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Management Plan for Armadillos on Cumberland Island

by

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**FRS 473
Fall 1995**

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TABLE OF CONTENTS

i.	LIST OF TABLES.....	iii
ii.	LIST OF FIGURES.....	iv
iii.	ACKNOWLEDGMENTS.....	v
I.	INTRODUCTION.....	1
II.	OBJECTIVES.....	3
III.	SITE HISTORY.....	
IV.	SITE DESCRIPTION.....	
	A. Location and topography.....	
	B. Climate.....	
	C. Soils.....	
	D. Vegetation.....	
	1. Dune community type.....	
	2. Interdune community type.....	
	3. Salt marsh community type.....	
	4. Fresh water community type.....	
	5. Upland forest community type.....	
	6. Burn area.....	
	E. Access.....	
V.	STATEMENT OF THE PROBLEM.....	
	A. Armadillos.....	
	1. Food habits.....	
	2. Reproduction.....	
	3. Impacts.....	
VI.	ALTERNATIVES.....	
VII.	SUMMARY.....	
VIII.	LITERATURE CITED.....	

LIST OF TABLES

DRAFT

LIST OF FIGURES

DRAFT

DRAFT

ACKNOWLEDGEMENTS

We would like to thank Jennifer Bjork, Resource Management Specialist at Cumberland Island National Seashore, for making this project possible. With her close coordination, along with help from the National Park Service, we were provided with trips to the island and a place to stay during our visits. We would like to give special thanks to Dr. Robert Warren, who was helpful in getting approval of the project from the National Park Service, initializing contact with Cumberland Island National Seashore, and for supplying us with a great amount of literature on Cumberland Island and on the National Park Service policies. We thank Mr. Doug Hall and Dr. Jeff Jackson for assistance

.....Dr. Greg Artaud, a committee member, was available for advice and direction. Finally, we would like to thank Dr. Wade Nutter and Dr. Larry Marchinton for reminding us of our deadlines and helping us stay focused throughout this project.

INTRODUCTION

Cumberland Island has been altered by humans for centuries. Humans have transported domestic animals, crops, and various exotic species of flora and fauna to the island. Some of the introduced species have been disruptive to the island's ecosystem (i.e., armadillos, feral hogs, feral horses, etc.). The National Park Service defines an exotic species as '... a species occurring in a given place as a result of direct or indirect, deliberate or accidental actions by humans' (NPS, 1991).

The park service is required to construct a list of exotic flora and fauna, and to categorize them as innocuous or disruptive. If a species is classified as innocuous they do not require management. However, if a species is listed as disruptive, then the National Park Service is mandated to manage the species. Many disruptive exotics are 'generalists' organisms that are able to exploit, disrupt habitats, and replace 'specialist' organisms. The National Park Service defines a disruptive species as having '... species, community-level, or ecosystem-level effects, significantly altering natural processes such as: fire regime, nutrient cycling, hydrology or successional patterns; or altering species composition and reducing populations of native species; ... affect localized resources such as archeological features or scenic qualities on a broad scale' (NPS, 1991). The National Park Service policy states:

'Control or eradication will be undertaken, where feasible,
if exotic species threaten to alter national ecosystem; seriously
restrict, prey on, or compete with native populations; present a
hazard to human health or safety; cause a major scenic or aesthetic
intrusion; disrupt the integrity of an historic site; damage

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archeological resources; disturb or displace historic cultivars;
extensively modify geographical processes, such as sand deposition
on beaches; or threaten resources or cause a health hazard outside
the park' (NPS, 1991).

The park service also is required to obtain public comment.

In this management plan we will concentrate only on the nine-banded armadillo. The armadillo was first documented on Cumberland Island in 1971, when an armored skeleton was observed on the beach (Hillestad et al., 1975).

Site History

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Cumberland Island, Georgia has a long history of human occupation and manipulation. The island served as hunting grounds for the aboriginal Timucuan Indians from around 2000 B.C. until the arrival of Europeans in 1562 A.D..

In 1569, the Spanish were the first Europeans to occupy Cumberland Island. The Spanish constructed a fort and a Jesuit Mission on the island. In July, 1742 the English forced a Spanish retreat following the Battle of Bloody Marsh. As a result of the British victory, the village of Barriemackie was established primarily of British soldiers families. Twenty-four families inhabited Barriemackie in 1740. Settlers were assigned lots which they cultivated and improved. The village of Barriemackie is said to have disappeared during the decade between 1756-1766 (Hillestad et al., 1975).

In 1763, the English Board of Trade began to accept applications for grants in Georgia and Florida. Cumberland Island was granted to nine individuals between 1765 and 1768. The island remained virtually unsettled.

