ENVIRONMENTAL

ASSESSMENT

FOR THE

FIRE MANAGEMENT PLAN

OUTER BANKS GROUP

Cape Hatteras National Seashore

Wright Brothers National Memorial

And

Fort Raleigh National Historic Site

Manteo, North Carolina

April 3, 2001

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SUMMARY

National Park Service (Service) policy requires that all National Park Service units with vegetation that can sustain wildland fire have an approved Fire Management Plan (FMP). A FMP must relate fire management objectives with firefighter and public safety and natural and cultural resources objectives. As part of the process, and in keeping with the National Environmental Policy Act of 1969 and its implementing regulations, an Environmental Assessment was completed to determine the best course of action that will meet Service policy requirements.

In November 2000, a series of meeting were held with National Park Service Employees assigned to the Outer Banks Group, personnel from Pea Island – Alligator River National Wildlife Refuges, fire management personnel from the North Carolina State Forest Service, a representative from The North Carolina Coastal Reserve, the Land Steward from Nags Head Woods, and members of local fire and public safety agencies. As a result of those meetings, four alternatives were developed.

Alternative A – No Action: Suppress all wildland fires.

Alternative B – Mechanical Fuel Reduction: Suppress all wildland fires and implement an aggressive mechanical hazard fuel reduction program followed up with a limited management ignited prescribed fire initiative.

Alternative C – Enhanced Management: Suppress all wildland fires and use management ignited prescribed fire to achieve resource management objectives.

Alternative D – Full Use: Use the full range of fire management options available for fire suppression, ecosystem restoration, and hazard fuel reduction.

As a result of the process of developing this document, the environmentally preferred alternative selected was Alternative C – Enhanced Management. Until such time as the wildland fuels can be reduced to more manageable levels, the environmentally preferred alternative would be one that includes suppression, mechanical hazard fuel reduction and management ignited prescribed fire to manage hazard fuels and achieve other resource management objectives. In wildland – urban interface areas this alternative will allow for a proactive initiative that would enhance public health and safety and reduce the likelihood of property loss due to wildland fire. In natural areas this alternative will afford management the opportunity to reintroduce fire into the ecosystem in order to achieve long-term environmental results that can only be accomplished through wildland fire.

On completion of a 30-day public review period, the National Park Service will assess public comments and modify the preferred alternative accordingly. If there are no substantive changes, a Finding of No Significant Impact (FONSI) would then be prepared finalizing the decision.

I. INTRODUCTION

Cape Hatteras was authorized by the Act of August 17, 1937 (50 Stat.669). On January 12, 1953, the Secretary of the Interior issued an order establishing Cape Hatteras National Seashore. The authorizing legislation states the purpose of the national seashore "shall be, and is hereby, established, dedicated and set apart as a national seashore for the benefit and enjoyment of the people." The act went on to say, " Except for certain portions of the area, deemed to be especially adaptable for recreational uses..., the said area shall be permanently reserved as a primitive wilderness and no development of the project or plan for the convenience of visitors shall be undertaken which would be incompatible with the preservation of the unique flora and fauna or the physiographic conditions now prevailing in this area."

Fort Raleigh National Historic Site was established by Secretarial Order (April 5, 1941, 9 CFR 2441) to preserve a nationally important historic site for the inspiration and benefit of the people of the United States. A collateral purpose was to honor an agreement with the Roanoke Island Historical Association by continuing to provide a site for the annual presentation of the pageant-drama, *The Lost Colony*. Congress further defined the purpose of the site in the Act of August 17, 1961 (75 Stat. 384) when it said that the purpose of the site was to preserve lands historically associated with the attempt to establish an English colony on Roanoke Island. On November 16, 1990, President George Bush signed P. L. 101-603, an Act to authorize the Secretary of the Interior to acquire approximately 335 acres on the north end of Roanoke Island as additions to Fort Raleigh National Historic Site. The Act also redefined the purpose of the site to include preservation and interpretation of the first English colony in the New World and the history of Native Americans, European Americans, and African Americans who lived on Roanoke Island.

The Kill Devil Hill Monument was established by the Act of March 2, 1927. The Executive Order of March 3, 1933, transferred administrative responsibility to the National Park Service. The site was established to commemorate the first successful human attempt at heavier-than-air, controlled, powered flight. The existing 431-acre land base stabilizes the remaining dunes existing during the Wright brother's flight experiments at the turn of the century. The Secretarial Order of December 1, 1953, re-designated the area monument as Wright Brothers National Memorial (National Park Service 1996).

Pea Island National Wildlife Refuge, which is within the boundaries of the national seashore, is administered by the United States Fish and Wildlife Service.

This environmental assessment (EA) was prepared in compliance with the National Environmental Policy Act of 1969 and its implementing regulations. Three alternatives, including a No Action Alternative, were developed and analyzed, and are included in the Alternatives Section. A preferred ecological alternative has been identified. The EA will be made available to the public for a 30-day review and comment period. Upon completion of the public review, the National Park Service will assess public comments and modify the preferred alternative accordingly. A Finding of No Significant Impact (FONSI) would then be prepared finalizing the decision.

Although this is a programmatic EA in that it establishes a direction for overall fire management within the Outer Banks Group, additional site-specific surveys and assessments will be performed prior to any prescribed burn to assess environmental impacts. Appropriate action would then be taken to avoid the unnecessary loss of any species.

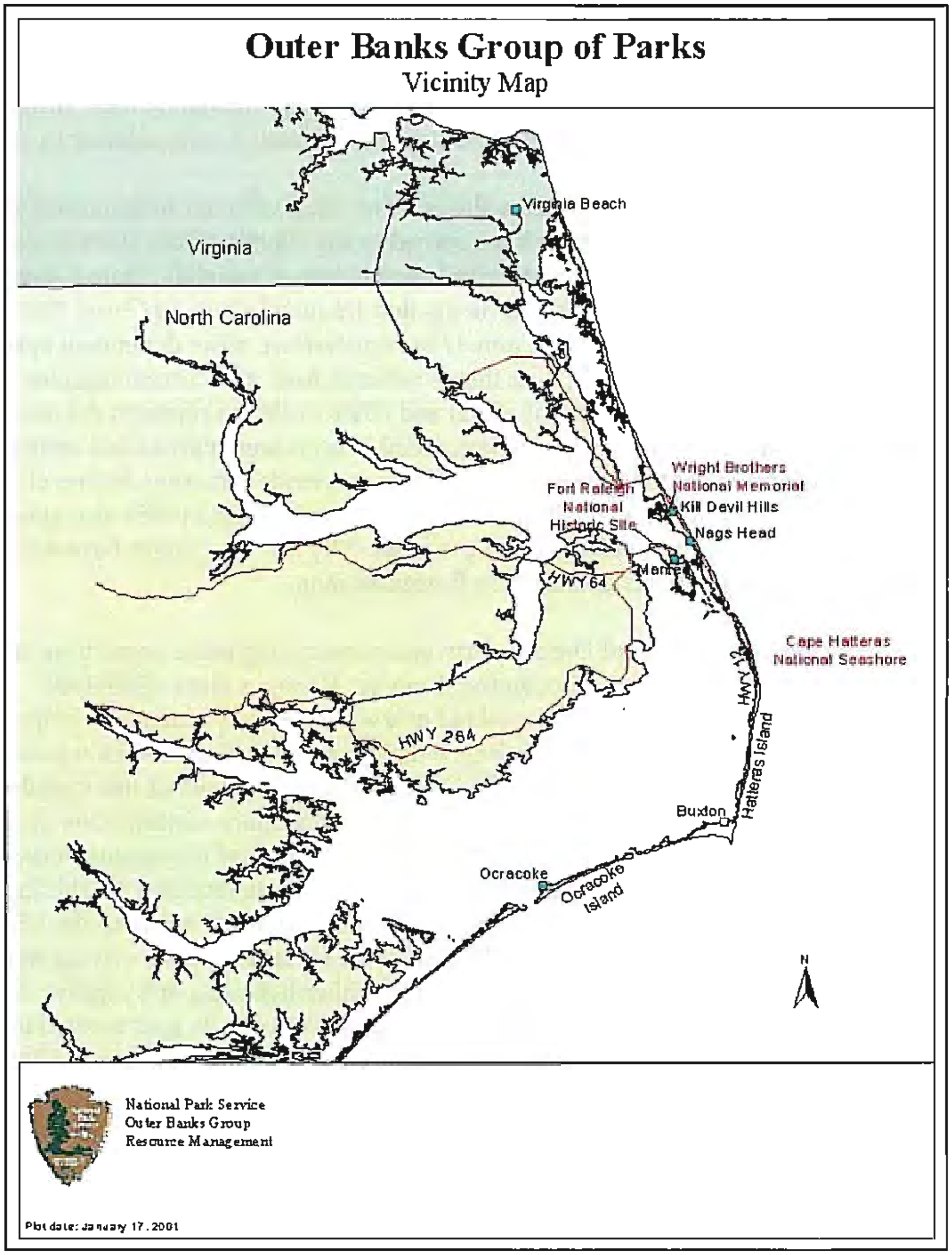
II. PURPOSE AND NEED

Over the past 29 years (1972-2000), 189 wildfires were suppressed on NPS lands. Records indicate that 513 acres were burned as a result of wildfire (Shared Application Computer System 2000). Service policy requires that all National Park Service units with vegetation that can sustain fire have an approved Fire Management Plan (FMP). A FMP must relate fire management objectives with firefighter and public safety and natural and cultural resource management objectives. The Wildland and Prescribed Fire Management Policy (1998) directs federal agencies to achieve a balance between suppression to protect life, property and resources, and fire use to regulate fuels and maintain healthy ecosystems. The guiding principles established by the Wildland and Prescribed Fire Management Policy that will be addressed in this document include:

- The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.
- Sound risk management is a foundation for all fire management activities.
- Fire management plans and activities must incorporate public health and environmental quality considerations.
- Fire management programs and activities are to be economically viable, based upon values to be protected, costs, and land and resource management objectives.
- Fire management plans must be based on the best available science.

Cape Hatteras National Seashore consists of the barrier islands of Hatteras and Ocracoke and the southern end of Bodie Island. Wright Brothers National Monument is located on Bodie Island north of the national seashore. Fort Raleigh National Monument is located on the northern tip of Roanoke Island (Figure 1). The islands that make up the national seashore are separated up to 25 miles from the mainland by marshes and the open waters of Pamlico Sound. By the very nature of a barrier island, the environment of the national seashore is dynamic. Waves, currents, and winds have constantly reshaped the islands. These long, narrow strands of unconsolidated and shifting sand absorb the full forces of ocean waves and storm surges (National Park Service 1981). The locations of the other two parks are more protected from the ocean, and at one time may have been tied to the mainland by vast marshes that reached from the mainland to Roanoke Island and possibly even Nags Head Woods (Frost 1999 in prep).

Figure 1: Vicinity Map – Outer Banks Group



Barrier islands are subject to another disturbance, wildland fire. Although the normal fire regime and the role fire played in the area are not completely understood, studies completed on the Outer Banks and elsewhere in similar fuel types indicate that fire played an important role in species composition and distribution. Davison (1983) found, for example, that the marsh and shrub communities of Cumberland Island, Georgia, were generally fire tolerant. She also noted that, due to their very nature and location, the more fire sensitive but less flammable live oak forest were protected by their structure even from a hot wildland fire, allowing these diverse vegetative communities to coexist.

It is possible that lightning ignited wildland fires and wildland fires ignited by Native Americans on the mainland may have spread to the islands (Frost 1999 in prep.). Marshes carry fire quite well and the marshes and canebrakes of mainland Dare County in pre-settlement times were huge compartments that frequently burned (Frost 1999 in prep). There is a small stand of longleaf pine (*Pinus palustris*), a fire dependent species, on the Fort Raleigh National Historic Site that is isolated from any current mainland remnant of pine savanna (Frost 1999 in prep). This and other evidence supports the theory that Roanoke Island and possibly even Nags Head Woods were part of this continuous fire compartment, connected to the mainland by marshlands sometime before closure of the various Currituck Inlets by 1828 (Frost 1999 in prep). Frost (1995) also speculated that the barrier islands not connected to the mainland by marshes might have been burned, first by native Americans and later by European man.

The earliest descriptions of Dare County and surrounding areas come from diaries and journals completed by explorers on the Roanoke Voyages circa 1580-1585. These first English explorers visited Roanoke Island and attempted the settlement of the first English colony in North America. The landscape that greeted the first settlers was swept and sculpted by wildland fire (Frost 1995). Many written accounts of these explorations were sent back to England and remain today the best authoritative information on the land and its early inhabitants during the time of contact with the first Europeans. One of the earliest accounts of wildland fire on the Outer Banks was recorded in The Roanoke Voyages 1584-1590 when three wildland fires were reported between the 15th and 17th of August, 1590 (Quinn 1955). Since there were no European settlers living in the area at the time, the fires were presumably ignited by either lightning or by native Americans (Frost 1999 in prep.). Sir Francis Drake in one of his journals was amazed at the numbers of fires that could be seen burning along the islands and mainland (Pyne 1982).

