United States Department of the Interior
National Park Service

Assateague Island National Seashore

Environmental Assessment of

Alternatives for Managing the Feral Horses of

Assateague Island National Seashore

May 2008

Table of Contents

List of Figures

List of Tables

Chapter 1 – Purpose of and Need for the Proposed Action

1.1 Purpose of and Need for the Proposed Action

Assateague Island National Seashore (ASIS) has prepared this Environmental Assessment (EA) to analyze alternatives relating to future management of the feral horse *(Equus caballus)* population inhabiting the Maryland portion of Assateague Island. It is the goal of the National Park Service (NPS) to manage the feral horses in a manner that protects both the long-term health and viability of the population as well as that of the barrier island ecosystem that supports them.

The 1982 General Management Plan for ASIS identified the horses as a "desirable feral species" and while recognizing the importance of the horses to the Assateague experience, identified the need for appropriate management. In 1985, a Feral Pony Management Plan was developed to address these concerns and guide long-term management of the population. The Plan identified the need for continued research into the effects of feral horse grazing and methods of controlling population growth, and recommended that the herd be managed to not exceed 150 horses.

During the intervening years when the population reached a peak of 175, the NPS continued to collect a large body of information about the feral horses and their effects on the Assateague environment. Scientific studies have found that the horses disrupt native plant and animal communities, harm rare species, and impede natural processes essential to maintaining a healthy barrier island ecosystem. Collectively, the results indicate that the recommended limit of 150 horses has failed to protect the other natural resources and values of Assateague Island.

The current population size of approximately 140 horses is the product of intensive efforts to control herd growth through the use of contraceptives. Since 1994, the NPS has treated the majority of the female population on an annual basis. The program has proven to be highly successful in controlling reproductive rates and reducing the size of the population, but island resources continue to be impacted by the feral horses at levels that might potentially result in loss of ecological integrity. It has also become clear that the intensive use of contraceptives is not without consequences. Extended use of contraceptives at the intensity needed to reduce the size of the herd has altered the age structure of the horse population, thereby reducing its reproductive capacity and potentially increasing the risks from demographic and genetic factors.

To help address existing conflicts between protection of the feral horse population and the ecological viability, stability, and integrity of Assateague Island, the NPS engaged the Conservation Breeding Specialist Group (CBSG) to conduct a Feral Horse Population and Habitat Viability Assessment (PHVA) (Zimmerman et al. 2006). The results of the PHVA showed that a feral horse population maintained in the range of 80-100 would best meet the goal of sustaining both herd and ecosystem health.

The NPS is faced with developing a combination of management strategies to achieve the recommended target range in order to reduce the harmful effects of a too-large feral horse population. This Environmental Assessment evaluates the environmental consequences of several alternatives for long-term management of feral horses within ASIS and seeks to achieve an appropriate balance that protects both the feral horses and the barrier island ecosystem. Potential outcomes of this process include actions to reduce the size of the population, manage reproductive rates, reduce negative human-horse interactions, and enhance the health and viability of the herd, as well as the natural system upon which it depends.

Assateague Island is also inhabited by two other large herbivores, the native white-tailed deer (*Odocoileus virginianus*) and the non-native sika deer (*Cervus nippon*). Similar to the feral horses, both species are known to exert considerable influence on plant communities, vegetation succession, and overall ecosystem conditions. At present, deer are being managed to maintain stable populations through a congressionally-authorized public hunting program. There is some potential that should the horse population be reduced through implementation of one of the action alternatives proposed in this EA, that deer populations could increase. The NPS is, however, engaged in research to better understand the relative effects of deer on island resources and to identify potential new management strategies. Any future changes in deer management will be proposed in a subsequent NEPA document.

This EA has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and its implementing regulations (40 CFR Parts 1500-1508), and is intended to analyze the management alternatives (the No-Action Alternative and other reasonable alternatives), as appropriate, and their impacts on the environment. The EA has also been prepared in accordance with the National Park Service's Director's Order #12 and Handbook, *Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2001a, b); NPS *Management Policies* (NPS 2006b).

OBJECTIVES IN TAKING ACTION

The following objectives were used in developing the range of management alternatives evaluated in this EA:

- Adopt a new herd size goal that improves barrier island health, ecosystem function and biodiversity while protecting feral horse population health.
- Protect the long-term health and viability of the feral horse population.
- Protect the free-roaming nature, and social and behavioral character of the feral horses.
- Develop and implement an appropriate strategy for reducing the size of the herd that is efficient and humane, that minimizes the duration and intensity of feral horse impacts, which safeguards the welfare of affected feral horses, and allows ASIS to achieve its mission.

1.2 History and Significance of ASIS

Long a favorite locale for fishing and hunting among regional residents, Assateague Island first came to national attention for such recreational pursuits in 1934. At that time, in an effort to bring the NPS to the east coast and protect remaining public shorelines from development, the NPS surveyed lands along the Atlantic and Gulf coasts to identify those areas that they could potentially acquire and administer as national seashore recreational areas, thus allowing creation of new recreational opportunities within the NPS. Based on its natural qualities, recreational values, and proximity to major populations, Assateague Island and the adjacent mainland comprised 1 of 12 areas found to qualify as a national seashore recreational area. Although several legislative bills were introduced in Congress in the 1940s, no action was taken to establish the national park.

Further study in 1955 concluded that the area seemed an unlikely candidate for a national seashore recreational area because of increased private development on Assateague Island, and was therefore not recommended at that time. Almost a decade later, in March 1962, a northeastern storm inundated much of the island, and called into question the wisdom of private development on such an unprotected property. The Secretary of the Interior and the governor of Maryland agreed to a joint study of the area to determine its best use. Major factors listed by the Department of the Interior as rationale for creating the national seashore included a growing demand for seashore recreation, the infeasibility of private development on the island, and economic benefits to the local two-county economy.

On September 21, 1965, Public Law 89-195 established Assateague Island National Seashore as a unit of the National Park System to protect the natural resources and recreational values of Assateague Island and adjacent coastal waters. The authorized boundary includes approximately 48,700 acres of land and water in Maryland and Virginia. Of this, 8,400 acres in Virginia are managed as Chincoteague National Wildlife Refuge, and 600 acres are managed as Assateague State Park in Maryland. The mission of the National Seashore is to preserve the unique coastal resources of Assateague Island and the natural ecosystem conditions and processes upon which they depend, while providing high quality resource-based recreational and educational opportunities.

