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Reintroduction of *Pseudophoenix sargentii* in the Florida Keys

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This is an article about restoring wild palms in their wild places. As a horticulturist, I delight in the cultivation of palms from around the world. As an ecologist, I live with a profound sense of loss, knowing that some palm species may exist only in gardens, their natural habitats destroyed.

As former Curator of Endangered Species at Fairchild Tropical Garden, I know that botanic gardens are more than just pretty places. Palm collections such as Fairchild's provide a tantalizing example of the diversity of palms that have evolved in dynamic natural systems. Yet palms grown in the controlled simplicity of a garden are at an evolutionary dead-end. Therefore, the collections and scientific resources of botanic gardens should be used to re-establish rare palms in appropriate natural habitats, where species can continue to evolve with a myriad of mingling plants and animals.

Reintroduction of plants into conservation areas is becoming a more common practice in efforts to prevent extinction of endangered species (Falk and Olwell 1992). Transplanting of an endangered species might take place if a site is being cleared and the plants would otherwise be destroyed, or for restoration of a wild population that has dwindled due to human activities. While championing endangered species reintroductions, I do not advocate jaunts into the woods to add to the flora of an area or to spread around species which one personally thinks should be more abundant. The motive for reintroduction should be more than an impulsive urge to right a wrong. Reintroduction should be a carefully planned and documented experiment in restoring a lost or abused member species in a native plant community.

Scientific staff of The Nature Conservancy, an international conservation organization that man-

ages numerous nature preserves, recently developed an elegantly simple dichotomous key to help in deciding when species reintroductions are appropriate (Gordon 1994). First, is the species really threatened? Are there protected populations? Is there protected habitat within the known range of the species? Has the original cause of species decline been identified and eliminated? Are verifiable and legal propagules available? Is site management within the requirements or tolerance of the species?

These questions will be addressed in the following description of a relatively straightforward reintroduction project for a threatened palm species in south Florida. While not the perfect model, it is an example of a stepwise process that we hope will result in a thriving and self-sustaining palm population in the wild.

A Rare Florida Native: *Pseudophoenix sargentii*

Pseudophoenix sargentii H. Wend. ex Sargent, the Sargent's cherry palm, was first discovered in 1886 on Elliott Key, an island ten miles from the shores of Miami, Florida, and was first described from specimens collected there (Sargent 1886). Soon thereafter, *Pseudophoenix sargentii* was found on Sands Key, adjacent to Elliott Key, and on Long Key, about 50 miles southwest of Elliott Key. Even upon discovery, palm populations on these three islands were small, from a few dozen to a few hundred palms.

A thorough and disheartening chronology of the status of this palm species in the Florida Keys, from its discovery through the late 1950's, was published in an early *Principes* article (Ledin et al. 1959) (Figs. 1,2). Hundreds of these attractive palms were dug up from Long Key to be sold as ornamentals, and a scraggly few remained. On Elliott and Sands Keys, all but a few of the palms were cleared for island plantations and homesites.

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1. Many Sargent's cherry palms were inadvertently destroyed in the Florida Keys by early settlers clearing hammock forests for pineapple (shown here), lime, and coconut plantations. Photo by Ralph M. Munroe, courtesy of Historical Association of Southern Florida.

Ten years after Ledin's surveys of *Pseudophoenix sargentii*, the interior of Elliott Key was bulldozed by spiteful developers just prior to federal purchase of the island for the formation of Biscayne National Park. By 1991, when volunteers and I had resurveyed all of the historical locations of the Sargent's cherry palm, no palms were found on Long or Sands Keys, and fewer than fifty palms remained on Elliott Key (for a full account, see Lippincott 1992).