It appears that fire has long been present on the Outer Banks and Roanoke Island. Burney and Burney (1984) as quoted in Bratton and Davison (1985) found charred plant fragments at 40 cm in a core of pond sediments in Nags Head Woods. They suggest that the area burned more frequently a few centuries ago when the water table was lower. Fire can thus be assumed to be at least an occasional disturbance on the Outer Banks in pre-Colonial times, although nothing is known of ignition sources (Bratton and Davison 1987).

Since Colonial times, a great deal of vegetative change brought about by both natural and anthropogenic disturbance has occurred (Firth 1987). In their paper, Disturbance and Succession in Buxton Woods, Cape Hatteras, North Carolina, Susan P. Bratton and Kathryn Davison (1987) use historic records, interviews, and paleontological data to determine that since colonial times, logging, livestock grazing, and fire have altered the species composition and structure of Buxton Woods, one of the largest surviving stands of maritime forest on the Outer Banks of North Carolina. Cecil Frost (1999 in prep., 1995) has also studied closely the changes that have occurred on the Outer Banks and attributed the current vegetative regimes to the same forces.

It is thought that logging and grazing played a larger role than fire in the vegetative changes that have occurred since the 1600's. Prior to 1937, when grazing was removed from the Outer Banks, cattle and other livestock kept the forest understory clear of small shrubs and the grasses sparse (Bratton and Davison 1987). Though fires were common, they were of low intensity. Following the cessation of grazing and logging, brush and shrubs returned and the fire regime changed from one of frequent low intensity fires to larger, more intense fires (Bratton and Davison 1987).

While wildland fire may have helped shape the environment, it can also have an adverse impact on it. Certain plant communities and animal species occupy sites that seldom, if ever support wildland fire. In other cases, the long-term exclusion of wildland fire has resulted in plant communities that have so altered a site that the area can only tolerate low intensity fire (Olson 1998, USDA Forest Service 1998).

During periods of drought or abnormal environmental conditions (low relative humidity, high winds, low fuel moisture), wildland fire can consume duff and peat, kill vegetation, and disrupt the mycorhiza association in mesic sites that under normal conditions would be too moist to burn. Similar effects can occur if an area burns too frequently under a variety of conditions. The results can be dramatic. Wildland fires under the previously described conditions and exacerbated by of long periods of suppression can result in high levels of tree mortality and open the area to invasion by other species, thereby changing the entire plant and animal species composition (Olson 1998).

In the case of the national seashore, it would be advantageous to reintroduce fire to the ecosystem to halt the spread of brush and encourage the growth of grasses adapted to salt spray and overwash. On barrier islands, rhizomatous grasses are adapted to overwash while shrub and tree communities are rare because they are vulnerable to salt spray and inundation (Doland et al. 1973). Vegetative succession to shrub thicket and maritime forest occurs only in locations where there is protection from salt spray and overwash with access to fresh groundwater (Firth 1987). Due to the construction of artificial dunes, shrubs have invaded the grasslands behind the dunes and have caused a decline in the grass species adapted to overwash (National Park Service 1981). Managers at Pea Island National Wildlife Refuge have successfully used prescribed fire to control brush encroachment and stimulate grasses (Crews, personal com.), creating habitat favored by migratory waterfowl.

Salt spray generated by storms over the past few years have killed a large number of trees, leaving an abnormally heavy accumulation of dead and down woody debris and other heavy concentrations of woody fuels near the boundary or adjacent to communities. The loss of canopy has permitted an invasion of shrubs, many of them highly flammable, to become established in these same areas. These conditions make the management and control of wildfires difficult, and place the public and fire suppression forces at risk.

Bratton (1991) observed that there should be concern for the protection of human-constructed improvements near scrub areas. She wrote with the number of private citizens living on the islands, fire management strategies must consider not only the ecological dynamics and structure of native plant communities, but also human safety and protection of private property. As the trend towards rural development continues across the United States into the 21st century, parks that share their boundaries with privately owned lands need to look more closely at their wildland-urban interface. The idea of having a National Park in one's backyard is so popular that realtors and other developers often use it as a primary selling point. In the east, many homeowners are unaware of the dangers of fuels build-up and do not perceive wildfire as a threat to a home "at the beach" (Morlock, date unkn). With each new home constructed along a park's boundary two management problems escalate. The first is the potential for a structural fire or a wildfire caused by a powerline failure to ignite nearby vegetation within the park, the second is the potential for a wildfire burning in a park to leave the park and destroy homes or other structures near the boundary (Morlock, date unkn).

Given the issues described above, the Outer Banks Group needs a fire management plan that will utilize a range of fire management strategies consistent with current knowledge. The long-term objective for this action is to reintroduce fire as a natural ecological process and restore habitats to meet specific resource objectives, while addressing fire fighter safety, protection of park resources and developments and neighboring land uses and improvements. Specifically, this environmental assessment analyzes the suppression of unwanted ignitions, introduction of wildland fire on a limited basis to achieve management objectives, and the use of mechanical means in concert with prescribed fire to reduce accumulations of hazard fuels in specific areas.

III. ALTERNATIVES

Under all alternatives, initial attack suppression actions will be taken on all human-caused wildland fires and escaped prescribed fires. Initial attack suppression actions would provide for public and firefighter safety, protect public and private resources, and utilize techniques that would cause the least impact to the Group's natural and cultural resources.

Throughout the Group, the use of suppression resources would be constrained as follows:

- Fire engines and other vehicles would not be driven off established roadways, unless there was imminent threat to human life or private or public property.

- Tractor plows or dozers would not be used without approval of the Superintendent, unless there was imminent threat to human life or private or public property.
- Retardant would not be used within 200 feet of a watercourse or an open body of water.
- Handtools and chainsaws would be used in a manner that results in the least impact to natural resources.

Alternative A – No Action: Suppress all wildland fires

Under this alternative no changes from current procedures would be implemented. All wildland fires would be managed using an appropriate management response. Fire suppression personnel would, in a cost-effective manner, seek to limit the spread of a fire as quickly as possible, while ensuring public and firefighter safety and protecting the Group's natural, cultural and historic resources, and private and other public property.

In many cases, an appropriate management response would entail the deployment of firefighters with handtools and engines to control the fire as quickly as possible. Another technique that could also be successfully used is indirect attack, where suppression forces burn out fuel in advance of the fire, using existing roads and trails and natural fuel breaks as control lines.

In the event of the report of more than one fire, the highest priority would be given to wildland fires that have potential to adversely affect human life or safety, or to spread onto private or other public lands outside the boundaries of a park or threaten developed sites located within the boundaries of a park.

Mechanical hazard fuel reduction to achieve resource management objectives would be used on a very limited basis. Prescribed fire would not occur under this alternative.

Alternative B – Mechanical Fuel Reduction: Suppress all wildland fires and implement an aggressive mechanical hazard fuel reduction program followed up with a limited management ignited prescribed fire initiative.

Under this alternative, wildland fires would receive an appropriate management response with the same control objectives described in Alternative A.

The key component of this alternative would be an aggressive mechanical fuel reduction program during the first 3 to 5 years followed by a limited management ignited prescribed fire program to maintain fire breaks and achieve limited resource management objectives. Power saws and drum choppers and other mechanical equipment capable of cutting brush and other heavy vegetation would be used to create fuel breaks adjacent to developed areas. Much of the residue would be chipped and broadcast throughout the treatment area where it would decay naturally. Limited prescribed fire would be used to reduce the amount of residue generated by the mechanical treatment process, treat critical areas not accessible to equipment, and accomplish other limited resource management objectives.

Alternative C – (Preferred): Suppress all wildland fires and use management ignited prescribed fire or mechanical means to achieve resource management objectives.

Under this alternative, wildland fires would receive an appropriate management response with the same control objectives described in Alternative A.

Management ignited prescribed fire would initially be used on a limited basis and in concert with the Minimum Impact Suppression Tactics (MIST) concept to reduce accumulations of hazard fuel and restore fire to the ecosystem to enhance and/or maintain selected habitats. These small-scale burns would be have a high degree of success. The prescribed burns would provide the Group with the opportunity to educate the public about the importance of wildland fire in the ecosystem and provide for staff development. Management ignited prescribed fire would be used hand-in-hand with a mechanical fuel reduction program designed to maintain and make safe existing firebreaks.

Prescribed fire would only be used when the prescriptive parameters are met. A prescription includes measurable criteria that define conditions under which a prescribed fire may be ignited. This criteria includes fuel moisture, weather parameters, holding and contingency forces, ignition sequence, desired fire behavior characteristics, air quality and public health considerations, and measures to be taken and techniques to be used to reduce the impacts of the operation. Pre and post-burn monitoring would be used to determine if treatment objectives were being met.

Management ignited prescribed fire and mechanical hazard fuel reduction would be used to reduce accumulations of hazard fuels around cultural sites, developed areas, and near park boundaries, to reduce the likelihood of wildland fire negatively impacting a park's resources or spreading onto other public and private lands. In some cases, the preferred treatment would be only prescribed fire, in others, only mechanical means would be used, or the two treatments would be used in combination to achieve the desired results.

Based on the training and experience level of the park staff and the projects identified to date, prescribed fire would be used to treat a maximum of 1000 acres annually over the next five years. During that period of time, the Resource Management Division would identify additional units for treatment. A listing of existing or proposed units that have been identified at this point and a map indicating their location can be found in Appendix B.

Scheduling of the various units for treatment would depend on environmental conditions and the availability of required staffing, rather than arbitrary dates. All factors associated with the burn would have to meet parameters indicated in the prescribed burn plans before a burn could be implemented. It is possible that prescribed fire would not be used in some years due to lack of adequate staffing or favorable weather.

Monitoring results would be used to fine-tune prescriptions, as necessary, to ensure resource management objectives will be achieved.

Alternative D – Full Use: Use the full range of fire management options available for fire suppression, ecosystem restoration, and hazard fuel reduction.

Under this alternative, wildland fires would receive an appropriate management response with the same control objectives described in Alternative A.

Management ignited prescribed fire and mechanical hazard fuel reduction would be utilized as outlined in Alternative C to reduce the likelihood of wildland fire negatively impacting a park's resources or spreading onto other public and private lands. Prescribed fire would be used to a greater extent than indicated in the third alternative to restore fire to the ecosystem when appropriate.

The major difference between this alternative and Alternative C is that under this alternative, a lightning-caused wildland fire occurring in a park would receive appropriate management response based on prescriptive parameters that consider potential benefits to resources that may occur as a result of the fire. Predetermined control objectives would allow lightning-caused fires to burn within current and predicted weather parameters. This would ensure the fire would meet stated resource objectives in a predetermined area. Lightning-caused wildland fires ignited outside the prescriptive parameters would be suppressed.

Lightning-caused fires would be monitored to ensure the fire remained within a designated area, the desired resource objectives are achieved, air quality and water quality are not adversely impacted, and the fire does not damage historic or cultural resources or threaten life or property. Current and expected weather would be monitored and tracked. The Group would ensure sufficient wildland suppression resources are available to contain the fire in the event the weather changes unexpectedly or if the fire exceeded the pre-established prescription parameters. Pre and post-burn monitoring would be used to determine if treatment objectives were being met. Monitoring results would be used to fine-tune prescriptions to ensure resource management objectives will be achieved.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

Due to the close proximity of dwellings and other improvements associated with the wildland-urban interface and the heavy accumulation of fuels, permitting lightning fires to burn even under prescriptive perimeters may be difficult. Until the fuels are reduced to more manageable levels, the environmentally preferred alternative would be one that includes suppression, mechanical hazard fuel reduction and prescribed fire to manage hazard fuels and achieve other resource management objectives (Alternative C). However, once fuel loadings in the vicinity of the wildland-urban interface are reduced to a more manageable level, it may be appropriate to revise the Fire Management Plan to include wildland fire use as an additional tool to achieve natural resource management objectives. If that were to become the case, a new Environmental Assessment or

Environmental Impact Statement would be prepared in compliance with the National Environmental Policy Act of 1969 and its implementing regulations.

ALTERNATIVES CONSIDERED AND DISMISSED

Full Suppression and Increased Use of Mechanical Treatments

The fragile nature of the sandy topography would limit the areas that could be treated using heavy equipment and the volume of work would be extremely time-consuming. As a result, a large-scale mechanical and chemical treatment would be cost prohibitive.

IV. AFFECTED ENVIRONMNENT

Soils: No other landscape in the eastern United States is as mobile as that of the barrier islands. Blowouts, shifting sand, and wandering dunes are characteristic of these maritime strands. The scale of disturbance ranges from 1,000 to 3,000 years in Nags Head Woods where vegetation may have been protected by tall dunes to daily in the case of the plants entombed by small fans of sand deposited in the lee of dunes with any sea breeze (Frost 1999 in prep). The barrier islands, comprised of Holocene sediments, are migrating westward as a continuing response to a rising sea level. The main mechanisms for migration are inlet formation and overwash. The land formations in the Buxton Woods and Nags Head areas appear to be a remnant of an earlier geologic process (Frost 1999 in prep). These two areas have been stabilized for a sufficient length of time to allow the formation of humus and sandy loam soils. The loamy sand and organic peat and muck found in marshes are significant in life cycle of some marine life and provide significant wildlife habitat (NPS 1981).