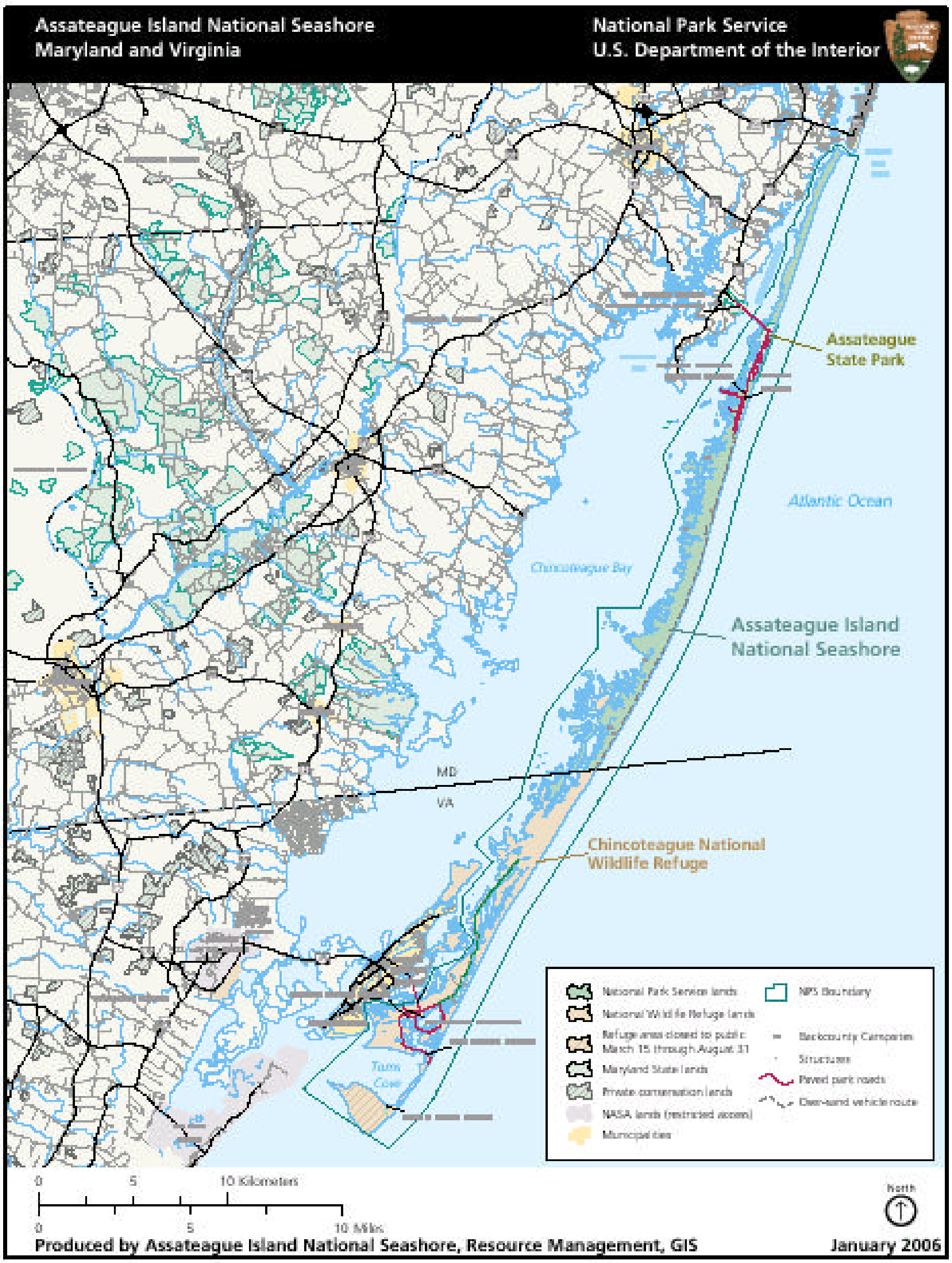
Today, Assateague Island National Seashore is nationally significant because it:

- is part of a natural system with geologic processes unique to barrier islands, characterized by constant change both seasonally and daily, subtle and dramatic.
- is one of the last surviving undeveloped shorelines along the east coast of the United States. Assateague's 37 miles of barrier beach and bay are a remnant of a natural continuum of islands that once stretched from Cape Cod to Mexico.
- is characteristic of the ecological habitats normally associated with barrier island systems including ocean, beach, dunes, maritime forest, inlets, salt marshes and bays.
- is a permanent and temporary home to a great diversity of land and aquatic life, including rare species that depend on the unique habitats that result from the overlap of northern and southern habitat zones and the confluence of estuarine and ocean waters.
- is a critical natural landform in the path of the Atlantic Flyway serving as a major stopover for migratory birds.
- is one of the few publicly accessible places along the developed East Coast where visitors can experience unimpaired seashore values such as clean ocean water and beaches, undeveloped bay and marshlands, natural sounds, quiet, solitude, natural viewsheds and night skies.
- is a premier outdoor recreational and educational resource offering outstanding opportunities for hiking, camping, nature study, beach combing, fishing, hunting,

shellfishing, swimming, birding, biking, picnicking, recreational off-road vehicle (ORV) use, as well as many other leisure and educational activities.

- o is home to the Assateague feral horses made famous by the book "Misty of Chincoteague" and provides a unique opportunity to view free-roaming horses in a natural barrier island setting.

Figure 1.1 Location of Assateague Island National Seashore



1.3 Project Background

Historical documents refer to the presence of horses on Assateague Island since the late 1600's. Early residents of the region used the island to graze horses and other livestock, with periodic roundups or “pennings” held to determine ownership, and to count and sell stock. Although the familiar legends of ponies escaping from a wrecked Spanish ship persist, they appear to have little basis in fact.

In the 1920's, pony penning on Assateague Island was formalized as a means of supporting the volunteer fire company on adjacent Chincoteague Island. With the establishment of Chincoteague National Wildlife Refuge (CNWR) on the Virginia portion of Assateague in 1943, ownership of the feral horses officially passed to the Chincoteague Volunteer Fire Department. Since then, the Fire Department has continued to graze that herd on the southern portion of Assateague through a special use permit granted by the U.S. Fish and Wildlife Service.

When the National Seashore was established in 1965, most of the horses had been removed from the Maryland portion of Assateague and confined to CNWR by a fence on the northern reaches of the refuge. The exception was a small, free-ranging herd belonging to a Maryland landowner who had purchased 9 “Chincoteague ponies” for private enjoyment in 1961. In 1968, the NPS acquired legal ownership of those horses and their offspring. At that point, the horse population inhabiting the Maryland portion of the Island numbered approximately 28.

The Park’*s 1982 General Management Plan* recognized the importance of the horses and directed that the horses be managed as a “desirable feral species” within the overall purposes of the National Seashore. As the population expanded during the 1970s and 1980s, park managers began to observe increasing evidence of resource damage caused by the feral horses. Recognizing the need for some form of population control, the park initiated research in 1985 to develop and test contraceptives. The result of that effort, a contraceptive vaccine, has been used to manage the population since 1994.

Sensitive habitats and species have been monitored to assess the effects of feral horses on biological and ecological parameters. Past and present efforts include: monitoring of low salt marsh vegetation communities to evaluate the long-term effects of feral horse grazing on aboveground primary productivity and species composition; monitoring of piping plover and seabeach amaranth to document the effects of feral horses on rare species distribution, abundance and status; assessing the effects of feral horse grazing in forested and shrub habitats, and; monitoring geomorphological change to understand the effects of grazing on dune vegetation and physical processes. Other monitoring and assessment activities have occurred on an intermittent basis, such as surveys to re-evaluate previously assessed species or habitat parameters.