The small Sargent's cherry palm population in subtropical Florida is peripheral to the species' wider distribution along the tropical coastlines of the Bahama Islands, Hispaniola, Cuba, and the Yucatan Peninsula of Mexico. Throughout its range in the northern Caribbean, *Pseudophoenix sargentii* is increasingly threatened by the activities of humans. On most of the shores where it occurs, *Pseudophoenix sargentii* is threatened by imminent development, as impoverished Caribbean nations lure foreign tourists with resorts and vacation homes. Mature palms are frequently dug from natural areas and transplanted into gardens, with few surviving the move. In areas such as Saona Island, a U.S. Coast Guard base where the wild palms are protected from harvest, almost no young

palms are found because feral grazers such as goats feast on fruits and seedlings (R. W. Read, personal communication). Reproduction of Sargent's cherry palm is also compromised by excessive fruit collection for livestock feed.

In summary, the survival of wild populations of *Pseudophoenix sargentii* throughout the northern Caribbean is tenuous. In Florida, the Sargent's cherry palm has been reduced in the last century from hundreds of palms on three islands to a few dozen palms on one island. We decided that this palm met the criteria of "threatened," and proceeded to plan for its restoration on the three Florida islands where it once occurred more abundantly.

Although I will use the term "reintroduction" inclusively in this article, the term is strictly defined (IUCN 1984) as the re-establishment of a species which no longer exists at a site, as in this case, the return of Sargent's cherry palms to Long Key, where palm harvesters had extirpated the wild population. Since palms still exist on Elliott Key, replanting on that island is correctly termed "restocking," and is usually done to moderate genetic risks associated with reduced population size.



2. In the late 1950's, Bruce Ledin (left) and Bob Read (right) searched the Florida Keys with Stanley Kiem for wild Sargent's cherry palms. They found only a few survivors on Long and Elliott Keys. Photo by Stanley Kiem.

Habitats Preserved but Poaching Still A Problem

Fortunately, all three of the islands where Sargent's cherry palm once occurred are now publicly

owned parks. Sands and Elliott Keys are undeveloped offshore islands in Biscayne National Park, and Long Key is a state recreation area with designated wilderness tracts, linked to the mainland by U.S. Highway 1.



3. Over thirty years after Ledin's surveys, Anne Deaton, Florida DEP biologist, maps a group of Sargent's cherry palms in the dense hammock on Elliott Key. Before Hurricane Andrew in August, 1992, 47 tagged *Pseudophoenix* palms were being monitored in Biscayne National Park.

Within these parks, the palms are protected from overt clearing. However, unscrupulous collectors are known to continue illegally to harvest fruits and seedlings from the wild, even though this species is readily available in the nursery trade. As incomprehensible as it is to me, there is apparently added value in the sale of wild-collected, versus garden-propagated, endangered plants. So since the allure of possessing a plant collected from the wild has not diminished, it was decided that the majority of the palms would be reintroduced into relatively inaccessible areas, and that their exact locations would be known only by park managers and collaborators directly responsible for the palms.

Cooperation and Volunteers

From the beginning, Biscayne National Park's Natural Resources Manager, Richard Curry, was enthusiastic about mapping and monitoring the remaining wild palms in the park. When Dr. Renate Skinner, District Biologist for the Florida Department of Natural Resources (now Department of Environmental Protection, DEP) suggested reintroducing *Pseudophoenix sargentii* to Long Key, the logical source for seed was the extant population on Elliott Key. My work with endangered plants at Fairchild made it possible for me to put together a cooperative agreement signed by the two parks and Fairchild, and an all-

win scheme to get this palm back into the wild began.

Before we could reintroduce seedlings, we needed seed carefully collected from Elliott Key, and before we could collect seed we needed to know the current size and condition of the wild population. Beginning in 1990, various volunteers donated their free time to help survey the three islands for wild Sargent's cherry palms. Don Evans, Fairchild's Chief Horticulturist, and Chuck Hub-buch, Fairchild's Curator of Palms and Cycads, and other staff members, wandered through tangled hammock forests in search of the telltale banded trunks of *Pseudophoenix*. DEP biologist Anne Deaton teamed up with DEP Ranger Joseph Nemeč and his wife, Marcella, and they located, tagged, and mapped 47 Sargent's cherry palms scattered among the dense hardwood trees of Elliott Key (Fig. 3). They also began periodic visits in hopes of collecting seeds. Finally, with collecting permits in hand, they selectively harvested several hundred seeds from nine parent palms over two years, which were then propagated in the nursery at Fairchild.