Recurring fires are common to the maritime strands of the Coastal Plain of the southeastern United States (Oosting 1954). Specific effects of fire on soil may vary greatly (Wade and Lunsford 1989). Frequency, duration, and intensity of the fire must be considered. Typically, erosional responses to burning are a function of several factors such as the degree of elimination of protective cover, steepness of slope, degree the affected soil sheds water, climatic characteristics, and how quickly the vegetation recovers (Tiedemann et al.1979, Wade and Lunsford 1989). On the coastal plain there is little danger of erosion following a fire (Wade and Lunsford 1989). The degree of elimination of protective cover and how quickly the vegetation recovers will have the greatest influence on the impacts of fire on soils.

The soil that comprises the beach, berm, and to some extent the grassland flats behind the berm has low water retaining ability and excellent drainage. The loosely consolidated sand that makes up much of this soil is held in place primarily by sea oats (*Uniola paniculata*). Sea oats can withstand exposure to wind, salt spray, occasional fires, storms, and drought to stabilize the dunes and hold the often deep and shifting sand (Carls et al. 1991).

Although blowouts, shifting sand, and wandering dunes are characteristic of maritime strands, these phenomena were much accelerated in the past when sea oats and other dune grasses were burned off to improve forage for cattle. This action reduced the total cover and greatly accelerated the inland movement of sand. On Smith's Island, North Carolina, what was formerly a barren area of shifting small dunes has developed substantial cover because of reduced grazing and elimination of fire (Oosting 1954). After a fire sea oats most likely sprouts from rhizomes after aerial portions are burned (FEIS 2000). This was possible because, sea oats sprouts from rhizomes and from perennating buds at the bases of culms (Hitchcock 1951, Eleuterius 1989). The length of time it takes the vegetation to fully recover is based in part on the time of year and environmental conditions. Because it is rhizomatous, an extensive root system is established which helps hold the sand in place until the grasses recover.

Before modern fire suppression, peatland vegetation was controlled primarily by master gradients of fire frequency and organic matter depth (Frost 1995). Fire shaped vegetation and distributed species into fire-frequency zones and niches. In marshes, fire interacted with two more important gradients, salinity and water depth to structure vegetation, but in the great peatlands, fire shared importance with depth of organic matter as one of the two master influences (Frost 1995). Peat fires can be a potential problem in marshy areas during periods of severe drought when the water table is below the surface of the ground (Penfound and Hathaway1938).

The soils of the island have been mapped and described by the USDA Soil Conservation Service (1977). The USDA Soil Conservation Service report is on file at Group headquarters.

Air Quality - Air quality in the Group receives protection under several provisions of the Clean Air Act (CAA), including the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Program. The area is considered to be in attainment of the NAAQS, the minimum standards for air quality throughout the country. The PSD Program provides additional protection from air pollution. One of the goals of the PSD Program is to preserve, protect, and enhance the air quality in areas of special natural, recreational, scenic, or historic, including the Group's values (Ross 1990). Under this program, Cape Hatteras National Seashore is designated Class II (USDI National Park Service, 1979). Only a limited amount of additional air pollution, due to moderate growth, can be allowed in the area over time (certain national parks and wilderness areas are classified as Class I and receive the highest protection under the CAA).

Over all, the air quality on the Outer Banks is considered to be good (EPA 1997). Wind and atmospheric instability generally result in rapid dispersion of most air pollutants during the day, but nighttime conditions are often conducive to the formation of fog.

Hydrology – Groundwater provides the freshwater resources for the national seashore. Its source was described and mapped by the U.S. Department of the Interior Geological Survey and consists of a water-table aquifer and confined and semi-confined aquifers (Winner 1975). Small ponds occur in depressions where the water table is above the surface. Rainwater enters directly into the water-table aquifer because of little or no surface runoff. The fresh groundwater is like a lens-shaped mass floating on top of denser salty water. The lens continually changes due to the rates of recharge and discharge. Where the island is high, there is sufficient head pressure for freshwater to circulate downward into a deeper confined aquifers. Elsewhere, the fresh groundwater moves away from the central part of the island toward the ocean and sound (Winner 1975). Given this hydrologic regime, there is a potential for contamination of fresh ground water. Wastewater effluent and other contaminants can enter the aquifer as easily as rainwater (NPS 1981).

Vegetation – Communities of specialized plant and animal species have adapted to the often harsh and unstable barrier island environment found on Cape Hatteras. The distance from the ocean, direction of prevailing winds, soil salinity, moisture and periodic over wash are among the factors that determines the distribution of vegetation. The sensitivity indicated for each zone suggests the vulnerability of its plants and animals to disturbance (National Park Service 1981).

Pre-settlement descriptions of the Outer Banks are few. Bratton and Davison (1985) recounted a report by Thomas Hariot (1588) of a predominance of pine on Roanoke Island, but also mentions cedars, sweet gums, and oak that were "faire, straight, tall and as good timber as any can be..." Also included in the report was an account by Jonathan Price (1795) describing the woods on Hatteras as "covered with large evergreen trees, such as live oak, pine and cedar... "and they included a report that Ocracoke Island, which now supports almost no native forest, as covered with woods of small live oak and cedar.

Today, sandy beaches give way to dunes where rhizomatous grasses such as sea oats, adapted to overwash, stabilize the dunes and hold the sand. Sea oats sites have in common exposure to wind, salt spray, storms, drought, often deep and shifting sand, and occasional fires and saltwater inundation. These unstable habitats suffer wind and water erosion. Evaporation rates at these sites are high due to constant air movement, high temperatures, and full sunlight (Carls et al. 1991). Shrub and tree communities are vulnerable to salt spray and inundation (Doland et al. 1973). Shrub thickets will form, however, where there is protection from salt spray and overwash.

On barrier islands such as Cape Lookout that have not been altered by man, vegetation succession to shrub thicket and maritime forest occurs only in locations with access to fresh groundwater which are protected from damage from the ocean and sound (Firth 1987). Due to the construction of artificial dunes within the national seashore, shrubs have invaded some of the grasslands behind the dunes and have caused a decline in the grass species adapted to overwash (National Park Service 1981). Pine plantations have been established in some of the open sandflats and dune areas. These forests are young, dating from Civilian Conservation Corps plantings in the 1930s to more recent plantings in the 1960s (Bratton and Davison 1987).

Maritime forest, such as Buxton Woods, may occur on protected, elevated sites (National Park Service 1981). Swamp forest occurred in the low-lying swales behind the ancient dunes. Tree species such as red maple (*Acer rubrum*), willow (*Salix caroliniana*), swamp dogwood *(Cornus stricta*), and persimmon (*Diospyros virginiana*) are common (Bratton and Davison 1987). Eastern red-cedar (*Juniperus virginiana*), Loblolly pine (*Pinus taeda*), American holly (*Ilex opaca*), flowering dogwood (*Cornus florida*), bayberry (*Myrica cerifera*), and yaupon (*Ilex vomitoria*) are also present.

On the sound side of the island, the marsh grasses contribute an important link to the estuarine ecosystem. The high marsh, flooded by spring and storm tides, is dominated by salt meadow cordgrass (*Spartina patens*), whereas the low marsh, flooded at mean high tide, is shared in dominance by salt meadow cord grass and black needlerush (*Juncus roemerianus*) (National Park Service 1981).

A listing of selected plant species and their relationships to fire is contained in Appendix C.

Table 1: Habitat Types – Fort Raleigh

Habitat Type	Acres	Percent
Deciduous Forest	01.5	00.4
Coniferous Forest	205.1	55.0
Low Marsh	53.4	14.3
Mixed Forest	61.7	16.6
Open Land	19.5	05.2
Pine Plantation	12.6	03.4
Residential Coniferous	00.3	00.1
Residential Open	00.0	00.0
Riparian	15.0	04.0
Shrub Savanna	02.7	00.7
Water	00.9	00.2
Total	372.6	99.9

Source:[1] Devine, Hugh A., McCaffrey, Beau, and Turner, Kent. Vegetation Mapping & GIS for the Cape Hatteras National Seashore, Feb.1995.

Table 2: Habitat Types – Wright Brothers

Habitat Type	Acres	Percent
Live Oak Scrub	141.6	33.6
Open Dunes, Grasslands, Disturbed grounds	146.1	34.6
Pine; pine-mixed hardwood	124.6	29.5
Wetlands: Ditches	06.3	01.5
Wetlands: Forested	02.7	00.6
Wetlands: Marsh	00.6	00.1
Total	421.9	99.9

Source: Devine, Hugh A., McCaffrey, Beau, and Turner, Kent. Vegetation Mapping & GIS for the Cape Hatteras National Seashore, Feb.1995.

[1] The percentages of habitat types may not equal 100% due to rounding.

Table 3: Habitat Types – Cape Hatteras

Habitat Type	Acres			Total	Percent
	Bodie Island	Hatteras Island	Ocracoke Island		
Barren Sand	689.3	1139.2	1086.1	2914.6	09.6
Br. Evgreen Maritime	810.7	170.5	07.9	989.1	03.3
Broad leaf/Needle leaf	00.0	730.1	00.0	730.1	02.4
Developed land	595.9	1023.2	36.4	1655.5	05.5
Dune Grassland	00.0	2480.3	800.4	3280.7	10.8
Fresh Marsh	1533.2	109.5	20.0	1662.7	05.5
Juncus R. High Marsh	407.8	1129.1	434.7	1971.6	06.5
Low Marsh	974.2	575.8	616.8	2166.8	07.1
Needle leaf/Broad leaf	00.0	2624.5	00.0	2624.5	08.7
Pinus Maritime Forest	65.4	286.7	46.4	398.5	01.3
Reeds	66.4	52.4	02.4	121.2	00.4
S. Patens High Marsh	00.0	80.3	685.7	766.0	02.5
Shrub Savanna <1/3	265.8	2182.6	644.5	3092.9	10.2
Shrub Savanna >1/3	457.7	940.3	463.9	1861.9	06.1
Shrub Thicket	49.0	814.4	422.3	1285.7	04.2
Water	288.2	199.0	13.3	500.5	01.7
No Data	700.0	2911.1	684.2	4295.3	14.2
Total	6903.6	17449.0	5965.6	30317.6	100.0

Source: Devine, Hugh A., McCaffrey, Beau, and Turner, Kent. Vegetation Mapping & GIS for the Cape Hatteras National Seashore, Feb.1995.

Wildlife – One of the guiding principles contained in the Wildland and Prescribed Fire Management Policy: Implementation and Reference Guide requires that "fire management plans must be based on the best available science" (NWCG 1998). The role wildland fire plays in the distribution and composition of wildlife species is not well known. Lyon, et al. (1978) in their state of knowledge report, noted that managers lack descriptions of both short-term and long-term ecosystem responses to wildland fire, including site-specific responses of food, cover, and animals, and differential response to season of burn and repeated burning. They also stated researchers lack knowledge of specific habitat requirements, life histories, and inter-species relationships of key faunal species or groups. However, Lyon concluded there is enough general knowledge available to resource managers to state that fire is beneficial to many wildlife species and the detrimental effects of fire on many animals are short lived (Lyon, et al. 1978).

Although the observations made by Lyon and his fellow researchers remains true today, several studies over the past two decades, including those by Bratton (1991), Davison (1983), Doland and Lens (1986) and Doland et al. (1973), Firth (1987), Frost (1999), and others of specific species and their habitats unique to the Group have been undertaken. These studies are expanding the knowledge available to resource managers. In keeping with the guiding principle referenced at the beginning of this section, as even more knowledge becomes available, the knowledge generated will be used to improve the fire management program.

The Outer Banks, including Cape Hatteras National Seashore and Pea Island NWR have been listed as globally significant Important Bird Areas (American Bird Conservancy 1999, National Audubon Society 1999). The Outer Banks provide vital nesting habitat for approximately one-fourth of North Carolina's federally threatened Piping Plovers (*Charadrius melodus*), 60,000 shorebirds, and more than 20 percent of the state's Least Terns (*Sterna antillarum*), Common Terns (*Sterna hirundo*), and Black Skimmers (*Rynchops niger*). During the spring and fall, neotropical migrant songbirds funnel through small areas where they rest and feed before beginning nonstop flights over water, so coastal habitats are particularly important stopover zones (North Carolina Partners in Flight 2000). Pea Island NWR is well known for the thousands of ducks, geese, Tundra Swans (*Cygnus columbianus*) and shorebirds that find safe haven there (National Audubon Society 1999).

The most conspicuous animals present are birds, which can be seen and heard in all habitats during all seasons of the year. Because the majority is migratory, the rich and varied birdlife changes throughout the year (National Park Service 1981). The marshes on the sound side of Bodie Island, together with those on Pea Island and Ocracoke Island, provide a wintering home for over half of North America's Greater Snow Geese *(Chen caerulescens*) on the Atlantic flyway, as well as significant numbers of other waterfowl (Firth 1987). Inlet areas, recently overwashed beaches, and estuarine islands are important nesting sites for terns (*Sterna spp.*) and skimmers (*Rhynchops spp.*) and the federally threatened Piping Plover.

