Dry Tortugas National Park-

Loggerhead Key Exotic Plant Management & Island Restoration Project

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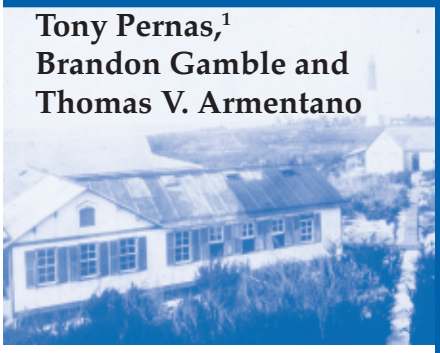

Carnegie Laboratory, c. 1917

Figure 1. Dry Tortugas area map

Figure 2. Fort Jefferson, Garden Key

INTRODUCTION

History

The Dry Tortugas, discovered in 1513 by Ponce de Leon are located 70 miles west of Key West, Florida. Named for the lack of freshwater and abundance of sea turtles they comprise the western terminus of an ancient coral reef tract that extends 220 miles from Miami (see Fig. 3).

The biologically rich waters pro

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vided food, and the islands safe harborage, to countless mariners who traversed this popular trading route. Consequently, the U.S. Military deemed this area an ideal place for protecting and controlling Atlantic-bound Mississippi River trade via the Gulf of Mexico.

Military occupancy of the Dry Tortugas during the 1800s paved the way for numerous construction projects that lasted throughout the century. The largest of which was never completed and is the Dry Tortugas's most famous structure, Fort Jefferson.

As the practical use of Fort Jefferson waned, protection of the cultural and historical resources of the area became the priority. In 1934, the Dry Tortugas area was designated Fort Jefferson National Monument. To assure that the natural resources of the area were also protected, in 1992 the Dry Tortugas was re-designated as a National Park. Dry Tortugas National Park at 100 sq. miles is now the second largest marine-based park in the National Park Service, harboring a unique assemblage of resources unparalleled within the National Park Service system.

Of the total area, only 85 acres is terrestrial habitat capable of supporting plant and animal communities. The native flora on these islands mainly consists of plant species typical of Caribbean islands including grasses, sedges, herbaceous flora, shrubs and trees. Of the 125 plant species reported 81 species (65% of total) are of exotic origin; the result of accidental and deliberate introduction by man during the past century. The smaller islands (East, Bush, Long, Sand) consist mainly of native species, while the larger islands (Garden and Loggerhead), with their long history of human habitation and disturbance, have a significantly larger abundance of exotic taxa.

The islands of the Dry Tortugas have been the subject of many studies since the 1800s, including detailed vegetation maps and floristic inventories giving the NPS valuable baseline information on historical flora.

Loggerhead Key

In the 1840s Loggerhead Key was covered with "a large stand of old white buttonwood trees" that was cut or burned by the island residents (Stoddart and Fosberg 1981) resulting in the first documented impacts to the island community.

The presence of two structures on Loggerhead Key, the U.S. Coast Guard Lighthouse of 1856 and the Carnegie Research Laboratory of 1910 functioned to draw people to the island, increasing the likelihood of plant introductions and habitat modifications.

Literature dating back to the early 20th century depicts this area as remarkably free from common exotic weeds, with the dominant community principally composed of bay cedar, *Suriana maritima* (Bowman 1918). By 1918, introduced plants were possibly influencing the natural ecology of the island by producing shade and conserving water. These introductions include coconut palms (*Cocos nucifera*), Australian pine (*Casuarina equisetifolia)*, fig (*Ficus elastica*), *Hymenocalis,* oleander (*Nerium oleander*), sea hibiscus (*Hibiscus tiliaceus)*, mahoe (*Thespesia populnea)* and century plant (*Agave* spp.*)*. By 1942, the once dominant *Surinana* began to be replaced by prickly pear cactus (*Opuntia stricta)*, Coastal beach sandmat (*Chamascyce mesembrianthemifolia*), century plant, as well as others (Davis 1942). At this time, the most prolific exotic was Australian pine