The noted American naturalist, William Bartram visited the Island in 1774. Bartram describes "deer, bear, and other game" on Cumberland and Jekyll Islands. Evidence of this is found in deeds, petitions, and proclamations from this period by absentee landowners attempting to prevent the hunting of "their" game, and the harvesting of "their" timber on the island.

The period of 1786-1880 is known as the plantation era on Cumberland Island. Live Oak (Quercus virginiana) was a primary resource of Cumberland Island. Landowners contracted with the government to furnish wood for the United States Navy. Plantations

produced hogs, cattle, and horses. Edible crops such as oranges, lemons, figs, corn, and sweet potatoes were grown. Sea Island Cotton was the most important crop to grow on the island. The end of the Civil War brought an end to the plantation era on Cumberland Island. When word of the Emancipation Proclamation came to the island, the slaves refused to work and were driven from the island. The lack of slave labor caused the plantation economy to collapse.

As a result of the depression, the island landowners sought a product to make the island financially self-sufficient. T. Morrison Carnegie, anticipating the increasing need for rubber and rubber products, experimented with growing tung trees. The nuts of the tung tree produce tung oil used in waterproof paints, varnishes and cloth compounds, and serves as a substitute for rubber.

Between 1955 and 1957 several mining companies showed interest in strip and hydraulic mining for titanium and ilmenite which are found in the sand on the island. The Glidden Company promised 2.25 million dollars in royalties. The deal fell through when the supreme court said a single trustee of the island had no right to enter into an agreement with Glidden.

In 1962, the owners of the island began to consider the sale of the island to the National Park Foundation. In 1972 Cumberland Island became an official part of the National Parks system of the U.S. Department of the Interior.

Location and Size

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Cumberland Island is located in Camden County, Georgia about 34 km southeast of Brunswick, Georgia and about 62 km northeast of Jacksonville, Florida. The center of the island is located at 30 48' N latitude, and 81 26' W longitude. Cumberland Island encompasses 23,227 acres (9404 ha), the island is 25 km long and 9 km broad at its widest point. Bordering the island are the Intercoastal Waterway on the west, the St. Mary's River on the south, the St. Andrews's Sound and Little Cumberland Island on the north, and the Atlantic Ocean on the east (Davison, 1984).

Climate

Cumberland Island is considered to be warm-temperate to subtropical (Davison, 1984). Rain occurs throughout the year and is primarily influenced by maritime air-masses flowing off the Atlantic (Green et al., 1980; Davison, 1984). In the winter, the average daily temperature is 53 degrees F. The summer average daily temperature is 81 degree F (Green et al., 1980).

Cumberland Island is characteristically warm and humid. The average relative humidity is 60 percent in midafternoon. At night, the humidity is usually higher. At dawn the average relative humidity is around 90 percent (Green et al., 1980; Davison 1984).

Soils and Plant Nutrients

Soils on Cumberland Island were deposited during the present Holocene and late Pleistocene epochs and consists of fluvial and marine sediments (Green et al., 1980). Parent materials consist primarily of quartz. Quartz sand is highly resistant to decomposition by chemical and physical weathering processes. These soils have resisted environmental degradation for 35-50,000 years (Hillestad et al., 1975). Cumberland Island soils are commonly placed in the Regosol soil group. Regosol soils are typically known as soils with a poorly differentiated profile (Hillestad et al., 1975).

Soil nutrients arrive to the island by high tidewaters and terrestrial birds and mammals feeding on marine organisms. Nutrients also leave the island due to the same agents. The net gain of nutrients from these sources is small if any at all. Nutrients are a commodity on the island (Hillestad et al., 1975).

The sandy soil is very permeable resulting in low water-holding capacity and rapid leaching. Due to the low cation exchange capacity, the sandy soil is entirely dependant upon the decaying of organic matter for cation adsorption sites (Davison, 1984).

The competition for nutrients freed up by decaying organic matter is intense. Dominant and climax vegetation on wet and dry sites are predominately evergreens. These species drop their leaves and release nutrients gradually throughout the year (Hillestad et al., 1975).

Different plant species has its own adaptation for gathering nutrients effeciently. The live oak (Quercus virginiana) has a shallow, spreading root system. The diameter of the root system is aproximately the same as the diameter of the crown, thus the root system is always

close to the nutrient supply. Pines (Pinus spp.) have a shallow root system combined with a deep tap root. These root system adaptations reduce the net loss of nutrients to the community (Hillestad et al., 1975).