Vegetative adaptations have resulted in vegetation zones including grassland flats, meadows, shrub thickets, maritime forests, fresh water marshes, and salt marshes. This variety of vegetative communities provides habitat for many faunal species, some dependent on specific vegetative types and other benefiting from an ability to utilize multiple communities. About one-half of the mammal species found in North Carolina's lower coastal plain are found on the national seashore (National Park Service 1981). Opossums (*Didelphis virginiana*), northern short-tailed shrews (*Blarina brevicauda*), rabbits (*Oryctolagus spp.*), rats (*Rattus spp.*), mice (*Peromyscus spp*), voles (*Microtus spp.*), raccoon (*Procyon lotor*), and white-tailed deer (*Odocoileus virginianus*) are common residents. Aquatic mammals such as muskrat (*Ondatra zibethica*), mink (*Mustela* spp.), nutria (*Myocastor coypus*), and otter (*Lutra* spp.) are observed around the ponds and marshes.

Research on the influence of fires on reptiles and amphibians is poorly documented. Data indicate because they generally inhabit moist or protected sites, very few individuals are killed during fires (Means 1981). Reptiles such as turtles and snakes are found in the national seashore. Turtles are confined primarily to the ocean and beaches and are not expected to be impacted by fire. Two species of poisonous snakes, canebrake rattlesnake (*Crotalus horridus atricaudatus*) and cottonmouth water moccasin (*Agkistrodon piscivorus*), have been observed in Buxton Woods. Fowler's toad (*Bufo woodhousei*), squirrel tree frog (*Hyla squirella*), green tree frog (*Hyla cinerea*), and southern leopard frog (*Rana sphenocephala*) are the most common amphibians.

Many species of commercially important invertebrates and fish are supported by the food chain of the seashore's salt marshes. The marshes and tidal creeks serve as nursery grounds for fish, clams and scallops, and crab and shrimp (National Park Service 1981).

A listing of wildlife species common to the Group is on file at Group Headquarters. A listing of selected plant species and their relationships to fire is contained in Appendix C.

Threatened and Endangered Species: Federally and state-listed endangered, threatened, and rare flora and fauna have been inventoried by the North Carolina Heritage Program in 1997 and the listing was updated in 2000, and by law and by NPS policy require special consideration and protection. There is a wide range of federally and state listed threatened and endangered species that live year around or visit Group lands part of the year. Many species such as the loggerhead sea turtle (*Caretta caretta*), Leatherback sea turtle (*Dermochelys coriacea*), and Piping Plover (*Charadrius melodus*) are limited to beach sites. Others such as dune blue curls (*Trichostema* spp.) and seabeach amaranth (*Amaranthus pumilus*) are federal species of concern that inhabit dune and disturbed areas. The state listed Brown Pelican (*Pelicanus occidentalis*) is known to nest on land in the vicinity of the national seashore. State listed species such as the Little Blue Heron (*Egretta caerulea*), Snowy Egret (*Egretta thula*), and the Carolina salt marsh snake (*Nerodia sipedon williamengelsi*) can be found in the marshy areas on the sound. Species such as the Peregrine Falcon (*Falco peregrinus*) and Bald Eagle (*Haliaeetus leucocephalus*) are winter visitors.

A complete listing of Threatened and Endangered Species that are listed in Dare and Hyde Counties is included in Appendix D.

Cultural Resources – There 44 listed classified structures within the parks' boundaries (Outer Banks Group 2000). Many are associated with the lighthouses and life-saving stations. Some of these structures may be vulnerable to wildland fire related damage, especially the four CCC cabins located in the vicinity of Buxton Woods. There are no known archeological sites that would be affected by fire management activities. A listing of classified structures and other significant cultural resources is on file at Group headquarters.

Residents and Visitors – There has been extensive growth in tourism along this portion of the Outer Banks with consequent resort and vacation home development, and the area has become a major visitor destination within close range of the densely populated eastern seaboard. Resorts, motels and hotels, and vacation homes occupy much of the land that is available for development. In addition, due to the mild climate, many more retired and semi-retired people have discovered the Outer Banks as well. A secondary economy has developed and grown to meet the needs of the ever-increasing numbers of visitors and residents. Several strip malls, restaurants and fast-food outlets, and other commercial development stretch from Southern Shores on the northern end of Bodie Island to Whalebone Junction. A new 18-bed hospital is being built in Nags Head.

Roanoke Island is home to the Dare County seat and is also heavily dependent on tourism.

There is a high demand for permanent and seasonal housing on the Outer Banks. Most private lands outside the park units have already been developed or are currently under development. Houses are generally constructed with wood siding, wooden shakes, and built on pilings with an open ground floor. There have been few, if any attempts to manage fuels on lands outside the parks. As a result, hazard fuel levels continue to increase due to shrub invasion and normal accumulation of fuels created by insect outbreaks and storms. Visitors come to the Outer Banks to enjoy the surf and beach, and to generally get away from it all. Often they come from areas where the only wildfire they have ever seen appeared on the nightly news. In all likelihood, the newcomers and visitors, unfamiliar with natural processes, do not want to deal with the smoke and other inconveniences that come with any type of wildland fire activity. They are here to enjoy the amenities the area has to offer.

Over the past decade, visitation has steadily increased. There were 2.1 million visitors to the Seashore in 1991 as compared to 2.78 million in calendar year 2000 (Cape Hatteras National Seashore 2001). The majority of the visitation to the area occurs from March through October. However, due to favorable weather conditions, more and more visitors are coming on a year around basis. The primary interest is beach and water related activities, such as swimming and beachcombing. Sea kayaking, surfing, boating, fishing, hiking, bird watching and visiting historic sites are other important activities. The vast majority of visitation occurs in the beach, inlet flats or developed areas.

Sacred Sites and Indian Trust Resources: Although there has been occupation by Native Americans in the area for thousands of years, past studies in the three parks have failed to find sites of significance. The majority of the sites identified have been determined to be temporary in nature.

V. IMPACTS

Soils

Short Term: Under the right set of conditions, wildland fire will spread through dune grasses. The sandy soils, though protected to some degree by the roots of the rhizomatous grasses, would be subject to wind erosion until the grasses recovered. This would be a possibility under all four alternatives.

Under all four alternatives, a portion of the organic nitrogen on upland sites with organic soils would be volatilized as the result of fire use activities. However, larger amounts of mineralized nitrogen would become available on a short-term basis for plant uptake due to fire-caused mineralization of organic nitrogen and increased nitrogen fixation associated with microsite changes caused by fire use (Wade and Lunsford 1989, EPA 1999). When fire changes a log or other woody material to ash, nutrients bound in chemical compounds are released and changed to a form that is more water-soluble. In this form, nutrients percolating into the soil are again usable in the growth of other plants (USDA Forest Service 1993).

Normally, sufficient moisture would be present in the soil on forested upland sites to prevent complete combustion of the duff and forest litter, providing a protective layer for the soil (Wade and Lunsford 1989). However, under Alternative A, there is a greater likelihood of more intense wildfires due to the present fuel loading that would be more likely to consume a larger percentage of the duff and forest litter. Through incremental removal of litter under the right the conditions by management ignited prescribed fire this may be avoided.

Very little soil erosion caused by wildland fire suppression activities is expected due to the relative flatness of the topography.

Using mechanical means, as proposed under Alternative B, would subject the treatment areas to the highest degree of disturbance. It is possible that equipment would form ruts in sandy and wet areas and strip away ground cover in others, leaving the soil exposed to erosional forces and colonization by exotic species. The limited use of mechanical equipment as proposed under Alternatives C and D would lessen the likelihood of long-term damage caused by the use of equipment. Prescribed fire could be used in critical areas where the use of equipment would not be appropriate due to the possibility of soil damage.

Prescribed burning as proposed in Alternatives C and D would free nutrients and normally would cause little or no detectable change in the amount of organic matter in surface soils. In fact, slight increases in organic matter have been reported on some burned areas (Wade and Lunsford 1989). Low intensity surface fires under a timber over story or in marshy areas conducted under prescriptive parameters would not be expected to cause changes in the structure of mineral soil because the elevated temperature are of brief duration and the burns would be conducted under controlled condition.

Long Term: Alternatives B and C would accelerate the natural decomposition process and increase nitrogen available to stimulate growth and restore surface herbaceous vegetation, perpetuating organic soil layers and increasing site productivity.

As the result of fire exclusion, soil productivity in areas with organic soils would decline slightly under Alternative A, as some nutrients become organically bound primarily in biomass (As a stand of timer matures, for example, as it would under a limited fire regime, an increasing portion of the nutrients on the site become locked up in the vegetation and would be unavailable for further use until the plants die and decompose). When heavy concentrations of fuel, like those currently present in most forested areas and marshes, burn during periods of high temperature and low fuel moisture, the heat per unit area may be elevated long enough to ignite organic matter in the soils and render the soils fallow for several years, or ignite a peat fire that could burn for some time (Personal observation). If the forest floor is completely consumed, which is more likely under Alternative A, the microenvironment of the upper soil layer would be drastically changed, perhaps even resulting in increased tree mortality (Wade and Lunsford 1989).

Soils would be better protected from the adverse effects of high-intensity fires through the fuel management techniques proposed in Alternatives C and D. The low-intensity prescribed fires proposed in these alternatives would speed up the nutrient recycling process, return nutrients back to the soil where they would be available to stimulate plant growth and vigor, and stimulate micro organisms on site. Prescribed fires, regardless of ignition source, would be conducted under predetermined conditions that would insure that the protective layer was not removed, exposing mineral soil to the effects of erosion.

Cumulative Impacts: In the event a storm would strike while an area of dune was recovering from a wildland fire, the erosion of the site due to wind and wave action could be accelerated.

Soils impacted by high intensity fires may become favorable colonization sites for exotic plant species entering the area from outside sources.

Methods to Reduce Impacts: Prescribed fire prescriptions designed to reduce fire severity during prescribed fire operations would be followed. Fuels would be pretreated to reduce fire severity. Existing roads and trails and natural barriers would be used to the greatest extent possible as control lines for both wildland and prescribed fires. Tactics involving the use of leaf blowers and handtools that do not result in soil disturbance would be employed to construct control lines, where appropriate.

Conclusion: Alternative A may lead to soil degradation as a result of increased likelihood of large-scale, high intensity wildland fires as fuel accumulations remain high. Under this same alternative, valuable nutrients would remain locked up in biomass. Alternative B would subject the soil to the greatest possibility of disturbance. Alternatives C and D would best protect soil resources in the long-term by increasing available nutrients, reducing soil disturbance and reducing the adverse effects resulting from high intensity wildland fires. Alternative C allows park management to proceed in a professional manner, using the best available science, to manage a park's resources.

Air Quality

Short Term Impacts: Under all four alternatives, wildland fires within the Group would continue to have minor short-term impacts on air quality. Based on fire statistics from the past 29 years (1972 through 2000), a typical wildland fires burns less than 4.9 acres (Shared Application Computer System 2000). The emissions from a fire of this size would primarily affect only the area adjacent to the scene of the fire for a short time, generally one to two days, depending on the size of the fire, the fuels, and the environmental conditions present. Human health standards (National Ambient Air Quality Standards for particulate matter size class of 10 microns in diameter and smaller and particulate matter of 2.5 microns in diameter and smaller) could be approached for short periods in the area immediately adjacent to the fire. Air quality on a regional scale would be affected only when many acres are burned on the same day (NWCG 1985).

Alternatives A and B would have the least short-term impact on air quality of the four alternatives because prescribed fire would not be used and almost all wildland fires would be suppressed, often within the first burning period. Large wildfires that are likely to result from the accumulation of fuel could actively burn and smolder for days, greatly impacting local, and in a worse case scenario, even regional air quality.

Alternative C would have a greater short-term impact on air quality due to the prescribed fire activity. When using prescribed fires on areas with light fuel loading such as grasslands or frequently burned pine stands, total smoke production would be low because smoldering combustion is minimal in these fuel types (NWCG 1985). It is unlikely maximum standards for public health outside the immediate vicinity of the fire would be exceeded due to management actions and prescriptive parameters. Fires that were no longer in prescription would be extinguished.

Alternative D would have the potential to have the greatest over-all short-term impact on air quality due to the provision that allows for the use of wildland fire to achieve management objectives. Fires burning under this provision may burn for several days under the right set of conditions. Techniques available to managers conducting prescribed burns, such as pre-treating fuels to reduce fuel loading or varying ignition patterns, often cannot be used to reduce emissions from naturally ignited fires (EPA 1998). However, wildland fire use operations would be conducted following predetermined prescriptions, including favorable conditions that would limit the impacts of smoke.