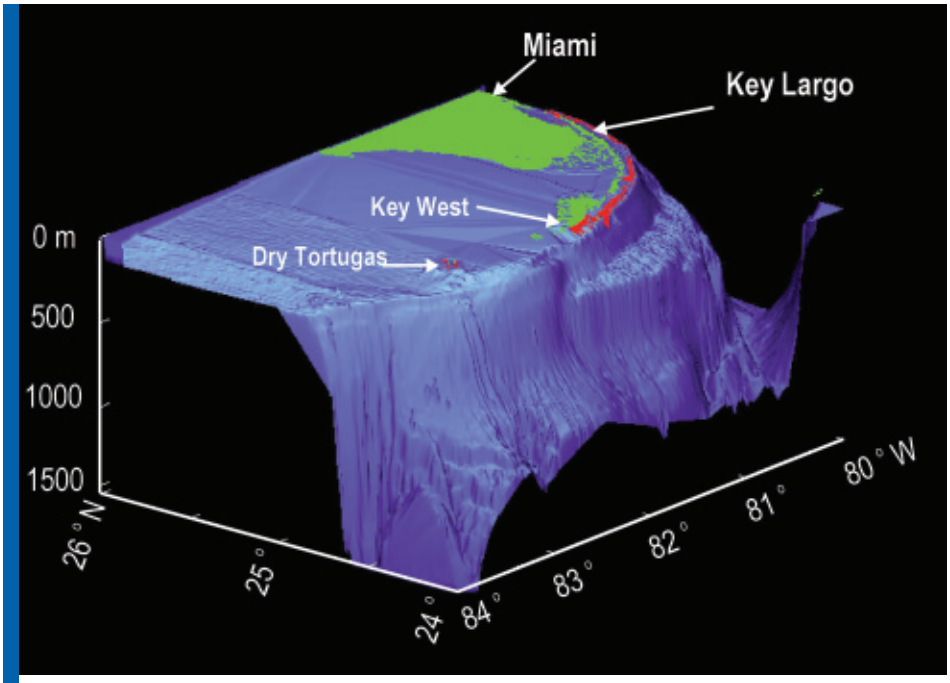

Figure 3. Bathymetric map of Florida keys region

(introduced by the director of the Carnegie Laboratory ca. 1910 (Stoddart and Fosberg, 1981)) had spread from its original plantings with seedlings noted to be growing over many parts of the island. Davis states, "It is entirely possible that these trees will continue to grow and eventually replace the existing vegetation." By 1980, the words of Davis came to fruition, as nearly all of the native communities were displaced and out competed by two species, Australian pine and century plant.

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North end of Loggerhead Key, circa 1916. Note the Australian pine planted around the Carnegie Laboratory.
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North end of Loggerhead Key, circa 1942. Note the expansion of Australian pine.
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North end of Loggerhead Key, 1995. Dense Australian pine covers the island.
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North end of Loggerhead Key, 2000. Restoration efforts aim to return the island to pre-Australian pine conditions.
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Management Activities

In 1992, upon the establishment of the Dry Tortugas National Park, resource managers began to assess the alterations to the communities of Loggerhead Key with the intent of restoring the island back to pre-settlement conditions.

In 1995, an exotic plant management plan was developed and implemented for Dry Tortugas National Park. The plan called for eradicating Australian pine and century plant from Loggerhead Key. Both genera have altered native plant communities and reduced the native habitats for island wildlife. Where Australian pine occurs on sandy beaches, the trees and their root systems have hindered the movements and nesting activities of federally listed threatened and endangered sea turtles. In many places, changes in beach morphology, from gentle slopes to steep embankments, have accompanied the invasion, further exasperating the problem of sea turtle habitat disruption. In addition, these invasive species have altered the composition and structure of the island's terrestrial plant communities by outcompeting native plants thus, reducing species diversity in areas where the exotics were dominant. The natural habitats and food sources of native animals that use these communities have similarly diminished.

The management of exotic pest plants on these islands is essential for maintaining the integrity of the natural and physical environments found at the Dry Tortugas. The establishment and spread of exotic plants can have severe consequences for any environment but, due to the effects of geographic isolation, islands are especially vulnerable. With its long history of human habitation, Loggerhead Key has been subjected to substantial human-influenced impacts, second only to Garden Key in this respect. The control of the ubiquitous Australian pine and century plant on Loggerhead Key is the focal point of the

Treatment of Agave sisalana, Loggerhead Key, Bill Snyder (left) and Biddy Simet (right).

Prescribed fire treatment and beach debris removal, 1995

vegetation management action within the Dry Tortugas.

Treatment of Australian pine involved the basal-bark application of Garlon 4 herbicide (20% solution diluted in JLB oil). Century plants not killed by fire were treated with a crown applications of Garlon 4 at 20%, diluted in JLB oil.

