes a living laboratory for flora and fauna.

Conservation action plans face challenges in Madagascar, but collaborative efforts that in-

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clude national institutions and provide training for students, not only address the conservation activities themselves, but also raise environmental awareness for the local community where the scientific work is undertaken. Madagascar recently has had its share of political upheaval coinciding with generalized strikes involving governmental agencies and the universities. As a result, changes in personnel often occur in the departments that administer environmental programs, complicating activities even further. Omaha's Henry Doorly Zoo was asked to provide training in orchid research, partly because of prior work conducted with terrestrial orchids. The training was to be provided for Malagasy citizens, who would then participate in orchid conservation activities upon their return to Madagascar. The zoo provided training and lodging for the students while in the USA in 2000 and 2003, and the field training took place in Madagascar. San Diego County Orchid Society granted funding to help support the cost for supplies and expenses related to orchid reintroduction field activities at Ranomafana, including photography and GPS (Global Positioning Satellite) equipment. The Association of Zoological Horticulture and private donors provided partial funding to support the Malagasy residents, while they each spent time on orchid research at the zoo.

Methods and Materials

Technology Training

In a cooperative effort to protect some of the endemic orchids found in the eastern rain forest, a project was undertaken that linked Malagasy environmental protection agencies, academia, private citizens, and Doorly Zoo personnel. The project was designed to help bridge the gap that sometimes exists between the scientific community and local residents in lesser developed nations. The main goal was to provide training so that Madagascar nationals themselves would be able to continue the work on orchid propagation and augmentation in-situ upon their return to Madagascar.

A University of Antananarivo graduate student in plant physiology spent three months in the horticulture laboratory at Omaha's Henry Doorly Zoo during the summer of 2000. Training was provided for aseptic laboratory practices in plant tissue culture, seed germination methods for in-vitro culture, orchid identification through literature review, and botanical record keeping. A large supply of orchid books and journal publications was sent back with the student to help initiate new orchid studies in Madagascar, since access to orchid literature is almost non-existent for the average Malagasy student. The same laboratory-trained graduate student accompanied two zoo horticulturists and Malagasy guides for the field studies in Ranomafana Park a few weeks after returning to Madagascar. Field studies focused on orchid identification, mapping orchid habitats, and photographing the plants. Maps were created to serve as a record of the local species richness and diversity of Ranomafana orchids, so that Madagascar nationals can use them to continue the work in the park. Seeds collected under permit were used for in-vitro germination studies. A small portion of seeds collected during the field survey was earmarked for cryopreservation experiments. As the human population in Madagascar continues to expand at a rapid pace, in-situ preservation may not be adequate for many plants because of the loss of habitat (Eberhart et al. 1991). Preservation of Madagascar plant species, including orchids, may depend on ex-situ conservation of genetic seed samples. Ex-situ methods used were drawn from those developed at the National Germplasm Repository at Corvallis, Oregon (Reed 1999) but simplified for easy reproduction in the laboratory in Madagascar, where minimal equipment is available. Cryopreservation techniques developed at the zoo were successful with the species tested. Cryopreservation of plant germplasm may become essential in preserving Madagascar's plant diversity in the future, as natural habitats are further reduced.

In late 2003, an orchid specialist residing at Ranomafana was brought to the zoo for training in biotechnology methods used for micropropagation and acclimatization of orchids to ex-vitro conditions. He also collaborated on orchid reintroduction methods to be used upon his return to Madagascar. The goal was to provide training that would help him plant the lab-produced orchids in the forests where the seeds originated. He combined his knowledge of orchids, local materials, and conditions at Ranomafana with the orchid culture methods used at the zoo. Working together, the Ranomafana orchid specialist and the zoo's greenhouse manager developed a plan for population augmentation experiments with in-vitro-produced orchids at the park. Training also was provided in basic computer skills for data collection and digital photography to assist in identifying orchids mapped in the October 2000 field survey. Upon his return to Madagascar in February 2004, the orchid specialist began training other residents, including regional forestry personnel and park guides, in orchid identification and monitoring. Involvement of the forestry department and park guides brought the issue of orchid conservation directly

to residents associated with the ecotourism industry at Ranomafana National Park. He also visits the local school to speak about orchid conservation and the place of orchids in forest ecosystems to raise the awareness of school children to the need to protect the environment in which they live. The zoo sent school supplies to the local school, where the children have created artwork depicting the plants and animals they feel are important to the forests in Madagascar.