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OBJECTIVES

It is necessary to discuss and understand the landowners' objectives before beginning any management plan. Since, Cumberland Island National Seashore is managed by the National Park Service there is no single landowner. We discussed the park management objectives with Park Superintendent Rolland Swain, who is responsible for implementing NPS policy. Jennifer Bjork, Resource Management Specialist, was our contact for this project. Mr Swain's objectives regarding the control of armadillos are listed below:

Armadillos

STATEMENT OF THE PROBLEM

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Armadillos

The nine-banded armadillo was first documented in North America, on the Texas side of the Rio Grande Valley, about the 1850's (Smith and Doughty, 1984). However, the first documentation of the armadillo east of the Mississippi River was in Florida, in 1922. A Marine from Texas that was stationed at Hialeah during World War I had brought a pair of armadillos with him. He promptly released them after the war (Bailey, 1924). The first appearance of armadillos in Mississippi was in 1928, how it got there is unknown. It is believed to of been transported by humans, because in 1934 armadillos were observed in railroad cars carrying cattle (Fitch et al., 1952). A few years later in Cocoa Beach, another pair escaped from a private zoo. Up until the 1940's reports of other escapees was common (Neill, 1952). Within the next twenty years the armadillo had expanded its range up the East Coast, and included all of Florida except the Everglades and the western Panhandle (Fitch et al., 1952). The armadillo was first documented on Cumberland Island in 1973 (Hillestad et al., 1975). Therefore, the armadillo did not arrive naturally on the East Coast, and can be classified as an exotic species on Cumberland Island.

Armadillos eat soil arthropods and invertebrates. Soil arthropods and invertebrates are important for nutrient cycling. As stated introduction the NPS is mandated to control any exotic species that is disruptive to the park ecosystem (NPS, 1991). Armadillos disturb and alter the nutrient cycling, decomposition of the litter layer, and soil. The loggerhead sea turtle and the gopher tortoise are protected by the state of Georgia and the National Park Service. The armadillo has been documented to prey on loggerhead's nest and hatchlings, as

well as being aggressive to gopher tortoises to the point of taking over their dens (Bushnell, 1952; Galbreath, 1982). Another reason for control of armadillos is because armadillos are capable of contracting Hansen's Disease (i.e., Leprosy), which might be communicable to humans (). Armadillos are exempt from protection afforded other nongame wildlife in Georgia under O.C.G.A. 27-1-28 ().

A Cumberland Island visitor study, conducted in May of 1986, noted that 87% of the visitors responded that wildlife was moderately to extremely important to their visit. However, only 11% of the total responses categorized armadillos as being significant wildlife seen or looked for and not seen (Absher and Bratton, 1986).

The armadillo can be classified as an exotic species that is disruptive to the park ecosystem. Further more, a low percentage of the public list the armadillo as a significant species on the island. Therefore, taking everything into consideration the National Park Service should try to control or eradicate the armadillo on the island.

Home Range

Site specific data has been documented concerning the home range size of armadillos on Cumberland Island (Bond et al., unpublished data). The area on the island that was studied was Ashley Pond and Plum Orchard. Armadillos home range size for the year is ha, home range size does not differ by sex. However, armadillos were observed to expand and constrict their home range in response to the weather. Therefore, armadillos' home range sizes were 5.34 ha in August and constricted to 1.65 ha in January, because of colder temperatures. Armadillos also spend more time in their burrows as it gets colder,

being active in the warmer parts of the day (Bond et al., unpublished data).

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Food habits

The armadillo is a generalists predator of invertebrates that live in soil, litter, and rotten wood (Galbreath, 1982). Armadillos prefer mesic habitats with abundant cover (Taber, 1945). They forage by digging in the soil, litter layer, and in rotten logs, locating food with their keen sense of smell. The greatest percentage of their diet is animal contents. Beetle larvae and adults, especially those of scarabeidae constitute the most important single food category (Kalmbach, 1943; Galbreath, 1982). In Texas, Louisiana, Alabama, and Florida the scarabieds occur in over 90% of all stomachs collected year-round (Kalmbach, 1943; Fitch et al., 1952; Breece and Dusi, 1985; Wirtz et al., 1985). A variety of other invertebrate groups are utilized as food to a limited extent including (but not limited to): Carabidae, Elateridae, Cebrionidae, Terebrionidae, Hymenoptera, Lepidoptera, Orthoptera, Isoptera, Hemitera, Diptera, Neuroptera, Coleoptera, Myriapoda, Arachnida, and earthworms (Kalmbach, 1943; Bushnell, 1952; Galbreath, 1982). It should be noted that in one study, in central Florida, 93% of all stomachs examined contained at least one earthworm and three of those stomachs were full of earthworms (Bushnell, 1952). Grasshoppers are consumed in colder weather due to their torpor state in lower temperatures (Fitch et al., 1952).