The NPS also monitors the status and trends of the feral horse population to guide management activities and assess herd health. The NPS monitors birth and mortality rates, contraception success, behavior, harem band associations, home range and seasonal activity patterns, habitat utilization, and human-horse interactions. Other information gathering activities are conducted on a non-recurring basis, such as genetic analyses or other research focusing on the feral horses.

1.4 Relevant Plans, Projects and Studies

The following plans, operational protocols, and relevant studies have informed and provided direction for the development and design of alternatives and the analysis of impacts in this EA. For additional vegetation and horse related studies see the annotated bibliography in Appendix C.

NPS Plans and Assessments

The 1982 **General Management Plan** (GMP) for ASIS is the park's primary guidance document and reflects a systematic approach to management whereby recreational use and development is balanced with the need to ensure long-term preservation of natural resources and values. The plan characterized the feral horses of ASIS as a "desirable feral species" and directed that a management plan be developed to thoroughly evaluate all feasible management alternatives based on past scientific studies (NPS 1982).

The 1985 **Feral Pony Management Plan** recommended a population limit of 150 based upon the research results of Keiper and Zervanos (1979) and estimated that this limit would be reached in 1987 (NPS 1985). The Plan also recommended investigation into the use of contraceptives and that, when feasible, population control measures be implemented and applied as necessary to maintain the herd at or near the desired number. The management plan determined that periodic monitoring of environmental impacts would be conducted to determine the short-and long-term effects of the feral horse population at the 150 level.

In 1995, the NPS developed an **Environmental Assessment** to evaluate alternatives for managing the size of the feral horse population because at that time the herd had exceeded the 150 horse limit (NPS 1995). The subsequent FONSI signed on February 24, 1995, supplemented the 1985 Feral Pony Management Plan and launched the immunocontraceptive program that is being used today. The EA proposed that contraception would be used to maintain a relatively stable population of around 150 horses.

The ASIS **Resource Management Plan** describes broad strategies that are used to protect and manage the park's natural and cultural resources in a manner that complies with the spirit and intent of the enabling and regulatory legislation and the provisions of the GMP (NPS 1999). The plan describes the negative effects of a growing feral horse herd on island resources and natural processes and identifies the need to manage the population at a size that both protects the horses and minimizes their impacts.

The ASIS **Long Range Interpretive Plan** presents strategies and actions that work toward achievement of the park's education and interpretive goals (NPS 2002a). The plan includes several actions that mainstream interpretation of resource management issues and ensures that a variety of audiences, not just those who come to a visitor center, are introduced to topics of importance. In particular, this plan identified that the Park should develop strategies to more effectively communicate with visitors about interactions with feral horses and other wildlife, and also recognized that the Park needs to do more to connect visitors to the values of wildness and the uniqueness of the ASIS feral horses.

The **Population and Habitat Viability Analysis (PHVA)** report presents the results of two workshops in which stakeholders and the NPS analyzed the interrelated and opposing goals of balancing ecosystem and feral horse population health (Zimmerman et al. 2006). For the workshops, ASIS enlisted the expertise of the Conservation Breeding Specialist Group (CBSG) of the IUCN-World Conservation Union, who has conducted over 200 species conservation planning workshops for 165 species in 70 countries, and possesses a unique combination of knowledge-based facilitation skills and experience in workshop organization and quantitative methods of wildlife population risk assessment. This effort resulted in important information and findings, and identified an optimum feral horse population size of 80-100, as well as several potential management strategies to consider in future feral horse management. The PHVA report serves as a pre-planning document and is advisory to the NPS for consideration in their development of a management strategy for feral horses on the Maryland portion of Assateague Island. This document deals only with the Maryland horse population and is not related to the management of the horses in Virginia.

Operational Protocols

The feral horse population on ASIS is managed, in general, as a wildlife resource. This includes maintaining the natural processes and events which act on the feral horses, both individually and collectively. Naturally occurring injuries, disease, and death are important factors driving the process of natural selection, and ultimately contribute to the overall health and vigor of Assateague's feral horse population. Barring special circumstances, the NPS does not interfere with natural processes and events. Except for documentation of an incident, no action is taken to treat sick or injured feral horses, with certain exceptions as described below.

The **Response Protocol for Field Personnel for Dealing with Sick, Dead and Injured Horses** describes the circumstances which dictate exception to the general policy of maintaining natural processes and these fall into three categories: 1) incidents where feral horses have been adversely affected by humans or human activities; 2) incidents where a sick, injured, or dead feral horse occurs in a developed area or highly visible portion of a natural zone and presents an unaesthetic situation; and 3) incidents where a sick or injured feral horse presents a public health threat (NPS 2003b). Examples include human caused injury from an automobile collision, a feral horse becoming terminally ill in the campground, or a feral horse infected with rabies. In these exceptions, the feral horses are humanely euthanized.

On Assateague, interactions between feral horses and humans result from both the feral horse's curious nature and the propensity for people to, intentionally or through neglect, interact with them. Most interactions involve the availability of human foods. The extent to which a feral horse is conditioned to humans and their food can influence its behavior and the level of management needed to offset the interaction with people. The Park has developed a **Response Protocol for Field Personnel for Dealing with Problem Horses** (NPS 2003a) that describes the major interactions between feral horses and people, levels of habituation, and management recommendations to reduce inappropriate contacts between the two groups. The goal of the protocol is to minimize opportunities that could result in horses developing problematic behaviors that result in human injury or excessive property damage. Some of the behaviors seen in past problem feral horses include: biting visitors or their clothing if the visitor is carrying bags or eating food, pushing people out of the way to get at food or containers, and refusing to move from a food location (e.g., tent, picnic table).

To help address the persistent and growing problem of roadside and campground feeding and petting of the feral horses, the **Volunteer Pony Patrol** was established in 1991. Its main focus is education (NPS 2005). Regular feeding and petting created "pony jams" when visitors stopped their vehicles in the roads for horses, and lax food storage in the campgrounds resulted in destruction of property as horses learned to tear through both screen and sleeping tents to get at food. As more feral horses lost their natural wariness and became habituated to the presence of humans, they were becoming very aggressive in seeking food from visitors, and were more likely to bite or kick when demanding food. Even when food was not involved, biting and kicking were more likely to occur simply because these feral horses were allowing visitors to approach and touch them. Although the Pony Patrol has improved conditions, all of these problems still exist, especially during the summer months when two-thirds of the feral horse population migrate into the developed area at the same time that park visitation is highest. Helping visitors understand that feeding and petting teaches the feral horses behavior patterns that ultimately endanger them can be the deciding factor in convincing visitors to keep their distance and respect the feral horses' wildness.

