seven of the alleles in this species unique to the island of Hawaii were found only in the Kahaualea population.

3) Although estimates of inter-island gene flow are generally high enough to prevent genetic differentiation of different island populations according to population genetic theory (i.e., $Nm > 1.0$), the presence of numerous island-unique alleles suggests that inter-island gene flow may not be significant in most cases at the present time. The overall low levels of genetic differentiation observed among different island populations may be due to relatively recent colonization of one island from another. The generally low frequencies of island-unique alleles may be due to fairly recent mutational events. Similar patterns of allelic distribution would be observed, however, if present interisland gene flow were high and mutation rates were sufficiently high to provide a source of new low-frequency, island-specific alleles. (Indirect evidence for a relatively high mutation rate in the rare *A. periens* L. E. Bishop has been obtained; Ranker, unpubl. data.)

There are two consequences of these observations on the existence of island-specific genetic endemism: a) conspecific populations on different islands may experience divergent evolutionary fates under changing environmental conditions, either due to random drift and/or to differential natural selection; b) from the standpoint of conservation planning and management, conspecific populations on different islands should be treated as distinct genetic entities. Merely recognizing and cataloging species-level biological diversity on the Hawaiian Islands has undoubtedly contributed to the loss of much genetic diversity through the lack of protection and preservation of genetically distinct populations. Not only is the recognition of localized genetic endemism in widespread species important for the conservation of existing genetic diversity, but it is also critical for the preservation of the evolutionary process because genetic endemics may represent incipient species.

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ARE TILLANDSIAS ENDANGERED PLANTS?

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ABSTRACT. In the last 10 years, the gray, so-called atmospheric tillandsias have become favored house plants. They are offered for sale from specialized nurseries as "carnations of air" which need little care, no substrate, and minimal water. The demand for these tillandsias has become enormous, and nurseries in Guatemala and Honduras cannot supply the current market. The propagation by seeds to get marketable plants takes about 3–5 years; it is easier to collect the plants from the wild. Therefore, many tillandsia plant communities have already been destroyed and some species should be considered as endangered, extirpated in nature in the near future. Therefore, certain species of the small tillandsias should be placed on APPENDIX I of the Washington Convention and all tillandsia nurseries should be encouraged to propagate these plants by seed and to control their international traffic.

Estan las especies de *Tillandsia* amenazadas?

RESUMEN. En los últimos diez años, las grisáceas epífitas *Tillandsia* especies han logrado un favoritismo como plantas decorativas en muchos hogares, particularmente en Alemania. Muchas de estas plantas, conocidas como "claveles de aire," son vendidas en muchos viveros especializados promocionándoseles como plantas que requieren poco mantenimiento, ningún substrato y un mínimo de agua. La demandas de estas plantas ha llegado a ser enorme, y viveros, especialmente en Guatemala y Honduras, no pueden abastecer la alta demanda. Propagarlas por semillas y disponer plantas aptas para el mercado, dura aproximádamente 3–5 años, asi que es mas fácil colectarlas en su medio natural. Es por ello que muchas comunidades de *Tillandsia* ya han sido destruidas, y algunas especies deberán referirse como amenazadas, y prontamente las mismas tenderán a desaparecer en el futuro. Por lo enunciado, sugiero que la mayoría de las *Tillandsia* especies pequeñas—la lista que se presenta en éste artículo—sea colocada en el Apéndice I de la Convención de Washington para obligar que todos los viveros de *Tillandsia* propaguen estas plantas por sus semillas, y se controle entonces su importación.

In the last ten years, many gray-leaved tillandsias have become favored house plants, especially in Germany. Nurseries which specialize in importing these plants from tropical countries sell these "carnations of air" as plants which need little care, no substrate, and minimal water. But botanists know that gray tillandsias need similar careful treatment to other house plants, especially high humidity. Gray tillandsias grow in regions with high air humidity (at least during the night); this humidity is absorbed via leaf trichomes, not through the roots.

The demand for "carnations of air" is enormous, and nurseries cannot supply the current market. The main exporting countries are Guatemala and Honduras; Mexico and South American countries provide a smaller portion of the imports. The largest tillandsia farms are in Guatemala, which cover more than 200,000 m^2 of land, where large numbers of tillandsias are cultivated for trade. At least 75% of these plants are collected from the wild. Every farm has a staff of indigenous workers, who are sent out into the forests to collect plants.