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Vertebrates are ingested to a lesser extent. Amphibians and reptiles are the majority of the vertebrates observed to be eaten. Species of reptiles reported to of been ingested include skinks, green anole, six-lined racerunner, worm lizard, Florida scrub lizard, (tantilla

gracilis and relicta), blind snake, and rough green snake (Kalmbach, 1943; Fitch et al., 1952; Galbreath, 1982). Amphibians that have been recorded in armadillos stomach include the dwarf salamander, amphiuma, oak toad, narrow-mouth toad, anurans of the genera Scaphiopus, Rana, and Pseudacris, salamanders in the genera Ambystoma and Notophthalmus (Kalmbach, 1943; Bushnell, 1952; Fitch et al., 1952; Galbreath, 1982). Consumption of reptiles and amphibians occurs principally during cold months of the year, probably because most of them are relatively torpid at low temperatures (Galbreath, 1982).

The eggs of reptiles and game birds are eaten by armadillos at a low frequency. Armadillos usually eat the eggs only if they happen upon them, instead of seeking them out (Bushnell, 1952; Breece and Lansley, 1973; Kennamer and Lunceford, 1973; Galbreath, 1982).

Soft fruits such as white bay, plums, muscadine, blueberries, dewberries, mulberry, juniper berries, holly fruits, persimmons, and various citrus fruits have been observed in armadillo stomachs (Kalmbach, 1943; Hamilton, 1946; Fitch et al., 1952). Long leaf pine seeds, mushrooms, and other fungi are seldom eaten by armadillos (Kalmbach, 1943; Fitch et al., 1952). Armadillos sometimes eat carrion as well as the maggots present (Clark, 1951; Fitch et al., 1952).

Plant materials account for a small percentage of the animals overall diet. Plant matter and soil are generally ingested during the armadillos digging for invertebrates, and from the bodies of ingested earthworms (Kalmbach, 1943; Bushnell, 1952). Armadillos have been observed to kill and consume young cottontails. Wildlife biologist believe the armadillos killed for the curdled milk in their stomachs (Newman and Baker, 1942). The

observations of armadillos killing vertebrates seems to be an unusual occurrence (Smith and Doughty, 1984).

Reproduction

The nine-banded armadillo is a monestrous and polyembronic animal (Enders, 1966). As spring approaches and warmer temperatures ensue, male armadillos initiate reproductive behavior. In mild winters males have been observe in their reproductive state as early as late January - February (Gause, 1980). The male persistently follows the females and tries to engage in reproduction. Until the female is in her reproductive state she simple walks away or kicks backwards with her hind legs. The older multiparous females enter their reproductive state earlier, ovulating in June through August. While, younger nulliparous females ovulate later, until November (Davis, 1974; Enders, 1966).

Armadillos display delayed implantation with the implantation occurs largely in October through December (Galbreath, 1982; Enders, 1966). Implantation has been noted to last up to 14 weeks (Smith and Doughty, 1984). The gestation period is about 150 days (Smith and Doughty, 1984).

Parturition in Texas and Florida occurs from March to May (Enders, 1966; Gause, 1980; Galbreath, 1982). Armadillos produce usually four sexually identical precocial young, but can range from two to five (Galbreath, 1982; Smith and Doughty, 1984). Sexual maturity is reached by the armadillo's second year (Davis, 1974).

Impacts

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The impact of this exotic animal on ecological processes and native biota on Cumberland Island and in the southeastern United States is unknown. However, there has been concern about the impact of armadillos on forest-floor communities within their expanded range (Carr, 1982). Soil macroinvertebrates and microbial communities, which are indispensable to litter breakdown, decomposition, and nutrient cycling (Price, 1984), may be altered significantly by armadillo depredation. Decomposition and cycling processes also may be disrupted by destruction of soil structural properties through armadillos digging and rooting. Foraging activity may likewise disturb seed bed microhabitats, thereby influencing plant community composition (S. Bratton, personal communication). Armadillos may compete for food with a variety of insectivorous species, many of which are preyed upon by armadillos. Armadillos also act out aggression upon the gopher tortoise(Galbreath, 1982). The armadillo has been documented to prey on the threatened loggerhead sea turtle eggs and hatchlings, when it wanders upon them at Merritt Island, Florida (Bushnell, 1952). Therefore, armadillos can potentially depredate sea turtle nest on Cumberland Island. Finally, the armadillo is able to contract Hansen's Disease (i.e., leprosy). However, their importance in transmission of the disease to humans has not been determined (Davidson and Nettles, 1988).

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