1.5 Public Involvement and Scoping

In an effort to solicit and consider public and stakeholder concerns and issues, a scoping process was developed that included meetings, consultations, and correspondences with both interested parties and agencies and the general public. Consultations and correspondences with potentially affected parties and resource agencies included:

- Maryland Department of Natural Resources - Assateague State Park (MD DNR ASP)
- Maryland Department of Natural Resources – Wildlife and Heritage Service
- Maryland Department of Natural Resources – Public Lands Policy and Planning
- Maryland Coastal Bays Program (MCBP)
- Assateague Coastal Trust (ACT)
- Assateague Mobile Sportfishermen Association (AMSA)
- Chincoteague National Wildlife Refuge (CNWR)
- Cape Lookout National Seashore
- U.S. Fish and Wildlife Service (USFWS)
- Bureau of Land Management (BLM), National Wild Horse and Burro Program
- Humane Society of the United States (HSUS)
- American Horse Protection Association
- IUCN/SCC Conservation Breeding Specialist Group (CBSG)
- Science and Conservation Center - Zoo Montana
- Wildlife Conservation Society

An informational scoping packet was sent to 65 contacts on the NPS's mailing list of individuals and groups known to be interested in horse management. Press releases were sent to 12 news agencies and related articles appeared in newspapers around the country. A meeting announcement and background materials were posted on the NPS Planning Environment and Public Comment (PEPC) website for public distribution on November 1, 2006. A public open house meeting to solicit input and identify the issues and concerns that should be considered in developing this document was held at the ASIS Barrier Island Visitor Center located at the northern entrance to the Seashore in Maryland on Wednesday, December 6, 2006 from 6:00-8:00 PM. Display boards presented information on the resources and issues, and NPS staff were on hand to answer questions and discuss a variety of issues regarding horse health and viability, island natural resources, visitor satisfaction and other topics of concern. Participants were encouraged to sign in and offer their comments on the forms provided. Additionally, the public used regular mail and the internet to email questions and comments.

The public scoping period lasted for 45 days (November 1 – December 15, 2006) and resulted in forty-one (41) written comments. The most common comment (12) expressed a desire to adopt a feral horse and suggested NPS hold annual auctions to sell foals similar to the pony penning in Chincoteague, Virginia. Comments regarding removal of feral horses included concerns of considering blood lines, genetics, and keeping removed feral horses in bands (7); concern that NPS not remove too many feral horses so that the health of the herd is compromised (4); sanctuary suggestions (9); and removal of all feral horses because of barrier island health (1). Comments regarding reducing the herd were broad and ranged from not supporting feral horse management at all (9); support for herd reduction because of damage to the barrier island health (3); to expressing a higher target population range of 100-120 feral horses (1). Comments regarding inhibiting reproduction included suggestions to geld stallions or to fence off mares from stallions (3). One comment suggested artificial enhancement of park resources and supplemental feeding of the herd, while other comments requested that the feral horses not be harmed or killed (4).

1.6 Impact Topics

Impact topics are issues or resources of concern that could be affected, either beneficially or adversely, by the range of management alternatives. Relevant impact topics were identified based upon federal laws, regulations and policies, from NPS knowledge of the resources present within the affected area, and through external scoping with regulatory agencies, interested parties and the general public. All of the issues and/or resources of concern that were identified could be categorized into at least one of the impact topics considered for the analysis. A brief rationale for the selection of each impact topic is given below, as well as the rationale for dismissing specific topics from further consideration.

1.6.1 Impact Topics Considered

Impacts of the alternatives on the following impact topics are analyzed in this EA and are discussed in more detail in Chapter 3 - Affected Environment.

- Natural and Physical Resources
    - Soils, Topography, Geology
    - Vegetation
    - Wetlands
    - Feral Horses
    - Wildlife and Wildlife Habitat
    - Threatened and Endangered Species
- Park Operations and Administration
- Visitor Use and Experience

<u>Impact Topic 1: Soils, Topography and Geology</u>

Barrier islands are governed by complex interactions between soils (i.e., sand, mud, shells), topography, geology, and physical processes; all of which influence, and are influenced by associated biotic communities. The issues related to this impact topic are soil compaction and/or disruption in marshes, and the effects of feral horse grazing on dune integrity, stability and formation, including indirect effects on other geophysical processes.

<u>Impact Topic 2: Vegetation</u>

It is the policy of the NPS to protect the components and processes of naturally occurring vegetative communities, including the natural abundance, diversity, and ecological functionality of all native plants. The issues associated with this impact topic include the effects of feral horse grazing on the nature and dynamics of shrub and maritime forests occurring within ASIS. Grazing effects on dunes grasses and the corresponding disruption of dune processes is covered in the Soils, Topography and Geology topic. The effects of feral horse grazing in island salt marsh communities are addressed under the Wetlands topic.

<u>Impact Topic: 3: Wetlands</u>

Executive Order 11990 (*Protection of Wetlands*) and NPS Director's Order #77-1: *Wetland Protection* defines the NPS's goal to maintain and preserve wetland areas. Wetlands are prevalent throughout the island and are a major component of the overall island ecosystem. The issues associated with this impact topic relate to the effects of feral horse grazing on tidal and non-tidal wetlands, including impacts to the health, composition, and functionality of associated vegetation.

<u>Impact Topic 4: Feral Horses</u>

It is the goal of ASIS to maintain a healthy, viable population of feral horses in perpetuity. As such, the impacts of each alternative on the feral horse population will be analyzed in detail. Each alternative will be evaluated based on whether it meets the horse management objectives of the Park, which include maintaining a free-roaming herd of feral horses that exhibit natural characteristics and are subject to natural processes, are healthy, and are capable of successful reproduction.

Impact Topic 5: Other Wildlife and Wildlife Habitat

A wide variety of other fish and wildlife inhabit ASIS, including deer and other smaller mammals, migratory shorebirds and waterbirds, reptiles and amphibians, and a variety of fish and shellfish. The issues associated with this impact topic include the effects of feral horses on: wildlife habitat quality and biodiversity; disturbance of ground-nesting birds, and competition for resources between feral horses and other wildlife species.

Impact Topic 6: Threatened and Endangered Species

Assateague Island National Seashore provides suitable habitat for several federally-listed threatened species including seabeach amaranth *(Amaranthus pumilus)* and piping plover (*Charadrius melodus*). The issues related to this impact topic include the effects of feral horse grazing on the health and viability of seabeach amaranth and piping plover populations, and state-listed species.

Impact Topic 7: Park Operations and Administration

Management of ASIS requires adequate staff and funding to ensure appropriate administrative and operational capabilities. The active management of a particular resource such as the herd of feral horses at ASIS involves allocation of fiscal and administrative resources by the NPS. Modifying management activities, as the alternatives presented in this EA propose to do, could affect Park operations and administration. Introducing new management strategies or eliminating existing programs or projects might affect budget allocations, job duties of NPS staff, and create a need for new equipment or supplies. The impacts of each alternative on Park operations and administration of the ASIS will therefore be evaluated.