Long Term Impacts: A common goal of all wildland owners/managers is to minimize the potential for catastrophic wildfires that could result from heavy accumulations of vegetative fuels (EPA 1998). Partially decomposed woody materials often can smolder for long periods of time, increasing the amount of particulate matter emitted. Fires that occur in areas with heavy accumulations of fuel can have the most adverse impact on air quality. The absence of fire and the limited use of other fuel management techniques due to cost, would result in increased accumulations of fuels that would contribute to larger fires of longer duration that would be more difficult to suppress. Fires of this type would be expected to impact air quality for extended periods of time. Both human health and visual standards would likely be exceeded for longer periods of time in the vicinity of the fire.

Under Alternative C, the potential for long duration air quality concerns would be reduced because the likelihood of large wildland fires occurring would be reduced through proactive fuels management. Because prescribed burns can be scheduled, Alternative C would provide the greatest flexibility in taking advantage of favorable condition to coordinate with other regional smoke producers to disperse smoke and avoid impacting sensitive areas. This would allow the distribution of emissions over time and space to avoid exceeding air quality standards.

Alternative D could potentially reduce most quickly the conditions that contribute to large, high intensity, long duration wildland fires that often impact air quality. Alternative D would also reduce potential smoke impacts from high intensity wildfires by conducting prescribed burns and by adding an additional tool, the management of natural ignitions occurring under favorable conditions. Allowing lightning-ignited wildland fires to burn under favorable environmental conditions would reduce accumulations of fuels that could lead to catastrophic fires. However, the number of lightning caused ignitions is so small and the conditions under which they burn are such that little advantage can be expected.

Cumulative Impacts: As adjacent lands are developed and visitation to the area increases, there is an increased risk of human caused ignitions. When coupled with increasing fuel loads that would be present under Alternative A, more frequent, large wildland fires could occur across agency boundaries, resulting in increased emissions, reduced air quality, and increased health risks.

Regional air quality during prescribed fire operations can be affected by meteorology; existing air quality; the size, timing, and duration of the activity; and other activities occurring in the same airshed when many acres are burned on the same day. Alternative C would provide park managers the greatest flexibility to schedule burns and to coordinate with other regional smoke producers to take advantage of favorable conditions that are required to disperse smoke and avoid impacting sensitive areas.

Methods to Reduce Impacts: The Environmental Protection Agency (EPA) recognizes that wildland fires of all kinds (wildfire, prescribed fires, etc.) contribute to regional haze, and there is a complex relationship between what is considered a natural source of fire versus a human-caused source of fire. For example, the increased use of prescribed fire in some areas may lead to particulate emissions levels lower than those expected from a catastrophic wildfire, especially in the wildland-urban interface. Given that in many instances the purpose of prescribed fire is to restore the natural fire cycles to the various ecosystems, the EPA will work with state and federal land managers to support development of enhanced smoke management plans to minimize the effects of emissions on public health and welfare (EPA 1999).

Several methods are available to reduce the impacts to air quality including,

- Minimizing the area burned.
- Reducing the fuel loading in the area to be burned through mechanical pretreatment.
- Reducing the amount of fuel consumed by fire through the use of smaller units.
- Minimizing emissions per ton of fuel consumed by burning under favorable conditions or using different firing techniques.

- Rapid and complete mop-up of fuels known to contribute to poor air quality.

Secondary emissions are pollutants formed in the atmosphere by photochemical transformation of primary emissions. They include oxidants such as ozone, a criteria pollutant as defined by the EPA. The specific emission factors for secondary emissions from prescribed burning are unknown but are believed to be relatively small (Haddow 1989). For ozone to form, nitrogen oxide (Nox) is required as well as volatile organic compounds (VOCs) emissions in the presence of sunlight. The amount of Nox and VOCs generated would be dependent on the types of fuel burned, the moisture content, and the temperature of the combustion process (Carson, personal communication). Currently, readings taken at all air monitoring stations nearest the Group are meeting the National Ambient Air Quality Standards for ozone and PM10 (EPA website). Prescribed burns would not be conducted under conditions favorable to the formation of ozone.

Prescriptive elements in prescribed burn plans would specify the proper conditions necessary to increase smoke dispersal and enhance burning, thereby reducing impacts from smoke. Prescribed burns could initially be conducted outside the normal fire season to avoid the high visitor use season.

All prescribed burns would be conducted in accordance with regulations established by the State of North Carolina and the Clean Air Act.

Conclusion: The tradeoff is between much higher average levels of smoke from prescribed fire and shorter-term but more severe wildfire smoke impacts (Sampson 1995). Under Alternative C, land and vegetation management practices would be promoted that are best for wildland ecosystems, yet protect public health and avoid visibility impairment. Several factors would be considered when selecting appropriate treatments, including the costs of treatment, the impact to air quality, and whether fire must be used to meet management objectives at a reasonable cost. When fire is the chosen management tool, a combination of treatment methods may be the best approach to achieving the desired resource benefits with minimum air quality impacts. The combination of treatments proposed under Alternative C, include mechanically pre-treating an area to reduce the fuel load prior to the use of fire will meet this objective. As a result, excessive fuel accumulations would be reduced most rapidly under conditions that would protect air quality through scheduling and other mitigating factors. The best combination of treatments are those that meet management goals with the most favorable environmental impacts at the most reasonable cost.

Due to the proactive nature of the latter three alternatives, potential for high intensity, long duration wildland fires would be reduced under Alternatives B, C, and D. Long-term air quality would be protected the least under Alternative A.

Hydrology

Short Term Impacts: Due to the nature of the terrain and the sandy nature of the soil, there is little likelihood that surface runoff that could affect water quality will occur after a fire. Contamination of ponds, estuaries, and other watercourses from fire retardant dropped from airtankers is a possibility. Under Alternatives B, C, and D there is a slight risk of equipment failure that could release hydrocarbons, such as lubricating oil, to the environment.

Long Term Impacts: Due to the complex nature of the water-table aquifer and the confined and semi-confined aquifers, there is a remote possibility that a contaminant such as fire retardant could enter the aquifer. Under Alternative A, the possibility of larger, more intense wildland fires can be expected. Fires occurring in the wildland-urban interface may require the use of airtankers and retardant to protect life and property, thereby increasing the risk of contamination.

The wildland fuel management program proposed under Alternative B would provide defensible space for firefighters to use fire suppression tactics that would greatly reduce the need for airtankers. Under Alternative C, using a combination of mechanical fuel treatments and prescribed fire, the park staff would selectively treat areas prone to high intensity wildfires under controlled conditions. The proactive nature of this alternative would reduce the likelihood of large, high intensity wildfires that require unusual measures to suppress from occurring.

Similar results would be expected for Alternative D.

Cumulative Impacts: A large multi-jurisdictional wildland fire involving structures in the wildland-urban interface could possibly impact water quality due to run-off, primarily from structure suppression or protection efforts. No cumulative impacts are expected from wildland fuel management activities under any of the alternatives.

Methods to reduce impacts: Site specific measures would be included in prescribed burn plans when appropriate. Chemical fire retardant drops during suppression actions would not be used within 200 feet of a watercourse.

Conclusion: The risk of impact to the water features is slight under all four alternatives and any impact is thought to be short-lived. There is a possibility that the use of fire retardant would be necessary under all four alternatives. Any action that increases the possibility that fire retardant may be used to protect life and property poses the greatest risk to the hydrological features.

Vegetation:

Short Term Impacts: Wildland fire may injure or kill part of a plant or the entire plant, depending on how intensely the fire burns and how long the plant is exposed to high temperatures (Wade and Lunsford 1989). Plants that are not fire adapted are more susceptible to fire. Small trees of any species suffer a higher rate of mortality. Under all alternatives the top-killing of small trees and shrubs within a burn area would continue to occur. Initially under Alternatives C and D, accumulations of fuel may actually initially increase during the restoration phase due to the top killing of smaller trees and shrubs by prescribed fire and debris resulting from mechanical fuel reduction operations. Alternative A would have the least impact in this regard. Alternative B would create the greatest amount of debris due to the extensive use of mechanical fuel reduction methods. All alternatives may lead to the establishment of exotic plant species in highly disturbed areas, and fire scars may make certain tree species susceptible to disease or invasion by insects (Wade and Lunsford 1989)[2]. It is expected that Alternative B would create the greatest amount of soil and vegetative disturbance, creating conditions most favorable to the establishment of exotic species while Alternative A would cause the least disturbance.

Long Term Impacts: Wildland fire is an evolutionary force that has helped shape many terrestrial ecosystems (Buckner-Turrill, date unknown). As an agent of disturbance, fire is important in maintaining high levels of species richness and diversity (Buckner-Turrill, date unknown). In forested areas, the absence of fire in the long run will favor more shade-tolerant, less fire-tolerant species, and succession will proceed toward a climax community rather than a fire-maintained sub climax type (Van Lear 1989, Olson 1998, Buckner-Turrill, date unknown). This in turn would lead to ecosystem altering conditions (Ladd 1991). For example, as a stand of maple matures, the site it occupies becomes even more resistant to fire (Olson 1998). Under Alternative A, the lack of fire in the ecosystem would continue the trend away from fire adapted species toward a community of fire-intolerant species where a large scale, high-intensity wildfire could result in a higher rate of mortality. On the other hand, prescribed fire as proposed under Alternative C could be introduced where appropriate to reverse this trend. The same benefits would be achieved under Alternative D.

In the absence of wildland fire, the increase of shade tolerant underbrush and pine and the maturing of volatile fuels would create ladder fuels that could contribute to catastrophic (stand replacing) wildland fires (Van Lear 1989). However, with the judicious use of prescribed fire and mechanical means as proposed under Alternative C, the understory could be managed to reduce ladder fuels and limit competition with desired species while at the same time providing browse for wildlife (Wade and Lunsford 1989). As stands of pine grow older, they are more vulnerable to insects and diseases (Buckner-Turrill, date unknown). During the past decade, pine stands at Fort Raleigh have been damaged by insects (Trick, personal comm.). Under Alternative A, there is a high likelihood that insect infestations would increase and the stressed pine would be less able to resist the attacks.

The majority of Buxton Woods is composed of the moderate fire danger types, of swamp and pine forests (Bratton and Davison 1987). The last major fire in

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[2] Bratton and Davison (1987) noted that hurricanes of 1933 and 1936 caused flooding that killed numerous loblolly pines. This was followed by insect outbreaks including turpentine beetles (*Dendroctonous terebrans*) and engraver beetles (*Ips* spp.) which further damaged mature trees. It is possible that other large-scale disturbance, including a catastrophic wildland fire, could possibly lead to similar results.

Buxton Woods spread from Jeanette Sedge, and although the cause was not recorded, it was probably human-caused. The continuous stretches of sawgrasses along the Sedge and connected stretch of marsh and swamp are possibly the greatest fire threat to the woods. Depending on the prevailing winds, a swamp fire could be extremely difficult to contain, and could threaten structures throughout the central portions of Hatteras Island. Private property adjacent to the park boundary, especially those holdings with brush and pine litter surrounding the structures may be endangered by a crown fire through the pine communities.

Alternative A would do little to prevent the likelihood of a catastrophic fire and over time would enhance conditions that would contribute to the impacts. In addition to the proactive management of wildland fuels, Alternatives B, C, and D include provisions for public education intended to make homes and communities more fire safe.

Any controlled burning should consider its relative effects on young oaks and pines (Bratton and Davison 1987). As the pines age and die out, succession probably favors the hardwoods already established in the shrub layer (Bratton and Davison 1987). Even with infrequent fire, Frost (1999) theorized the understory might remain open enough that occasional live oaks could grow large enough to resist fire and replace old canopy trees, maintaining something like an oak savanna or woodland. This would serve to return the forest to a composition more similar to that of pre-colonial times, and would help to protect maritime hardwood forest, a limited resource. Replacement of pine by oaks and deciduous species would lower surface fuel loading and reduce fire hazard (Bratton and Davison 1987). Alternatives C and D would reverse the trend perpetuated by full suppression by opening the forest floor, protecting the overstory, and favoring fire dependent species. Prescribed fire has also been successfully used under very exacting fuel and weather conditions to control insects. Prescribed would tend to promote a more natural forest composition and structure, increasing tree vigor and spacing to combat insect infestations. Prescribed burning generally costs much less than traditional chemical control methods used to control forest pests.

Under Alternative A, brush fields that have resulted from dune building would perpetuate, crowding out grasses and other species more commonly found in the areas behind the primary dunes. Alternative B does not address this issue. Alternatives C and D would use mechanical means and prescribed fire to reduce the encroachment of brush and trees, such as Eastern red cedar which have or are taking over large expanses of grasslands and encroaching on marshes, and return these areas to a more natural state. The reduction or elimination of brush would make wildland fires easier to control due the lowered fireline intensities.

Cumulative Impacts: Actions being taken by the U.S. Fish and Wildlife Service at Pea Island National Wildlife Refuge would enhance action items proposed under Alternatives C and D. Alternative A would reduce the effectiveness of increased fire use by other agencies by allowing continued accumulations of hazard fuels, the loss of fire adapted ecosystems, and the loss of grasslands and marsh areas. This would work counter to the efforts of other agencies.