Planting Palms in the Wild

The real fun began when the South Florida Chapter of the International Palm Society provided funds in 1991 that allowed Fairchild to hire helpers to reintroduce the nursery-propagated palms and then to monitor them regularly. Rob Campbell, a skilled native plant propagator, accepted the arduous task of planting, which involved loading potted palms, water buckets, soil, tools, maps, and notes onto a boat, traveling across several miles of open water, then trying to ignore the suffocating clouds of mosquitoes and oppressive summer heat while chipping holes in sharp limestone rock crouched in tangled masses of thorny stems. I know that Rob signed on to the project out of sincere concern for the palms, because I doubt that the pay was worth the suffering.

Anne Deaton took responsibility for the reintroduction on Long Key. Before proceeding, she prepared a reintroduction proposal that included the history of the palm in Florida, and plans for documentation, maintenance, and long-term monitoring of the reintroduced Long Key palms. This was the first reintroduction proposal prepared for a Florida state park, and it was both approved by

DEP and praised as a model for other park districts.

The palms that we planted in this first attempt included the one year old seedlings as well as several seven year old palms grown from seeds collected on Elliott Key in 1984 by BNP staff and brought to Fairchild for propagation (Fig. 4, left). Although somewhat larger than optimum for transplanting, we decided that they should be repatriated to native soil. As a backup, several of these palms were planted in Fairchild's conservation collection, in case of loss of the wild palms.

The sites selected for planting resemble habitats where the remaining wild palms are found, or are areas known from the literature to have supported Sargent's cherry palms in the past. These sites primarily consisted of mixed-species tropical hardwood hammock on limestone or beach sand substrate, topped with a thin layer of humus and leaf litter. The canopy above the palms varied from about 20% to 100% closed. The planting technique involved minimal alteration of the site or substrate.

The reintroduced palms were watered periodically and fertilized as needed for one year following planting (Fig. 4, right). A year after planting, most of the larger palms appeared healthy, with the exception of the few planted on Sands Key, which were defoliated, probably by marsh rabbits. To our dismay, a third of the 62 one year old seedlings planted on Long Key (mostly at two of the six planting sites) were eaten to ground level by herbivores, probably marsh rabbits again. Anne placed wire-mesh cages around the seedlings and caged the bases of the larger palms, and they have so far escaped further damage.

Lessons from Hurricane Andrew

The eye of Hurricane Andrew passed directly over Elliott Key in August, 1992. The Atlantic Ocean swept across the island, and the wild and recently planted Sargent's cherry palms were battered by a massive tidal surge, whipped to a frenzy by sustained winds in excess of 140 miles per hour (Fig. 5). I kept reminding myself that this species had evolved on the coastlines of northern Caribbean islands, where hurricanes are frequent and severe.

The hurricane emphasized the value of maintaining botanic garden conservation collections of endangered species as a backup to populations in



4. Left, Sargent's cherry palms being returned to the wild. Seeds collected by BNP staff in 1984 were grown at the Fairchild nursery for reintroduction, to bolster the park's dwindled wild population. Right, the first reintroduced palms were visited regularly by Anne Deaton and volunteers for the first year, but required little maintenance after initial planting and watering.



5. Surging ocean and shearing winds of Hurricane Andrew severed 19 of the 47 palms on Elliott Key. However, the surviving Sargent's cherry palms are thriving in the open, sunlit hammock.