Impact Topic 8: Visitor Use and Experience

Providing a safe and rewarding visitor experience is a goal of all NPS units, including ASIS. The NPS strives to meet this goal by providing opportunities for forms of enjoyment that are appropriate to the natural and cultural resources found in parks. The feral horses of Assateague Island draw many visitors to ASIS ever year, and it is very important for the NPS to assure the public that not only will the feral horse population remain on the island for future generations to enjoy, but also that the island ecosystem remains healthy and viable. And although there has never been a fatality associated with the feral horses on ASIS, there have been many documented minor injuries, and the benefits of a smaller herd has the potential to reduce threats to public safety. As such, the alternatives for the proposed action will be analyzed for their impacts on visitor use and experience, including health and safety, at Assateague Island National Seashore.

1.6.2 Impact Topics Eliminated from Further Analysis

The following impact topics were considered, but found to not be relevant to the project, or would not be affected, or only negligibly affected by the alternatives evaluated in this EA. Negligible effects are effects that are localized or at the lowest levels of detection in a local or regional context. Therefore these topics have been dismissed from detailed analysis.

Surface and Ground Waters

NPS Management Policies 2001 (NPS 2000) states the NPS will "take all necessary actions to maintain or restore the quality of surface waters and ground waters within the Parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations." Assateague Island National Seashore is bordered by Sinepuxent Bay, Chincoteague Bay, and the Atlantic Ocean. In addition to these water bodies, the island is scattered with small inlets and wetlands that all play a key role in the ecology of the island and the health of the surrounding bays. It is, however, difficult to evaluate the direct impacts that changes in feral horse management would have on surface or ground waters. Much clearer are the effects that feral horses can have on wetlands, and the presumptive indirect effects on local water quality. For the purpose of this EA, surface and ground waters have been eliminated from further analysis, and wetland analyses will be used to assess the potential for impacts to water quality associated with the horse management alternatives.

Floodplains

Executive Order (EO) 11988 (*Floodplain Management*) and NPS Director's Orders #77-2: *Floodplain Management* requires the NPS and other federal agencies to evaluate likely impacts of actions on floodplains. None of the alternatives described in this EA would elevate the areas above the floodplain or reduce the capacity and function of the floodplain.

Air Quality

The federal 1963 Clean Air Act as amended (42 USC 7401 et. seq.) requires land managers to protect the nation's air quality, and Section 118 of the Clean Air Act in particular requires parks to meet all federal, state, and local air pollution standards. *NPS Management Policies* (NPS 2006b) addresses the need to analyze potential impacts to air quality during park planning. Assateague Island National Seashore is classified as a Class II clean air area. Implementing a one-time capture and removal of feral horses has the potential to temporarily increase vehicle exhaust and emissions, however because air stagnation is rare in this area any increase in air born pollution particles would be quickly dissipated. As a result, there is negligible potential that overall air quality be affected by any of the alternatives and therefore this impact topic is dismissed from further consideration.

Soundscapes

Natural soundscapes exist in the absence of human-caused sound and are the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting natural sounds. Natural sounds occur within and beyond the range of sounds that humans can perceive, and can be transmitted through air, water or solid materials. (*NPS Management Policies 4.9, Soundscape Management*, NPS 2006b). Assateague Island National Seashore is an ideal place to experience the sounds of nature absent from human intrusions. However, because none of the alternatives described in this EA have any potential to change existing soundscape conditions at ASIS, this impact topic is eliminated from further consideration.

Visual Resources (e.g., scenic vistas, night skies)

Natural lightscapes and night sky are natural resources that exist in the absence of human-caused light. Recognizing the roles that light and dark periods play in natural resource processes and the evolution of species, the NPS seeks to preserve, to the greatest extent possible, natural darkness and other components of the natural lightscape in parks (*Management Policies 4.10 Lightscape Management*, NPS 2006b). None of the alternatives described in this EA will alter night sky conditions at Assateague Island National Seashore. Therefore, this impact topic is eliminated from further consideration.

Cultural Resources

The NHPA; NEPA; the NPS Organic Act (16 USC 1-4); *NPS Management Policies 2006* (NPS 2006b); NPS DO #12; and NPS DO #28: *Cultural Resource Management Guidelines* require the consideration of impacts on cultural resources either listed on or eligible for listing on the National Register of Historic Places.

ASIS contains a variety of cultural resources including historic structures, cultural landscapes, archeological sites, and associated documents, artifacts and objects. Historic structures and sites make up the majority of the cultural resources found on Assateague Island, and include the former Assateague Beach U.S. Coast Guard Station complex, the sites of two former industrial facilities, a graveyard, and eleven former private residences and hunting camps. The Coast Guard Station also includes an associated cultural landscape. Archeological resources include several 18^{th} and 19^{th} century shipwrecks, the remains of three former U.S. Lifesaving Service Stations, the remains of a former hotel site and small community associated with the former Green Run Lifesaving Station, and occasional pre-historic artifacts reflecting use of the island by Native Americans. Of these resources, only the Assateague Beach Coast Guard Station and its cultural landscape (located in Virginia) have been determined to be eligible for the National Register of Historic Places.

While the feral horses are known to use areas where cultural resources are present, there have been no documented incidents of any horse-related impacts. The National Register-eligible resources (Coast Guard Station and associated landscape) are located in the Virginia portion of Assateague Island and, therefore, not subject to any potential effects from the feral horses under NPS management in Maryland. Potential National Register eligible resources include the former private residences and hunting camps. These structures and their associated landscapes are currently being assessed to determine their National Register eligibility.

As prescribed by the 1995 Programmatic Agreement among the National Park Service, the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers, ASIS, in consultation with its cultural resource advisory team, has reviewed the proposed undertaking and determined that *no historic properties will be affected*. As such, cultural resources are dismissed from further consideration as an impact topic.

Parks and Parklands

Assateague Island covers the coastline of Virginia and Maryland. The southern, Virginia section of the island is separated from the Maryland side by fence at the state line, and is managed by the U.S. Fish and Wildlife Service as Chincoteague National Wildlife Refuge. The Maryland Department of Natural Resources (MD DNR) manages 680 acres of the northern end as Assateague State Park (ASP) and the remainder of the Maryland portion is managed by NPS as ASIS.

A fence does not separate ASP and ASIS and the feral horses are managed as a free-roaming herd. The feral horses often inhabit ASP in large numbers during the summer months because it is narrow enough to be influenced by ocean breezes, and adjacent salt marshes offer forage. For this reason, summers with severe tabanid fly hatches can result in a mass migration of feral horses into the State Park seeking relief. NPS works in collaboration with MD DNR in an effort to fulfill both agency missions. NPS is responsible for managing the feral horse population and for the purpose of this EA, the impacts will be evaluated for the entire Assateague Island, including ASP, and thus the State Park does not need to be examined separately.