Methods to reduce impacts: Prescribed burning has direct and indirect effects on the environment. Proper use of prescribed fire, and evaluation of the benefits and costs of a burn require knowledge of how fire affects vegetation (Wade and Lunsford 1989). Prescribed burns would be conducted using valid prescriptions when the treatment is most beneficial to the target species, and would be used only when resource management objectives are most likely to be achieved.

Conclusion: Increased fire use would restore vegetative composition and structure in areas where fire has been excluded. Short-term increases in exotic plants would likely occur. However, based on current knowledge, Alternative C would have the effect of creating a healthier ecosystem and one most typical of a barrier island. Alternative D would have the potential to restore certain plant communities a little more quickly and increase their resilience to disturbance. However, due to the low number of naturally ignited wildland fires, there is not expected to be any appreciable increase in the number of acres treated over the next five to ten years.

Alternative A would allow continued degradation of the fire adapted plant communities and the processes that maintain them. Neither Alternatives A or B would address the encroachment of brush in areas behind the dunefield that were once grasslands.

Wildlife

Short Term Impacts: Alternative A would benefit established species in the short-term because it would preserve the *status quo*, that is an environment that favors species that are not fire-dependent or species that do not prefer fire disturbed sites. Under Alternatives A, C and D, there may be short-term negative effects from wildland fire to a wide variety of wildlife such as limited mortality, loss of food sources, and the loss of protective cover (Lyon et al. 1978). The most significant effects on fauna as an outcome of Alternatives C and D are the resulting changes in the environment and habitat structure, with ensuing differences in food and cover being the greatest and immediate change, as opposed to direct mortality resulting from prescribed fire activities (Shortess 1986). Wildfires ignited by lightning often occur primarily during the summer months. Under Alternative D, such fires may impact nesting birds.

Long Term Impacts: Long-term population declines of neotropical migrant songbirds, shorebirds, seabirds, wading birds and others is well known. Although the factors that cause declines are complex, there is a broad consensus among scientists that habitat loss and degradation are the major factors affecting breeding grounds, migratory stopovers and pathways, and wintering areas (National Audubon Society 2001). For example, distribution of the Eastern Kingbird (*Tyrannus tyrannus*) in Eastern North America in precolonial times may have been limited to swamps, marshes, edges of lakes and rivers, and open, disturbed environments like forest areas affected by blowdowns and forest fires (Johns 2000). These areas are being lost overtime to development and mismanagement.

Cape Hatteras has a long history of human-ignited wildland fire to clear brush and open marshes for wildlife (Bratton 1981). Periodic fire tends to favor understory species that require more open habitat (Lyon et al. 1978, Wade and Lunsford 1989). Changes in breeding species are likely to occur over time due to changes in structure and composition of the burned areas. Opening the forest midstory would create critical habitat for neotropical migrants that require a more open woodland and other species such as the Indigo Bunting *(Passerina cyanea)* that seems to do well in disturbed sites, occupying the transient, scrubby vegetation that covers areas after woodlands are impacted by natural disturbances like fire or storms (Johns 2000). A reduction of bushes and shrubs in the grassland flats would provide increased food sources for migratory waterfowl. Improving the health and vigor of marshes would provide increased foraging for birds and small mammals (Wade and Lunsford 1989).

Two species of ducks that historically nest in North Carolina, wood ducks (*Aix sponsa*) and black ducks (*Anas obscura*), have experienced similar habitat losses. Only wood duck numbers in North Carolina have increased. Black duck populations are still in trouble (USFWS 2001). In the past, as winter approached, ducks, geese, and swans, came to North Carolina to eat the grasses that grew abundantly in the marshes of the sounds of the Outer Banks. In the 1970 s, many of the submerged aquatic vegetation began dying due to changes in water quality. Since the availability of this food source was limited, many birds did not remain here (USFWS 2001).

Large mammals such as those found on the Outer Banks can be expected to benefit from any increase in wildland fire activity. The major effects are indirect and pertain to changes in food and cover (Wade and Lunsford 1989). Small mammals are effected by the same changes. Studies have shown that following a wildland fire, populations of small mammals drop in number but recover quickly, and increase in the following two to three years (Lyons et al. 1978, Masters et al. 1989). An increase in small mammals would benefit those animal and bird species that rely on them for food. Little is known about the reptile and amphibian populations that inhabit the parks of the Group and the effect fire or the absence of fire will have on them on a long-term basis. Further study may be appropriate.

Although Alternative A might be beneficial in the short-term for a few wildlife species, generally, wildlife species are expected to be more impacted over the long-term as the result of a full suppression policy. Full suppression would result in a further decline in habitat quality and diversity and an increase in the probability of high-intensity, stand altering fires, which, by extension, could actually increase the numbers and types of species that would frequent the parks. The maintenance of all successional stages of habitats through positive management should insure at least minimal levels of all potential species in an area (Lyon et al. 1978). Alternatives C and D will over time create the mosaic of vegetation in various successional stages that are necessary to provide habitat for the greatest variety of wildlife species. Pea Island National Wildlife Refuge, as an example, has successfully created foraging areas, supplementing those lost due to changes in water quality, using prescribed fire as proposed in Alternatives C and D.

Cumulative impacts: Actions being taken by the U.S. Fish and Wildlife Service at Pea Island, and to some extent Alligator River National Wildlife Refuge, would enhance action items proposed under Alternatives C and D. Alternative A would contribute nothing to the efforts of the U.S. Fish and Wildlife Service and organizations such at The Nature Conservancy, Partners in Flight, and the Audubon Society to improve wildlife habitat on the Outer Banks.

Methods to reduce impacts: Due care would be taken to avoid impacts to ground nesting birds and to other wildlife during sensitive periods. Additional protection would be afforded listed species (see Threatened and Endangered Species).

Conclusion: Alternatives C and D would have the potential to restore biotic communities to the desired conditions and create a diversity of habitats suitable to a wider range of wildlife. These alternatives would also complement the efforts of the U.S. Fish and Wildlife Service and other organizations working to improve habitat for migratory waterfowl and neotropical birds. It does not appear that large and small mammals would be severely impacted, and would, in the long-run benefit from a healthier vegetative community. Any changes to the vegetative community in the form of increased edge habitat and savanna-like forests would take 5-10 years to be realized. Alternative A would allow continued degradation of the entire ecosystem and the resulting impact on wildlife. Alternative B would have a similar effect.

Threatened and Endangered Species

Short Term Impacts: By adhering to existing National Park Service policies and following established protocol, very little potential impacts to federally and state listed species would occur under all four alternatives. Measures (discussed below) would be taken to ensure protection of all known occurrences of these species.

Seabeach amaranth (*Amaranthus pumilus*), wooly beach heather (*Hudsonia tomentosa*), and dune bluecurls (*Trichostema* spp.) are listed plant species that inhabit disturbed foredune areas. Seabeach amaranth is typical of these species. It is seldom found in well-vegetated areas (Langley 1999, National Park Service 1998). Because these plants inhabit open sandy beach areas that are far removed from wildland fuels, they are not expected to be impacted by fire management activities.

Piping Plovers are representative of shore birds that occupy the barren beaches and foredunal areas. They breed along the Atlantic Coast from March through August (Dyer et al. 1988). They nest from mid-April through late July with a typical clutch size of four eggs and an incubation period that averages from 27 to 28 days. Nests are shallow depressions in sand, mixed with pebbles or shells in areas with little or no vegetation. Nesting locations are on sandy beaches and spits above the high tide line, on gently sloping dunes, in blowout areas behind dunes, in over wash areas between dunes and on sandy dredge material (Dyer et al. 1988). Other threatened and endangered species of shorebirds and sea turtle species also utilize the same areas. None of these species should be impacted by fire management activities.

Star-nosed moles (*Condylura cristata*) are very agile and inhabit muddy or damp soils (Rankin 1997). This species and others that occupy similar habitats are not expected to be impacted by fire management. Due to the high moisture content of the duff and soil, the surface fuels are not likely to even carry a fire. The greatest threat to animals that occupy areas that normally are wet is a wildfire occurring during a period of extensive drought. Under adverse conditions, the fuels, including duff and organic soil, could become dry enough to burn.

Long Term Impacts: Species such at the Northern Harrier (*Circus cyaneus*), Peregrine Falcon (*Falco peregrinus*), and Bald Eagle (*Haliaeetus leucocephalus*) are expected to benefit from the use of prescribed fire as described under Alternative C. Prescribed fire would open grasslands and expose prey that serves as food for the Northern Harrier. The Peregrine Falcon would benefit from an increase in numbers of other birds that provide a large portion of the Peregrine's diet. Prescribed fire as proposed under Alternatives C and D could be used to create snags that are important to the Bald Eagle as perches. Stand replacing fires, which are more likely to result from continued fuel accumulation and poor forest health that is expected to occur under Alternative A, would likely change the Bald Eagle's use of the forest and could reduce eagle populations (National Park Service 1991). Even aged forests that result from stand replacing fires may not produce snags for years (FEIS 2000).

Alternatives C and D could be very beneficial to birds such as the Snowy Egret (*Egretta thula*), American Bittern (*Bataurus lentiginosus*), and Yellow Rail (*Coturnicops noveboracensis*). A healthy marsh system is key to their survival (Illinois Natural Resources 2001). Prescribed fire would create and maintain natural wetlands and also maintaining successional stages necessary for the American Bittern and Yellow Rail.

Based on current knowledge, Alternative C best protects these species in the long-term because that alternative would reduce threats from large scale, high intensity wildland fire and prescribed fire would be used to create favorable habitats, consistent with known ecological conditions required by many listed species.

Group resource managers would complete surveys prior to conducting a prescribed burn to determine the presence or absence of threatened and endangered species. In the event a listed species was present in the treatment area, the U.S. Fish and Wildlife Service would be consulted and a plan formulated to lessen or eliminate any impacts to the protected species.

Although similar surveys would be conducted for management ignited prescribed fires proposed under Alternative D, areas burned by lightning ignited fires that were allowed to burn under controlled conditions often could not be surveyed. As a result, the wildland fire that resulted may adversely impact nesting birds, depending on season and time of year.

Cumulative Impacts: Activities currently underway at Pea Island and Alligator River National Wildlife Refuges to restore habitat for migratory waterfowl and wading birds would complement the actions proposed under Alternatives C and D. Alternatives A and B would reduce the effectiveness of actions taken by the United States Fish and Wildlife Service by reducing over time, the amount of available habitat and by allowing continued accumulation of hazard fuels in areas that could pose a threat to habitats favored by threatened and endangered species.

Methods to Reduce Impacts: A burn unit would be evaluated as part of the planning process to determine the impact, if any, of the proposed management action to listed species. Methods to reduce or limit impacts would be specified in the prescribed burn plan. Marsh burns could be scheduled to avoid nesting birds or dry periods that could possibly injure species which inhabit bogs or other similar wet areas not prone to wildland fire. Management actions could also be planned to avoid sensitive areas needed by piping plovers, sea turtles, and other species for their perpetuation.

Conclusion: Based on existing ecological data, Alternative C would provide the best means of restoring and protecting vegetative communities necessary for the survival of threatened and endangered species, with minimum impact to other important habitats.

Cultural Resources

Short Term Impacts: Under all four alternatives there are no known short-term impacts to cultural sites that could not be resolved using mechanical treatment methods. Examples of mechanical methods include mowing grass near cultural sites that could be damaged by fire, and cutting and removing brush and other woody materials to form a buffer between the structure or site to be protected and the wildland fuels. Currently, structures such as the CCC cabins at Buxton are at risk due to the lack of defensible space. Alternative A would do little to correct the situation. Historic buildings and other structures would be afforded the best protection under Alternative B due to the proactive, large-scale mechanical fuels reduction program in the urban interface.

Under all four alternatives, heat generated by a wildland fire may unavoidably impact exposed materials at archeological sites.

Long Term Impacts: Presently, the grounds around many of the buildings associated with lighthouses and the lighthouses themselves are afforded a great deal of protection by mowing, as are key features at Wright Brothers and Fort Raleigh. However, under Alternative A, houses, outbuildings, and other structures located in heavily wooded areas would be placed at greater risk from high intensity wildfires as heavy accumulations of wildland fuels continue to increase and encroach on a site or structure. Through the manipulation of fuels described in the remaining three alternatives, sites would be safeguarded by removing accumulations of fuel from close proximity to the buildings, thereby reducing the threat of catastrophic wildland fire and enhancing control options.

Cumulative Impacts: Currently little if any fuel management activities are taking place on the park boundaries. Any fuel management actions taken on adjoining private and other public lands may provide additional protection to a park's resources by creating a buffer or reducing fuel accumulations to aid in control efforts.

Methods to Reduce Impacts: The creation and maintenance of defensible space between structures and wildland fuels and making the structures fire safe would greatly enhance the protection of the structures. The concurrence of the State Historic Preservation Officer (SHPO) would be obtained, when appropriate, during the planning phase of a prescribed burn or mechanical fuel reduction project.