Conclusion

Many things have changed in Madagascar since 2000. Bakolimalala Rakouth and the Madagascar Plant Specialist Group within the International Union for the Conservation of Nature and Natural Resources (IUCN) have recommended inclusion of many Malagasy orchids for the IUCN Red List. Such listings will help prioritize future orchid conservation activities in Madagascar. The annotated checklist and bibliography in *The Orchids of Madagascar* (DuPuy et al. 1999) provides a valuable orchid identification resource for researchers and students in Madagascar and elsewhere.

Long-distance conservation plans are inherently complex, difficult, and costly. This is especially true in Madagascar, where modern telecommunication technologies are generally unavailable in the isolated parts of the country. Conservation action plans that involve local residents, however, have a greater chance of succeeding, if collaborators maintain the patience and determination to deal with the multiple challenges posed by the country's logistics. The plans that do succeed will do so, only if Madagascar residents themselves are convinced that actions taken will reflect their own best interests and lead to improvements in their lives.

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CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA: A CITES TIMELINE

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ABSTRACT. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has been described as the best-recognized international treaty on endangered species and, at the same time, as the least understood. This paradox may result from CITES being structured, implemented, and enforced as a trade treaty, rather than as a conservation measure. The title of the treaty fails to mention conservation and makes no such promises, even though endangered species may rely on wise-use conservation for their survival. By specifying endangered wild species, the title contributes to the paradox, because nations party to the treaty not only address endangered species but also threatened species and, adopting the precautionary principle, species that might become threatened because of trade. To accommodate port-of-entry inspectors untrained in taxa identification, whole families, such as the Orchidaceae, are listed on CITES appendixes, including species that are neither endangered nor wild. A timeline of significant events in the establishment of international flora and fauna treaties, beginning with a 1900 London Convention to conserve wild animals of Africa and moving forward to CITES and beyond, is presented to increase the general understanding of how CITES came to be, how it applies to plants, and especially how it applies to orchid conservation.

Key words: CITES history, implementation, Conference of the Parties, endangered species, threatened species, precautionary principle

INTRODUCTION

Highlights in the history of international legislation on flora and fauna are presented in chronological order to emphasize how one event has influenced the next. Concern for the survival of species began with charismatic mega-fauna, such as elephants, and then extended to their habitats, which brought the survival of plant species into focus. The CITES timeline documents that conservation does not happen quickly but takes years of planning, effort, and expense and that the impact of such efforts, especially the impact on orchid conservation, is difficult to measure.

General material on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is supplemented with examples of implementation, primarily in the USA, since this U.N. treaty was known in its early years as the "Washington Convention," the USA was the first nation to ratify CITES, and U.S. archival material was most accessible to the author. An account of how nations party to the treaty enforce it in their homelands would make another article, as would a behind-the-scenes account of each of the thirteen Conferences of the Parties.

TIMELINE

1900

Wild Animals in Africa Convention

The London Convention Designed to Ensure Conservation of Various Species of Wild Animals in Africa Which Are Useful to Man or Inoffensive was adopted in 1900 as a pioneer effort to use international legislation to promote wildlife conservation (McNeely 2003). Note that the emphasis was clearly on "man" and "wild animals." Plants weren't mentioned, but this pioneer treaty did include an early use of "conservation" based on the German foresters' concept of sustainable yield—not harvesting more in a year than a natural population can reproduce.

1911

Fur Seal Convention

The Fur Seal Convention, another early attempt, was designed to deal with over-exploitation of fur seals on the Pribilof Islands off the coast of Alaska. Over-exploitation was the obvious threat.

1933

Fauna and Flora Preservation Convention

In 1933, governments of Anglo-Egyptian Sudan, Belgium, Egypt, France, Great Britain, Italy, Portugal, Spain, and the Union of South Africa met in London to establish the London Convention Relative to the Preservation of Fauna and Flora in Their Natural State. Note this early evidence of a fauna-first bias and the use of "preservation," suggesting protection rather than wise-use conservation.