Transportation (including site access and circulation)

Safe and efficient circulation of vehicles and pedestrians at ASIS is important to continued use of the site by visitors. None of the alternatives described in this EA will impact any current or future site access and circulation at Assateague Island National Seashore. As such, this impact topic is dismissed from further consideration.

Land Use

None of the alternatives described in this EA will impact land use issues, including occupancy, income, values, ownership or type of use at Assateague Island National Seashore. Therefore, land use is dismissed from further consideration as an impact topic.

Socioeconomic Resources

None of the alternatives described in this EA will impact any socioeconomic resources, including employment, occupation, income changes, tax base, or infrastructure at Assateague Island National Seashore. Implementing a one-time feral horse reduction could slightly increase the economies of any agency or organization employed, however any potential increase would be temporary, lasting only for the duration of the removal. Therefore this impact topic of socioeconomic resources is dismissed from further consideration.

Environmental Justice

Executive Order 12898, Environmental Justice in Minority and Low-Income Populations directs federal agencies to assess whether their actions have disproportionately high and adverse human health or environmental effects on minority and low-income populations. None of the alternatives described in this EA will impact any minority or low-income communities in the park's region – no increase in development, traffic, noise or air pollution are associated with any of the alternatives described in this EA.

Indian Trust Resources

Secretarial Order 3175 requires that any anticipated impacts to Indian Trust Resources from a proposed project or action by the U.S. Department of the Interior agencies be explicitly addressed in environmental documents. The federal Indian Trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. There are no Indian Trust resources at Assateague Island National Seashore. The lands encompassing ASIS are not held in trust by the Secretary of the Interior for the benefit of Indians. Therefore, the project will have no effect on Indian Trust resources, and this topic was dismissed from further analysis.

Indian Sacred Sites

Executive Order 13007 requires that all Executive Branch agencies having responsibility for the management of federal lands will, where practicable, permitted by law, and not clearly inconsistent with essential agency functions, provide access to and ceremonial use of Indian sacred sites by Indian religious practitioners and will avoid adversely affecting the integrity of such sacred sites. The EO also requires that federal agencies, when possible, maintain the confidentiality of sacred sites. The island itself is considered by some Native American Indians to be a sacred portal for souls entering and exiting the Earth plane (Olson 2003). However, none of the alternatives described in this EA will impact the sacred designation of Assateague Island.

Ethnographic Resources

Per NPS Director's Orders #28 *Cultural Resource Management*, ethnographic resources are defined as any site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it. According to Director's Orders #28 and Executive Order 13007 on sacred sites, NPS should try to preserve and protect ethnographic resources. An ethnographic study of Assateague Island has been tentatively funded and is scheduled to begin in 2008. However, none of the alternatives described in this EA are anticipated to impact any ethnographic resources at Assateague Island National Seashore.

Prime and Unique Farmlands

The Farmland Protection Policy Act of 1981 requires federal agencies to consider adverse effects to prime and unique farmlands that would result in the conversion of these lands to non-agricultural uses. For the purpose of the Act, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland does not have to be currently used for cropland to be subject to the Act's requirements. It can be forest land, pastureland, cropland, or other land, but not water or urban built-up land. There are no prime or unique farmlands or other lands of statewide or local importance within ASIS.

Chapter 2 – Alternatives

This chapter describes alternatives for long-term management of the feral horse population of Assateague Island National Seashore. A range of alternatives for the proposed action were developed to meet the objectives described in Chapter 1 and achieve the NPS goal of managing the feral horse population to protect the long-term health and viability of the herd as well as the barrier island ecosystem that supports it. At this time, the NPS does not have a preference among the action alternatives.

2.1 Alternatives Development

Alternatives were developed based upon information derived from previous studies, NPS experience in managing the Assateague feral horses, and through public scoping. The scoping process included a public meeting and comment period as well as interagency and stakeholder coordination with ASP, MD DNR, Smithsonian-National Zoological Park, Humane Society of United States, and USFWS. This process helped to identify issues and concerns that refined the range of alternatives considered. An Alternatives Development meeting was held on December 8, 2006 with the NPS planning team to further clarify and define the alternatives. A full range of alternatives were considered in the initial scoping. Three action alternatives were carried forward for detailed analysis in this EA, along with the no action alternative. Four alternatives were initially considered but were dismissed from further analysis because they did not meet the project purpose, need, or objectives.

2.2 Alternative A: No-Action

Alternative A, the No-Action Alternative, would continue all present feral horse management activities and operations at ASIS. The No-Action Alternative, required by federal regulations, provides a basis for comparing the management direction and environmental consequences to that of the proposed action. Should the No-Action Alternative be selected, the NPS would respond to future needs and conditions associated with the feral horses without major changes in the present course. The NPS would continue to operate under the *1985 Feral Pony Management Plan* (NPS 1985), and the 1995 Environmental Assessment (NPS 1995) that supplements the management plan.

Under the No-Action Alternative, the NPS would continue the use of the porcine zona pellucida (PZP) immunocontraceptive vaccine to manage feral horse reproduction and maintain the population at a relatively stable size of 150 horses. A varying number of mares would be treated annually to maintain a relatively stable population and the current practice of limiting reproductive output to one live and standing foal per mare would continue. The NPS would not seek to further reduce the size of the population below its current size of approximately 140 horses as prescribed by the Feral Pony Management Plan and the 1995 EA.

The NPS treats approximately 70% of reproductive age mares in the population each year using the PZP immunocontraceptive vaccine. The vaccine works by stimulating the immune system of female horses to produce antibodies, which inhibit fertilization, and thus prevents pregnancy.

The vaccine is administered by trained NPS staff, who deliver the contraceptive remotely using a .22 cal. cartridge-powered dart rifle which fires a barbless, self-injecting syringe, which eliminates the need to capture and handle the feral horses to administer the treatment.

At present, every mare begins contraceptive treatments at two years of age and is then treated for three consecutive years. At that point the mare is allowed to foal once, after which she is returned to annual contraceptive treatments for life.

Sensitive habitats and species would continue to be monitored to assess the effects of feral horses on biological and ecological parameters. Ongoing efforts include: monitoring of low salt marsh vegetation communities to evaluate the long-term effects of feral horse grazing on aboveground primary productivity and species composition; monitoring of piping plover and seabeach amaranth to document the effects of feral horses on rare species distribution, abundance and status; assessing the effects of feral horse grazing in forested and shrub habitats, and; monitoring geomorphological change to understand the effects of grazing on dune vegetation and physical processes. Other monitoring and assessment activities could occur on an intermittent basis, such as surveys to re-evaluate previously assessed species or habitat parameters. Additional research to further understand the ecological effects of feral horses on the barrier island environment could also be conducted.

The NPS would also continue to monitor the status and trends of the feral horse population to guide management activities and assess herd health. The NPS currently monitors birth and mortality rates, contraception success, behavior, harem band associations, home range and seasonal activity patterns, habitat utilization, and human-horse interactions. Other information gathering activities could be conducted on a non-recurring basis, such as genetic analyses or new research focusing on the feral horses.