6. A. Paul Ochre, Biscayne National Park staff, examines remains of the former National Champion *Pseudophoenix* in the tangle of hurricane debris. B. The new National Champion, over 20 feet tall, towers above the recovering hammock on Elliott Key.

the wild. Minus a few tags, the hundreds of seedlings from Elliott Key palms were safe beneath a heavy bench in the Fairchild nursery. Although the Garden's collection was badly damaged by the storm, I immediately noticed the lack of damage to the *Pseudophoenix* and other northern Caribbean palms; their leaves were barely frayed! In fact, one week after the storm, a Sargent's cherry palm in the Bahama planting burst into full bloom amidst the wreckage.

Four months after the storm, the Nemeacs and I began a slow reconnaissance for the palms in Biscayne National Park. Our markers were mostly washed away and other subtle landmarks were unrecognizable. The upper hammock canopy was sheared off, limbs and wreckage littered the forest floor, and a profusion of vines and sprouting branches made passage slow and difficult. I am now convinced that the Joseph and Marcella pos-

sess some innate capacity to sense nearby palms, as we were able to relocate almost all of them in spite of the disorienting conditions.

Of the 47 wild palms, 19 of the tallest, including the National Champion (Fig. 6A), were killed when the crown shaft was severed or the trunk was sheared off at about twelve feet, presumably where the palms met the combined assault of waves and wind. Fortunately, dozens of seedlings from five of these deceased palms were still alive in Fairchild's nursery. One dominant survivor, over 20 feet tall (Fig. 6B), now reigns as the new National Champion. Shorter palms fared better, are thriving in the increased sunlight of the bare hammock, and are actively producing robust, deep green leaves. Although the storm uprooted two of the reintroduced palms, the remaining palms appear healthy, in spite of being covered by layers of plant debris.



7. A and B. Monitoring of the reintroduced palms continues, as Dena Garvue of Fairchild Tropical Garden measures the growth of a thriving two year old seedling (7A) and a ten year old palm (7B).

There is much to be learned about the dynamics of hammock forests from this impressive hurricane. It is obvious that the *Pseudophoenix sargentii* which were not directly killed in the hurricane are somehow benefitting from the changes in their habitat brought about by the storm. Do the palms grow best in the more open-canopied hammocks following hurricanes? Do palm seeds have a long dormancy period which is broken by the heat or long wavelengths of light which reach the forest floor after a severe storm? What is the role of periodic inundation of saltwater in providing these palms with a below-ground competitive advantage? Are herbivore populations, such as rabbits, reduced by tidal surges?

Post-Hurricane Reintroduction

By the spring of 1993, the remaining two year old seedlings in the Fairchild nursery had their

first few pinnate leaves and were ready to be planted. Again, a representative sample was held back to be planted in the conservation collection at Fairchild. Anne Deaton and a hard-working crew transferred over a hundred seedlings to natural areas on Long Key. Here, caging of young palms to prevent damage by herbivores appears to be crucial to successful establishment. My successor at Fairchild, Dena Garvue, helped to plant more than 50 seedlings on Elliott Key (Figs. 7A, B). Ten months later, every single seedling on Elliott Key is robust and actively growing, with no signs of damage.

Measuring Success

How do you gauge success of an endangered species reintroduction? If the goal is to achieve a self-sustaining population, then success is more than just survival of some planted individuals. Our

goal will be met beyond our lifetime, when fourth or fifth generation progeny from these planted palms exist in a viable population with only minimal human intervention. This implies that palm collectors stop harvesting *Pseudophoenix* from the wild in Florida, that no more habitat be cleared for development (especially in these publicly owned parks), and that herbivore populations be maintained at natural levels by their natural predators.

I believe that a large measure of the initial success of this project has been due to cooperation among a federal and a state park and a botanic garden, to devoted volunteers, and to a concerned constituency of palm enthusiasts. However, one of the most difficult chores has been to explain to eager supporters that we cannot take them to see the palms, since increased access leads to unethical collection, which is still a very real threat. To satisfy this legitimate request, we planted several young palms near nature trails, eventually to be incorporated into the parks' interpretive walks. Our hope is that, as they grow and reproduce, these Sargent's cherry palms will become a more common sight in the hammocks, eventually taken for granted as yet another component of subtropical Florida's fascinating native flora.

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