Conclusion: The greatest threat to cultural resources is a large-scale, high intensity wildland fire that could lead to the loss of historic structures. Alternatives B, C, and D would reduce the threat to these resources from wildland fires, while Alternative A would contribute to the problem.

Residents and Visitors

Short Term Impacts: Under all four alternatives, residents and visitors may be impacted by low concentrations of smoke and certain areas of a park may be temporarily closed to visitors for safety reasons. Noise and a small amounts of dust may be produced during mechanical thinning operations as proposed under alternatives B, C and D. Alternative D would restrict public use the most and could possibly produce longer smoke events as wildland fires are allowed to burn so long as they remained in prescription. However, due to the low occurrence of lightning ignited wildland fires, little additional impact would be anticipated. If smoke were to become an issue under Alternative D, the fire would be declared a wildfire and suppressed. As the fuels continue to increase under Alternative A, there is an increased likelihood that State Route 12 may have to be closed because of a large wildland fire. Under Alternative A, there is also and increased likelihood of property loss due to wildfire and fuels continue to increase in close proximity to developments. The other three alternatives would reduce that threat.

Long Term Impacts: Alternatives A and B would have little impact on residents and visitor use except for large wildland fire occurrences. During these events, large sections of a park or major roads and highways may have to be closed for extended periods and homes and other improvements would be at ever increasing risk from the destructive forces of a wildfire.

Under Alternative C the continued use of short-term restrictions in various sections of the parks due to prescribed fire activity would continue indefinitely. However, many of these restrictions would involve remote sections of a park that are seldom frequented by visitors. Local residents and visitors may be impacted due to the smoke produced from prescribed fire activities, but their homes and property would be less vulnerable to wildfire.

Impacts identified for Alternative C would be similar for Alternative D. Residents and visitors may be impacted longer when lightning ignited fires are allowed to burn to achieve resource benefit. Certain sections of a park may have to be closed for extended periods.

Cumulative Impacts: In the unlikely event the U.S. Fish and Wildlife Service and the National Park Service were to conduct a prescribed burn on the same day in close proximity to each other, the smoke produced could adversely impact nearby residents and impair visitor enjoyment.

Methods to Reduce Impacts: When it would be necessary to close an area during wildland fire suppression operations and prescribed fire operations in order to provide for visitor protection, all affected trailheads would be signed so that closures would be easily recognized. Measures to be taken to provide for resident and visitor safety, such posting traffic warning signs and public notices, would be identified in the prescribed burn plan. Interpretative programs would be presented in conjunction with other agencies, including the North Carolina Forest Service, when appropriate, to better inform the public of the role of fire in the ecosystem and how fire can be used to accomplish management objectives. The Group will work with adjacent landowners and the Fish and Wildlife Service to coordinate activities so that residents and the visiting public are impacted as little as possible.

Conclusion: Alternative C best protects residents and visitors to the Outer Banks and enhances their quality of life in the long term because the risk of large catastrophic fires is reduced and the natural scene is enhanced to more truly represent conditions that previously existed. The increased use of wildland fire to manage Group resources would provide the Group staff with increased opportunities to explain the role of fire in the ecosystem.

Table 4: Impact Topics and Alternatives Summary Table

Impacts	Alternative A	Alternative B	Alternative C	Alternative D
Soils	Short term: Increased nutrients available on limited basis. Organic matter may be consumed and soil altered at fire site. Potential wholesale loss of litter layer Long term: Increased risk that organic matter may be consumed and soils altered as fuel loads increase. Soil productivity would decrease.	Short term: In addition to those listed for Alt. A, there may be on-site soil disturbance due to mechanical fuel reduction operations. Long term: In addition to those listed for Alt. A, the increased soil disturbance resulting from mechanical fuel reduction may slightly increase the likelihood of soil erosion.	Short term: Increased nutrients available over a larger area. Slight increase in the likelihood of erosion to the foredune due to the temporary loss of ground cover. Incremental duff reduction Long term: Nutrient recycling process would be sped up. Soil protection from the effects of high intensity fires would be increased.	Short term: Same as Alt C. Long term: Because more acres would be treated, the effects described for Alternative C would be increased.
Air Quality	Short term: Very minor short-term impact on visib-ility. Impacts to health limited to fireline. Regional AQ only impacted if large fire. Long term: As fuel loading increases, fires will tend to be larger. More particulate matter will be released, resulting in increased reduced visibility for longer periods of time and increased health risks.	Short term: Same as Alt. A Long term: Same as Alt A.	Short term: Greater short-term impacts due to increas-ed use of fire. Impacts to health and regional air quality would be better managed due to the ability to schedule a prescribed vs. an un-planned wildfire. Long term: The potential for long duration fires would decrease as fuel loading is reduced and fuel breaks constructed Impacts would be lessened due to the ability to schedule prescribed burns. Regional AQ stand-ards would be safe-guarded.	Short term: Greatest short-term impacts due to increased use of fire and fires would burn longer. Long term: Impacts similar to Alternative C. Increased fire use may further reduce fuel loading and reduce the likelihood of large fires by creating fuel natural breaks, etc., reducing the possibility of large scale events.

Table 4: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C	Alternative D
Hydrology	Short term: Possibility of short term contamination from fire retardant. Long term: Increased likelihood of contamination by retardant as fires become larger and managers and local fire suppression authorities are forced to use airtankers to control them.	Short term: Slight possibility that water features could be contaminated by hydrocarbons leaking from mechanical equipment. Long term: Increased likelihood of contamination by retardant as fires become larger and park managers and local authorities are forced to use airtankers to control them. The use of fuel breaks near communities may lessen the need to use airtankers.	Short term: Same impacts as Alternative A. Long term: Proactive use of fire under controlled conditions would reduce loss of ground cover and increase rain absorption. The possibility of impact to water features by retardant would be reduced. Ground water yields could be increased slightly due to less absorption by plants.	Short term: Same impacts as Alternative A. Long term: Results similar to Alternative C would be expected.
Vegetation	Short term: Plants may be injure or killed. Possibility of exotic species becoming established. Certain trees may be more susceptible to disease than under Alternatives C&D. Long term: The vegetation woul become fire-intolerant Ladder fuels would increase. Trees and other woody species more likely to invade cultural landscapes. Structures and improvements would be placed at greater risk from wildfire.	Short term: Plants may be injure or killed by fire. Possibility of exotic species becoming established. Certain trees may be more susceptible to disease than under Alternatives C&D. Long term: The vegetation woul become fire-intolerant in areas not treated. Ladder fuels would increase in areas not treated. Structures and improvements would be better protected from wildland fire.	Short term: Impacts similar to Alternative A would be expected. Accumulations of fuel may increase as a result of top-killing trees and shrubs. Long term: A mosaic of vegitation would be created. Marsh areas would become healthier and more productive. Fire adapted species would be less impacted Stands of pine would be less susceptible to infestations of insects. The possibility of high intensity fires would be reduced. Native grasses would replace brush fields.	Short term: Impacts similar to Alternative C woul be expected. The increased accumulation of fuel would be expected to be higher. Long term: Impacts similar to those identified under Alternative C would be expected.

Table 4: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C	Alternative D
Wildlife	Short term: The lack of fire would benefit existing species. Limited mortality. Loss of food sources and loss of protective cover a possibility. Long term: The decline in habitat diversity will limit the number and type of species. Fire adapted species would be greatly impacted. Existing species such as waterfowl would be impacted as food becomes limited. The numbers of animals and variety of species would be reduced.	Short term: Same as Alt. A Long term: Same as Alt A. The increase in edge effect that is expected to result from thinning operations may provide increased habitat for species requiring it.	Short term: Limited mortality, loss of food sources and loss of protective cover a possibility. Long term: Possibility of competition from new species as habitats change. Wildlife such as waterfowl and wading birds would benefit and increase in numbers. Birds and animals that prey on small mammals would have the possibility of increased food sources. The edge effect and the mosaic created would benefit a wider range of wildlife.	Short term: Limited mortality, loss of food sources and loss of protective cover a possibility. Due to timing of lightning ignitions, fires may impact ground nesting birds. Long term: The effects are expected to be the same as those listed for Alternative C.
Threatened & Endangered Species	Short term: Very little potential for impact to T&E species. Long term: The habitat known to be favored by certain species would be further impacted. As a result, a listed species may be lost. Severe fires may destroy seed sources and damage rhizomes	Short term: Same as Alt. A Long term: Same as Alt A.	Short term: Very little potential for impact to T&E species. Long term: Sensitive habitats would be protected from high intensity fires. Habitats preferred by fire adapted species or species requiring a certain habitat would be perpetuated, increasing the possibility that a listed species would recover.	Short term: Very little potential for impact to T&E species. Long term: The effects are expected to be the same as those listed for Alternative C.

Table 4: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C	Alternative D
Cultural Resources	Short term: There are no known short term impacts. Long term: Historic structures would be at greater risk from wildland fire.	Short term: There are no know short term impacts. Long term: Historic structures would be better protected from wildland fire.	Short term: There are no known short term impacts. Long term: Historic structures would be better protected from wildland fire through fuel management. Cultural landscapes would be perpetuated in a cost efficient manner. The possibility of cultural values being damaged by suppression actions would be reduced.	Short term: There are no known short term impacts. Because lightning ignited fires would burn in areas that have not been surveyed, a fire may impact a previously unrecorded site. Long term: The effects are expected to be the same as those listed for Alternative C.
Residents & Visitor Use	Short term: Residents and visitors may be impacted by smoke in the immediate vicinity of a wildfire. There may be temporary closures. Long term: The extent of the closures may be longer and more widespread during large fire events. Homes and property would be at greater risk from wildfire.	Short term: Residents and visitors may be impacted by smoke in the immediate vicinity of a wildfire There may be temporary closures. Long term: The extent of the closures may be longer during large wildland fire events. Residents and visitors are better protected due to the construction of fuel breaks between wildland fuels and structures.	Short term: Residents and visitors may be impacted by smoke in the immediate vicinity of a wildfire. There may be temporary closures. More individuals may be impacted as a result of the prescribed fire operations. Long term: The short-term closures would continue indefinitely. Increased opportunity to explain role of fire in the ecosystem. Residents and visitors are even better protected due to the construction of fuel breaks between wildland fuels and structures and the management of wildland fuels.	Short term: Visitors may be impacted by smoke in the immediate vicinity of a wildfire. There may be temporary closures. The closures may be longer under this alternative. Long term: The short-term closures would continue indefinitely. The closures may be longer when lightning ignites fires are allowed to burn. Increased opportunity to explain role of fire in the ecosystem. Residents and visitors better protected as in Alternative C.

VII. CONSULTATION AND COODINATION

The Draft Fire Management Plan and associated Environmental Assessment from Colorado National Monument were used in the development of this plan. These two documents were prepared by a working group to serve as a guide for small to medium sized parks that do not have a heavy wildland fire load. The draft Fire Management Plan and associated Environmental Assessment for Big South Fork National River and Recreation Area were consulted to provide guidance.

Under the provisions of the Endangered Species Act of 1973, as amended, the Service must work with other federal and state agencies to protect, conserve and enhance the continued existence of any endangered species or threatened species. Any actions that may impact these species are subject to review by the U.S. Fish and Wildlife Service. A copy of this document will be made available to the U.S. Fish and Wildlife Service for consultation under Section 7 of the Endangered Species Act.

The National Historic Preservation Act, as amended in 1992 (16 USC 470 *et seq.*); the National Environmental Policy Act; the NPS Cultural Resource Management Guideline (1994), and NPS Management Policies (2001) require the consideration of impacts on cultural resources listed, or eligible for listing, on the National Register of Historic Places. The actions described in this document are also subject to Section 106 of the National Historic Preservation Act, under the terms of the 1995 Programmatic Agreement among the NPS, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. Impacts to cultural resources therefore have been analyzed and will be reviewed in accordance with applicable laws, policies and agreements.

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APPENDIX A: GLOSSARY OF TERMS

Appropriate Management Response: Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

BI - Burning Index: A number related to the contribution that fire behavior makes to the amount or effort needed to contain a fire in a particular fuel type within a rating area. An Index for describing Fire Danger.

Catastrophic Wildfire: A large scale, high-intensity wildland fire that could result in high plant mortality, removal of the majority of ground cover over a large area, possibly damage or destroy structures and other property, and/or severely impact water and air quality.

Closed Area: An area in which specified activities or entry are temporarily restricted to provide for to public safety or to reduce risk of human-caused fires.

Closure: Legal restriction, but not necessarily elimination of specified activities such as smoking, camping, or entry that might cause fires in a given location.

Confine: Confinement is the strategy employed in appropriate management responses where a fire perimeter is managed by a combination of direct and indirect actions and use of natural topographic features, fuel, and weather factors.

Ecosystem: An interacting system of interdependent organisms.

Expected Weather Conditions: Weather conditions indicated as common, likely, or highly probable based on current and expected trends when compared to historical weather records.

Experienced Severe Weather Conditions: The most severe, though infrequent, weather conditions that have been observed on the fire site area during the period weather records have been kept. These conditions can be used in making fire behavior forecasts for different scenarios.