2.3 Alternative B: One-time Capture and Removal

Alternative B, the One-time Capture and Removal Alternative, would reduce the feral horse population to the desired range of 80-100 within two years, using the strategy of a one-time capture and removal of feral horses. A “one-time capture and removal” is defined as the capture and removal of selected feral horses that would occur once during this two-year period to act as an initial reduction strategy. This alternative would reduce the herd to the lower range of the population limit (subject to safeguards to prevent reduction below the lower limit), and then use immunocontraception for long-term management to maintain the herd within the 80-100 range. The intent of this alternative is to reduce the number of feral horses as rapidly as possible to minimize the time that island resources are being impacted by a too-large feral horse population. This alternative would also allow for a period of unrestricted reproduction until the population approached the upper limit, at which time contraception would be re-initiated.

The exact number of feral horses removed would depend on the size and demographics of the overall population at the time of implementation. Based upon the current size of the population and assuming continued reduction through the use of intensive contraception while removal plans are formulated, it is estimated that the one-time capture and removal would involve between 15 and 30 feral horses.

The following are criteria that would be used to select feral horses for removal. The relative importance of each criteria and the final selection methodology would depend on the size and demographics of the population at the time of implementation.

- Demographics (e.g., sex, age and reproductive potential)
- Genetics (as described by mean kinship[?])
- Non-responsiveness to the PZP immunocontraceptive
- Reproductive Potential (whether they can still reproduce),
- Age
- Social Bonds
- Degree of Habituation (habituated animals might do better in off-island circumstances)
- Home Range (would be beneficial to reduce population on north end to reduce stress on threatened species by lowering what is currently the highest density of horses)

Feral horses selected for removal from ASIS would be dispersed either through an "adoption" program, or to a horse "sanctuary". The adoption program would place selected feral horses with private individuals where they would be managed as domesticated horses for the duration of their lives under conditions specified by the NPS. The sanctuary option would place groups of selected feral horses in privately owned sanctuaries, where they would be managed, as feasible, as wild horses for the duration of their lives under conditions specified by the NPS. Feral horses selected for adoption or for the sanctuary would remain the property of the NPS and would be routinely monitored for the duration of their lives in order to ensure their health and well-being. All monitoring, tracking, and inspection activities would be managed by the NPS.

The NPS would continue to monitor the status and trends of the feral horse population on ASIS as described under the No-Action Alternative in order to guide herd management and assess population health. Additional analyses of genetic and demographic characteristics (e.g., mean kinship) would be conducted on a recurring basis to inform contraception decision-making and as a further means of monitoring population health.

The NPS would also continue to monitor and assess the effects of feral horses on sensitive habitats, species and ecological processes. In addition to the activities described under the No-Action Alternative, monitoring would be expanded to include long-term monitoring of American beachgrass (*Ammophila breviligulata*) abundance in dune communities, and long-term monitoring of Assateague Island's secretive marsh bird communities. Collectively, the monitoring activities are representative of the range of ecological effects caused by the feral horses. The overall objective would be to detect and document improvements in the ecological health of the island in response to lower feral horse grazing pressures in order to inform future herd management decisions.

[?] Mean kinship is the measure of how related to each other any member of the herd is.

2.4 Alternative C: Intensive Contraception

Alternative C, the Intensive Contraception Alternative, would reduce the feral horse population to the desired range of 80-100 within 5-8 years through the intensive use of PZP immunocontraception. There would be no capture and removal of horses under Alternative C; rather, this alternative would limit reproduction to the maximum extent possible using only contraceptives and would rely on natural mortality to reduce the size of the population to the desired range. Once the desired reduction was achieved, a less intensive regime of contraception would be used for long-term management of the population within the 80-100 range. As in Alternative B, the initial reduction would target the lower range of the population limit (80). This would allow for a period of less restricted reproduction until the population approached the upper limit, at which time contraception would be re-initiated.

Under this alternative, the NPS would conduct the monitoring programs described in Alternative B, (both existing and new monitoring) to document the effects of the slowly decreasing herd size on sensitive habitats, species and ecological processes. The NPS would also monitor the status and trends of the feral horse population as described in the No-Action Alternative.

2.5 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D, the Intensive Contraception with Periodic Removals/Additions Alternative, is essentially the same as Alternative C, except that it would also include the option to periodically capture and remove select individuals from the herd and replace them with horses from off-island sources. The intent of the removals/additions would be to provide a mechanism to periodically manipulate the genetic and/or demographic composition of the herd and thereby safeguard population health and viability. Removals under Alternative D would be strictly to manage population health and would not be used as a means of reduction.

The removal/addition of feral horses would be conducted when and if measures of population health such as mean kinship (a measure of how related to each other any member of the herd is) or reproductive capacity indicate an increased risk to the population from inbreeding or other factors. Removals/additions would involve small numbers (2-5) of horses at any given time, except in cases of catastrophic mortality (e.g., from storms or disease outbreaks when a large addition of horses might be required). The criteria used to select feral horses for removal would be as described in Alternative B, and would also depend on the genetic and demographic characteristics of the population at that time. Feral horses selected for removal under this alternative would be dispersed either through an "adoption" program or to an off-island "sanctuary" as described in Alternative B. The NPS would retain ownership, and monitor removed individuals to ensure their health and well-being.

Should future additions to the herd become necessary, the NPS would attempt to acquire those horses from other east coast populations. These coastal populations are believed to be primarily from similar early European-American working stock that have experienced some level of transition into a feral or free-roaming condition and also have been exposed to the rigorous living conditions typical of barrier island life. The ability to integrate into a harem band social organization and thrive on typical barrier island resources is critical for potential immigrants. Potential donor populations include NPS-owned horses occurring at Cape Lookout and Cumberland Island National Seashores. Criteria used to select suitable individuals would likely include age, gender, and physical characteristics similar to the Assateague horses.

Under this alternative, the NPS would conduct the monitoring programs described in Alternative B, (both existing and new monitoring) to document the effects of the slowly decreasing herd size on sensitive habitats, species and ecological processes. The NPS would also monitor the status and trends of the feral horse population as described in the No-Action Alternative.

2.6 Mitigation Measures

Mitigation measures and development constraints are specific actions that when implemented, minimize, avoid, or eliminate impacts on resources caused or affected by alternative actions. The NPS would fully comply with all applicable laws, regulations, and policies governing resource protection including the Endangered Species Act, Clean Water Act, National Historic Preservation Act, and agency specific guidelines.

Reducing the size of the feral horse population, as would occur under each action alternative, would decrease the number of feral horses potentially available for viewing by the visiting public. Because a reduced opportunity to view the ASIS horses might affect visitor satisfaction, the NPS would mitigate that potential impact by developing improved visitor information and guidance on how to find and view feral horses. The NPS would also develop a new observation platform adjacent to the primary visitor use area that would improve opportunities to see feral horses over a wider area than is currently possible.