Information from the World Wildlife Fund in Germany suggests that from January 1988 to March 1988, 150 tons (ca. 6 million plants) have been exported from Guatemala, mostly to Germany and The Netherlands. This quantity is undoubtedly even higher today.

Many bromeliads, including most tillandsias, can be propagated vegetatively from offshoots. After flowering, the mother plant dies after producing 1–5 offshoots ("pups") in the axils of the basal or upper leaves. These can be removed and used for vegetative propagation. After cultivation for 8–10 months, they are robust enough to be sold and exported. These imported plants are cultivated in European nurseries for some months, and then they are sold as plants grown from seed. This is false information; these are not seedlings grown from seed, but rather plants propagated as pups. The number of plants propagated by pups alone is not sufficient to satisfy the current European market. Therefore, farmers repeatedly send out indigenous workers to collect more plants from the wild. If this method of farming continues over a span of many years, some species of small gray tillandsia will be in danger of extirpation.

At present, there appears to be no real danger to wild populations, but we do not know what will happen if gray tillandsias continue as popular house plants in the future. Species that have very restricted distribution areas seem especially vulnerable, e.g., *T. andreana, T. funkiana, T. velickiana,* and certain others.

While travelling in Mexico and Guatemala, I made the following anecdotal observations:

In 1982, I travelled through pine forest in

Chiapas from San Cristobal de las Casas to the Lagos de Monte Bello. Every stem, even close to the road, was loaded from the crown to the earth surface with the magnificent white stars of *T. magnusiana.* When I returned to the same place in 1987, almost all tillandsias were gone. I assume they were collected; only very few were still growing in the crowns of the pines.

In the region of Fortin de la Flores (Estado Vera Cruz), I encountered American nursery collectors with big trucks, loaded with thousands of *T. ionantha* and *T. argentea.* In Guatemala, I made similar observations of *T. xerographica, T. magnusiana,* and *T. matudai.* In 1983, I visited the dry valley of El Rancho (Guatemala). The crowns of the trees were white with the rosettes of *T. xerographica*; in 1989, I observed only three individual plants in the same region. All the other plants had been collected. In tillandsia nurseries in Guatemala City, I saw several thousand *T. xerographica* plants piled on tables exposed to full sunlight and rain. About 50% of these beautiful slow-growing tillandsias had rotted, due to exposure. According to my view, this robbery is a crime on nature. Interesting communities of epiphytic plants are being destroyed.

One way to preserve and protect the endangered tillandsias in the wild is to propagate them by seed. This has been shown to be possible 30 years ago by the tillandsia collector, Dr. Richard Oeser, in Germany. However, it takes longer (3–5 years) to get a marketable plant for sale from seed. Seed-grown plants thus cost more than wild-collected ones, though they are much cleaner and have a better chance to survive in cultivation. I am convinced that the public would pay higher prices for better quality plants. Seed-cultured plants could be available in greater abundance with selected genetic characteristics.

Fortunately, some of the tillandsia "farmers" have already recognized the situation and are starting to change their growing methods. The orchid- and cactus-growers have long recognized this situation and propagate rare species by seed or meristem-tissue culture.

The export and import of wild-collected orchids and cacti are heavily controlled, and possible only with the presentation of permits from CITES. Why not enforce the same process with the rare tillandsias before it is too late? Naturally, it is not necessary to protect all bromeliads and list them as endangered species. Therefore, as I have done some years ago, I propose to protect only the rare, the most desired, and the most endangered species and to list them on APPENDIX I of the Washington Convention to control the export of these species and to force the farmers to propagate them by seed. It may soon be possible to propagate tillandsias by meristem cultures.

I propose to place the following species into APPENDIX I of the Washington Convention: *Tillandsia andreana* (Colombia), *T. argentea* (Mexico, Guatemala), *T. atroviridipetala* (Mexico), *T. edithae* (Bolivia), *T. filifolia* (Mexico, Costa Rica), *T. matudai* (Mexico, Guatemala), *T. mauryana* (Mexico), *T. plumosa* (Mexico), and *T. velickiana* (Guatemala). Particularly important are all species of small tillandsias of the Organ Mountains in Brazil such as *T. brachyphylla, T. grazielae, T. rosea, T. sprengeliana,* and *T. sucrei.* This list is not definitive; it can be shortened or expanded as more data on wild populations and commercial demand become available. Without rapid action, the prospects for survival of wild populations of rare tillandsias look very poor.