Fire Effects: The physical, biological, and ecological impacts of fire on the environment.

Fire Management: Activities required for the protection of burnable wildland values from fire and the use of prescribed fire to meet land management objectives.

Fire Management Plan (FMP): A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

Fire Management Unit (FMU): Any land management area definable by objectives, topographic features, access, values-to-be-protected, political boundaries, fuel types, or major fire regimes, etc., that set it apart from management characteristics of an adjacent unit. FMU's are delineated in FMP's. These units may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives.

Fire Regime: A combination of fire frequency, fire timing and fire behavior characteristics operating in an ecological system.

Fire Retardant: Any substance except plain water that by chemical or physical action reduces flammability of fuels or slows their rate of combustion.

Fire Use: The combination of wildland fire use and prescribed fire applications to meet resource objectives.

Fuel Complex: Combinations of material that burn in a fire including organic soils, duff, litter, grass, dead branch wood, snags, logs, stumps, brush and to a limited degree, live tree foliage. Thirteen standard fuel models have been developed and are used to predict fire behavior within fuel complexes.

Fuel Loading: The amount of dead fuel present on a particular site at a given time; the percentage of fuel available for combustion changes with the season.

Hazard: A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition and resistance to control.

Hazardous fuels: See Hazard.

Hazard Fuel Reduction: **Any treatment of living and dead fuels that reduces the threat of ignition and spread of fire.**

Heavy fuels: **Fuels of large diameter such as snags, logs, large limbwood, which ignite and are consumed more slowly that flash fuels.**

Initial Attack: An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Mitigation Actions: Actions taken by Park officials to reduce the severity of a wildland fire.

National Wildfire Coordinating Group (NWCG): A group formed under the direction of the Secretaries of Interior and Agriculture to improve the coordination and effectiveness of wildland fire activities, and provide a forum to discuss, recommend appropriate action, or resolve issues and problems of substantive nature.

Natural Fires: Fires resulting from lightning or other forms of natural ignitions.

Preparedness: Activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination.

Prescribed Fire: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

Prescribed Fire Plan: A plan required for each fire application ignited by managers. It must be prepared by qualified personnel and approved by the appropriate agency administrator prior to implementation. Each plan will follow specific agency direction and must include critical elements described in agency manuals.

Prescription: Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economical, public health, environmental, geographic, administrative, social, or legal considerations.

Wildfire: An unwanted wildland fire.

Wildland Fire: any nonstructural fire, other than prescribed fire, that occurs in the wildland. *This term encompasses fires previously called both wildfires and prescribed natural fires.*

Wildland Fire Management Program: The full range of activities and functions necessary for planning, preparedness, emergency suppression operations, and emergency rehabilitation of wildland fires, and prescribed fire operations, including fuels management to reduce risks to public safety and to restore and sustain ecosystem health.

Wildland Fire Situation Analysis (WFSA): A decision making process that evaluates alternative management strategies against selected safety, environmental, social, economic, political, and resource management objectives.

Wildland Fire Suppression: An appropriate management response to wildland fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire.

Wildland Fire Use: The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outline in FMP's.

Wildland – Urban Interface: The location where homes and other structures are co-mingled with wildland fuel complexes.

APPENDIX B: PROPOSED TREATMENT AREAS

Park or Location	Type of Treatment	Acres	Description
Wright Brothers	Mechanical	17	100' buffer between park and subdivision on NW corner and on West boundary.
Fort Raleigh	Mechanical	3	Increase defensible space in employee housing area, near maintenance area, around Fort and Elizabethan Gardens and nursery facilities, and around HQ buildings
Fort Raleigh	Mechanical	10	100' buffer and subdivision on NW side.
CAHA - Bodie	Mechanical	1	Clear around antennae site.
CAHA - Hatteras	Mechanical	5	Improve Buxton Woods fire road to Open Pond
CAHA - Hatteras	Mechanical	53	100' buffer between seashore and Buxton.
CAHA- Ocracoke	Mechanical	3	Maintain and improve existing fuel break on SW side of town.
Fort Raleigh	Prescribed burning	2	Remove heavy accumulations of dead and decant marsh vegetation in SW area of the park.
Wright Brothers	Prescribed burning	1	Islands of pine between runway and Kill Devil Hill.
South Nags Head	Prescribed burning	665	Interface between Route 12 and community (Power line ROW)
Bodie Lighthouse	Prescribed burning	25	Demonstration burn between lighthouse and antennae site.
South Frisco	Prescribed burning	29	Control cedar encroachment at Salvo DUA and create a buffer between Salvo and seashore.
CAHA- Ocracoke	Prescribed burning	100	Burn brush fields to stimulate grass production.
CAHA- Ocracoke	Prescribed burning	500	Burn brush fields to stimulate grass production.

The locations of the two units on Ocracoke Island are yet to be determined.

APPENDIX C: SELECTED SPECIES AND THEIR RELATIONSHIPS TO FIRE

Table 1: Vegetative Species Common to the Outer Banks Group and Their Relationship to Fire

Common Name	Scientific Name	Habitat	Fire and Disturbance Related Comments
Red maple	Acer rubrum	Moist sites and floodplains	Fire intolerant Has the ability to resprout Common on burnt lands
Swamp dogwood	Cornus stricta	Moist sites and floodplains	Not listed in available literature. Flowering dogwood (*Cornus florida*) is well adapted to periodic fire.
American holly	Ilex opaca	Shortleaf pine Oak-Hickory	Very susceptible to fire. May resprout from root crown
Yaupon	Ilex vomitoria	Longleaf - slash pine Loblolly - shortleaf pine	Is only moderately well adapted to fire. Presumably, it survives fire by sprouting from the root crown.
Eastern red cedar	Juniperus virginiana	Loblolly - shortleaf pine Oak - pine Grassland	Eastern red cedar was historically restricted to sites that were protected from fire. In many areas it has been vigorously encroaching into grasslands since the 1920's.
Southern bayberry	Myrica cerifera	Loblolly - shortleaf pine Savanna and Wet grasslands	Is a fire survivor. Its root collar survives fire and it regenerates by basal sprouting
Loblolly pine	Pinus taeda	Loblolly - shortleaf pine	Considered fire resistant. Mature loblolly pine survives low- to moderate-severity fires because of relatively thick bark and tall crowns. Young pines become resistant to low-severity fire by age 10.

Table 1: Vegetative Species Common to the Outer Banks Group and Their Relationship to Fire (Cont.)

Common Name	Scientific Name	Habitat	Fire and Disturbance Related Comments
Live oak	Quercus virginiana	Oak - pine	Has thin bark and is readily top-killed by fire. This species has two primary means of surviving fire: (1) Root crowns and roots survive fire and sprout vigorously, and (2) live oak forests discourage entry of fire from adjacent communities
Laurel oak	Quercus laurifolia	Oak - pine	Is fire intolerant. It is frequently top-killed by even low-severity surface fires.
Beech	Fagus grandifolia	Oak-Hickory Shortleaf pine	Fire intolerant. Will resprout after fire.
Poison ivy	Toxicodendron radicans	Widespread	Poison-ivy is a component of many fire-influenced communities. Rhizomes buried moderately deep in the soil would survive most fires. Sprouting after fire indicates that poison-ivy is adapted to moderately severe fires.
Greenbrier	Smilax spp.	Oak-pine Maple-beech	Common greenbrier resists fire by sprouting from rhizomes. Canopy openings caused by fire may favor common greenbrier.
Black needlerush (Black rush)	Juncus roemerianus	Wet grasslands	Black rush survives fire by sending up new growth from surviving underground rhizomes after aboveground plant portions have been consumed.

Table 1: Vegetative Species Common to the Outer Banks Group and Their Relationship to Fire (Cont.)

Common Name	Scientific Name	Habitat	Fire and Disturbance Related Comments
Saltmeadow cordgrass	Spartina patens	Wet grasslands	Saltmeadow cordgrass is adapted to light fires and resprouts from rhizomes .
Sea oats	Uniola paniculata	Sandy areas Wet grasslands	Sea oats culms are probably killed by fire. It probably sprouts from rhizomes after aerial portions are burned.

Source: USDA Forest Service. 1998. Fire Effects Information System. Rocky Mountain Research Station – Fire Sciences Lab. Missoula, Montana

Table 2: Selected Animal Species Common and Their Relationship to Fire

Common Name	Scientific Name	Fire and Disturbance Related Comments
Voles	Microtus spp.	It appears likely that mortality rates are affected by season and timing of fire, fire intensity, and rate of fire spread.
Mink	Mustela spp.	There are no reports of direct mortality of mink due to fire. Because mink are highly mobile, semi-aquatic animals and often den underground, it seems unlikely that fire-caused mortality is ever substantial.
White-tail deer	Odocoileus virginianus	Benefit through improved habitat and improved nutritional quality of forage
Muskrat	Ondatra zibethicus	Muskrats can be killed by fire either through direct mortality or complete kill of food and cover.
Raccoon	Procyon lotor	Are very mobile and probably escape most fires.
Snow Goose	Chen caerulescens	Snow geese are attracted to freshly burned ground.
Tundra Swan	Cygnus columbianus	No specific information was found in the literature regarding the direct effects of fire on tundra swans. However, adult non-molting tundra swans can probably easily escape fire.
Bald Eagle	Haliaeetus leucocephalus	Bald eagles have continued nesting during wildfire and returned to the nest the following year.
Peregrine Falcon	Falco peregrinus	Other than nesting disturbance, no other direct fire effects on peregrine falcon have been noted.

Source: USDA Forest Service. 1998. Fire Effects Information System. Rocky Mountain Research Station – Fire Sciences Lab. Missoula, Montana

APPENDIX D: FEDERAL AND STATE LISTED SPECIES

A Listing of Federal and State Protected Species Occurring in the Outer Banks Group as of September 1, 2000

Compiled by
North Carolina Heritage Program
North Carolina Division of Parks and Recreation
Department of Environment, Health, and Natural Resources

Table 1: Plants

Scientific Name	Common Name	State Status	Federal Status
Amaranthus pumilus	Seabeach Amaranth	T	T
Hudsonia tomentosa	Wooly Beach Heather	SR	
Lilaeopsis carolinensis	Carolina Grasswort	T	
Ludwigia alata	Winged Seedbox	SR	
Trichostema sp 1	Dune Bluecurls	C	SC

Note: NC Heritage Program uses a database developed and maintained by The Nature Conservancy

State Codes:
E Endangered
T Threatened
SR Significantly Rare
C Candidate

Plant status are determined by the Plant Conservation Program and the Natural Heritage Program. E, T, and SC species are protected by state law. C and SR designations indicate rarity and the need for population monitoring and conservation action.

Federal Codes:
E Endangered
T Threatened
P Proposed
C Candidate
SC Species of Concern

Table 2: Animals

Scientific Name	Common Name	State Status	Federal Status
Condylura cristata pop 1	Star-nosed mole – Coastal Plain	SC	
Peromyscus leucopus easti	Pungo White-footed Mouse	SR	
Bataurus lentiginosus	American Bittern	SR	
Charadrius melodus	Piping Plover	T	T
Charadrius wilsonia	Wilson's Plover	SR	
Circus cyaneus	Northern Harrier	SR	
Coturnicops noveboracensis	Yellow Rail	SR	
Egretta caerulea	Little Blue Heron	SC	
Egretta thula	Snowy Egret	SC	
Egretta tricolor	Tricolored Heron	SC	
Falco peregrinus	Peregrine Falcon	E	
Haliaeetus leucocephalus	Bald Eagle	E	
Laterallus jamaicensis	Black Rail	SR	SC
Pelecanus occidentalis	Brown Pelican	SC	
Plegadis falcinellus	Glossy Ibis	SC	
Rynchops niger	Black Skimmer	SC	
Sterna antillarum	Least Tern	SR	
Sterna caspia	Caspian Tern	SR	
Sterna dougallii	Roseate Tern	E	E
Sterna hirundo	Common Tern	SR	
Sterna nilotica	Gull-billed Tern	T	
Alligator mississippiensis	American Alligator	T	T(S/A)
Caretta caretta	Loggerhead Sea Turtle	T	T
Chelonia mydas	Green Sea Turtle	T	T
Dermochelys coriacea	Leatherback Sea Turtle	E	E
Malaclemys terrapin	Northern Diamondback Terrapin	SC	SC
Nerodia sipedon williamengelsi	Carolina Salt Marsh Snake	SC	
Papilio cresphontes	Giant Swallowtail	SR	

Note: NC Heritage Program uses a database developed and maintained by The Nature Conservancy

State Codes:
E Endangered
T Threatened
SR Significantly Rare
C Candidate

Animal status are determined by the Plant Conservation Program and the Natural Heritage Program. E, T, and SC species are protected by state law. C and SR designations indicate rarity and the need for population monitoring and conservation action.

Federal Codes:
E Endangered
T Threatened
P Proposed
C Candidate
SC Species of Concern

T(S/A) This species is no longer biologically endangered or threatened and is not subject to Section 7 consultation.