Treated Australian pine trees were left standing; however, trees adjacent to beaches were cut down and treated with herbicide to prevent their falling and impacting sea turtle nesting habitat. In early 1998, the remaining 13.5 acres of Australian pine growing on the island's northern half were cut down (no herbicides were used). The felled wood was burned in late 1998, eliminating not only the Australian pine slash on the ground but also killing a large number of century plants. Vegetative sprouts and seedlings of Australian pine and century plants in the treatment areas continue to be controlled by hand-pulling and application of herbicides. Other invasive exotic species on Loggerhead Key (*Colubrina asiatica, Scaevola taccada, Panicum maximum, Thespesia populnea, Terminalia catappa*) occur only sporadically and are treated as they appear.

The National Park Service has carried out treatment and monitoring work. From 1994-2001 the U.S. Forest Service and the U.S. Fish and Wildlife Service provided assistance with tree cutting and prescribed burning. In addition, the NPS Southeast Archeological Center conducted an archeological survey of Loggerhead Key in early 1998 to determine the effects vegetation management actions may have, if any, on the island's cultural resources.

Natural areas along the eastern beach strand were protected from management activities. These areas were monitored and used as a tool to determine if restoration objectives were being met.

Monitoring

Monitoring the restoration effort was accomplished through a series of 10 permanent transects. Transect were established perpendicular to the axis of the island. Vegetation along these transects were measured utilizing the line intercept technique. This technique involved extending a line between two fixed points and measuring the length of occupancy of a species along that line, thus depicting the spatial patterns in vegetation cover.

Transect 1-5, with the exception to the native community along the eastern beach strand, are in an area which was heavily dominated by exotics. This area was used to monitor the response to the management activities, namely chemical and mechanical treatment. Transects 6-10 represent the native communities and were used as the target for defining restoration success.

Vegetation Response

During the sampling period 1994-2001, a total of 48 species were identified on Loggerhead Key. Of the 48, 17 are considered exotic in origin, and 31 are native.

Within treatment area we have seen reductions in the numbers of exotics, with a concomitant increase in the numbers of native species (Fig. x). Essentially all of the exotic species present in the managed areas in 1994 have been removed as of 2001.

Sea Turtle Nesting

One of the primary environmental threats to nesting sea turtles in Dry Tortugas National Park is the presence of Australian pine on Log-

gerhead Key. The trees have reduced suitable turtle nesting habitat and impeded efforts of nesting females and emerging hatchlings. (Reardon 2000). Ocean waves have undercut the sand adjacent to the roots of the trees creating steeper beach embankments; these embankments make the beaches difficult to surmount by nesting sea turtles. In addition, the network of roots themselves can interfere with the excavation of nesting holes by these turtles. Successful nest excavation by sea turtles is dependent upon soft, debris-free sand, a condition not found in or around the root systems of Australian pine. Fallen Australian pine trees have also physically hindered the movements of nesting turtles on the beaches and reduced the amount of nesting beach available to them. The consequences of these conditions include trapped turtles, hatchlings encountering roots, altered nesting routes, nesting in fallen branches, and turtles abandoning pits due to obstructions. "The trees have reduced suitable turtle nesting habitat and impeded efforts of nesting females and emerging hatchlings." (Reardon 2000).

Visual observations of the beaches over the past two years indicate that the removal of Australian pine has caused marked improvements in beach morphology at some locations: beaches, gradually sloping and without embankments, are largely free of surficial and buried debris. The program can expect to see further enhancement of sea turtle nesting habitats on the island as the physical barriers created by Australian pine are eliminated.

The transformation of Loggerhead Key has been nothing less than remarkable. The vegetation structure of the island now visually approximates the pre-Australian pine condition. Monitoring of native species succession will continue to shed light on the dynamics of the sand island plant community's response to restoration.

Literature Cited

Bowman, H.H.M. 1918. Botanical Ecology of the Dry Tortugas. Papers Dept. mar. Biol. Carnegie Instn Wah. 12: 109-138.

Davis, J.H., Jr. 1942. The ecology of the vegetation and topography of the sand keys of Florida. Paper Tortugas Lab. 33: 113-195.

Reardon, R.T., 2000. Annual Report - 2000 Season. Dry Tortugas National Park Sea Turtle Monitoring Program. Dry Tortugas, Florida. 49 p.

Stoddart, D.R. and F.R. Fosberg, 1981. Topographic and floristic change, Dry Tortugas, Florida, 1904-1977. Atoll Research Bulletin No.523. The Smithsonian Institution. Washington DC.

Nesting turtle impacted by Australian pine roots.

Russell Reardon conducting the annual nesting turtle survey, Loggerhead Key.