REVIEWER'S NOTE

A proposal to list the genus *Tillandsia* (ca. 600 species) under APPENDIX II of CITES was withdrawn due to lack of supporting data. The German proposal to list under APPENDIX II the following seven species was adopted at the Kyoto conference in March, 1992.

Tillandsia harrisii R. Ehlers (Guatemala); *T. kammii* Rauh (Honduras); *T. kautskyi* E. Pereira (Brazil); *T. mauryana* L. B. Smith (Mexico); *T. sprengeliana* Klotzsch ex Mez (Brazil); *T. sucrei* E. Pereira (Brazil); and *T. xerographica* Rohweder (Mexico, El Salvador, and Guatemala).

[Submitted by H. E. Luther, Curator of Bromeliaceae and Director of the Mulford B. Foster Bromeliad Identification Center, The Marie Selby Botanical Gardens.]

Selbyana 13: 140–142

THE CONSERVATION OF EPIPHYTES AND THEIR HABITATS: SUMMARY OF A DISCUSSION AT THE INTERNATIONAL SYMPOSIUM ON THE BIOLOGY AND CONSERVATION OF EPIPHYTES

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ABSTRACT. A one-day round-table discussion using the small-group nominal process was held in conjunction with the Symposium on the Biology and Conservation of Epiphytes in May 1991 at The Marie Selby Botanical Gardens. Botanists, horticulturists, and conservationists participated in the effort to formulate concrete and creative suggestions to answer the question: how can epiphytes and their habitats be conserved in the future? Small groups "brain-stormed" and then prioritized their suggestions into viable solutions to six aspects of this question, and then presented them for discussion to the entire group. Four major trends were noted in the proposed solutions: 1) directly and indirectly involve institutions, scientists, and lay people in tropical countries; 2) develop active communication between researchers and lay people; 3) increase participation and commitment from the governments of countries where epiphytes occur and where research and education is being carried out, especially in regard to regulations for collecting and transporting plants across international borders, and 4) increase funding from private and government sources for research, education, and direct protection of epiphytic plants and their habitats. It was concluded that the growing body of botanical, ecological, and horticultural knowledge about these plants will aid in their conservation.

INTRODUCTION

The importance of epiphytes and their habitats is now established in the scientific literature. At the recent international Symposium on The Biology and Conservation of Epiphytes (5–9 May 1991, Sarasota, Florida), epiphytes were shown to affect many aspects of the ecosystems they inhabit. Epiphytes were documented to: 1) contribute substantially to ecosystem diversity, production, and nutrient cycles; 2) provide appreciable nutrient and energy sources to associated organisms such as pollinating birds and mutualistic ants; 3) act as global indicators for climate change; 4) provide humans with materials of horticultural, medicinal, and economic value; and 5) create an arena for observational and experimental studies on a wide range of biological questions including systematics, plant interactions, ecophysiology, and mechanisms of evolutionary change.

There is a growing recognition that the survival and maintenance of many epiphyte populations are increasingly threatened. In formal presentations and informal discussions, Symposium participants articulated the growing threats to epiphytes themselves and to the habitats in which they dwell. Causes for epiphyte extirpation and population reduction are both direct (e.g., over-collecting of horticulturally valuable species for commercial exploitation) and indirect (e.g., loss or degradation of epiphyte habitats due to activities such as removal and fragmentation of forests for permanent conversion to pasture). These forces have extremely complex roots in political, social, economic, and cultural patterns around the world.

A major goal of the Symposium was to create a forum for botanists, horticulturists, and conservationists to suggest means to preserve epiphytes and their habitats. The Symposium was an unprecedented opportunity to incorporate many viewpoints and approaches from individuals of diverse disciplines, geographical locations, nationalities, and experiences. The basic question addressed was: how can epiphytes and their habitats be conserved in the future?

METHODS

The complexity of the issues and the large number of participants (ca. 150 individuals) demanded a formalized structure. Our goals were to: a) incorporate the ideas and beliefs of as many individuals as possible; b) allow discussions of proposed solutions among all participants; and c) produce a prioritized list of "doable" solutions to the scientific community and to the general public.