All three action alternatives also involve some additional measure of risk to the long-term health of the feral horse population as a result of the proposed reduction in size. While genetic and demographic analyses have characterized the risk as minimal, Alternative D further mitigates the risk through the potential use of periodic removals/additions of horses to manipulate herd composition and thereby increase the probability of long-term population health and viability.

Any feral horse currently in the Assateague Island National Seashore Foster Horse Program selected for the proposed one-time capture and removal would be removed from the program. ASIS would contact the "foster parents" and provide them an opportunity to "adopt" another feral horse. Although some foster parents might be disappointed in the removal of "their" horse, outreach and education materials discussing the rationale and need for the action is expected to mitigate the impacts.

2.7 Alternatives Considered but Dismissed from Further Consideration

The following options were considered during the early stages of the planning process but were rejected based on their inability to meet the purpose and need and/or the objectives of the project.

Not all of these options encompass an entire alternative, but rather various components of the alternatives.

Use of fencing or other landscape level mechanisms specifically designed to limit the mobility of the feral horses and thereby reduce the effects of grazing on sensitive resources

The rationale for rejecting an alternative that uses fencing or other landscape level barrier mechanism is that it would not meet the objectives of the proposed action. Limiting feral horse mobility into sensitive areas could benefit those areas where horses are excluded but would also exacerbate the impacts of horse grazing in those areas where horses were permitted. In addition this alternative would not maintain the free-roaming character and behavior of the feral horses.

Different target population numbers (below 80 and above 100)

The rationale for rejecting an alternative that maintains a target herd size above 100 or below 80 is that it would not fulfill the purpose and objectives of the proposed action. Based on the results of genetic and demographic analyses and population modeling conducted as part of the Assateague Horse Population and Habitat Viability Assessment (PHVA), a target population size of 80-100 horses was identified as the best possible compromise between the conflicting NPS objectives of protecting the health and viability of the feral horse population and minimizing the ecological impacts they create.

The PHVA concluded that a population of at least 80 horses would face virtually no risk of extinction from randomly determined sequences of events and would retain >90% of its gene diversity over the next 50 years. The retention of at least 90% gene diversity is a common goal for small, managed populations. A population of fewer than 80 horses would increase the risks of inbreeding depression and catastrophes. While introductions of new horses, genetic management, manipulation of sex ratio and other interventions could be used to maintain a smaller population, a population of 80 horses appears to be sustainable with no additional management. As such, the proposed lower limit of 80 meets the objectives of protecting the long-term health and viability of the population and the feral horse's free-roaming, social and behavioral characteristics.

The best available scientific information describing ecological impacts observed at various feral horse densities on ASIS suggest that a population above 100 exceeds the tolerance threshold of sensitive island resources and, therefore, fails to meet the Park's objectives for the proposed action.

Artificial supplementation of forage base by feeding or manipulation of vegetation (e.g., fertilization, planting)

The rationale for rejecting an alternative that provides supplemental feeding of feral horses is that it does not fulfill the Park's objectives for the proposed action. Supplemental feeding would alter the natural foraging behavior of the horses and condition the horses to associate food with people, both of which would reduce their "wild" characteristics. Supplemental feeding would also potentially alter horse distribution and home range, pose the threat of introducing new non-native invasive plant species to the island, and increase trampling impacts in areas where feeding would occur. Fertilizing or planting to create unnatural conditions runs counter to NPS policies and would be unlikely to have prolonged beneficial effects since the primary foraging habitats (i.e., salt marshes) used by the horses are known to not be nutrient limited.

Dispersal of horses by means other than adoption or relocation to sanctuaries (auction, euthanasia, etc.)

During scoping, the most common comment received suggested the NPS hold annual auctions to sell foals to private citizens similar to the pony penning in Chincoteague, Virginia. However, an alternative that utilizes dispersal strategies other than adoption or relocation to a sanctuary would not sufficiently ensure the long-term health and well being of any horse removed from the island. Euthanasia is incompatible with the values and importance of the Assateague horses and contravenes the public trust responsibilities of the NPS. An auction, where legal ownership transferred from the NPS to a private individual, would restrict the ability of the NPS to guarantee appropriate care and treatment of any horses removed from the island.

2.8 The Environmentally Preferred Alternative: Alternative B

The NPS is required to identify the Environmentally Preferred Alternative in its NEPA documents for public review and comment. The Council on Environmental Quality (CEQ) defines the Environmentally Preferred Alternative as the alternative that best promotes the national environmental policy expressed in NEPA (Section 101(b)). Simply put, “this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources” *(CEQ NEPA’s 40 Most Asked Questions).*

Based on the results of the analysis presented in this EA, Alternative B is the Environmentally Preferred Alternative. Alternative B would attain the widest range of beneficial uses of the barrier island environment without further degradation at a level that might potentially result in loss of ecological integrity and would avoid undesirable consequences of a too-large feral horse population on the environment by implementing a new management strategy for feral horses. The barrier island ecosystem would accrue greater benefits from an immediate reduction of feral horses as opposed to the slow reduction over the course of 5-8 years, as outlined in Alternatives C and D. Affected resources would experience a more immediate release from grazing pressure under Alternative B, and with that release, a greater potential for recovery. Other benefits of reducing the herd quickly (Alternative B) as opposed to slowly (Alternatives C and D) include reducing the amount of time the herd experiences intensive contraception and the associated loss of reproductive capacity.

2.9 Alternatives Comparison Table / Matrix

The No-Action Alternative (Alternative A) would not change park operations and procedures, and the current activities and studies would be implemented indefinitely in order to manage the feral horses at a relatively stable population size of 150. With Alternatives C and D, current park operations would not change immediately, and would require the Park to continue current population management practices until the feral horse population reaches and is maintained within the target population range.

One notable difference between Alternative B and Alternatives C and D is the time factor. Alternative B achieves the desired population range faster, within two years, allowing for dune, wildlife and vegetation recovery sooner while maximizing the reproductive potential and long-term genetic viability of the feral horse population. Alternatives C and D could possibly take 5-8 years to achieve that same herd size, and the cumulative effects of a too-large feral horse population on island health and function prolonged over 5-8 years would at worst be the same as under the No-Action. Continued impacts could result in potential loss or reduction in the capacity of the ecosystem to recover and be restored to natural conditions. However it is more likely that the barrier island ecosystem would benefit more from an immediate reduction of feral horses (Alternative B) as opposed to the slow reduction over the course of 5-8 years, as outlined in Alternatives C and D. Benefits of reducing the herd to the lower population limit via Alternative B include immediately reducing grazing impacts, enabling a much earlier break in the immunocontraceptive administration, which in turn would allow increased reproduction in the feral horse population for a time. This would enhance the herd's health by increasing the effective size of the breeding population (long-term contraception causes loss of fertility).

Alternative B also provides an opportunity for making adjustments to the demography and genetic characteristics of the herd. Selective removals could potentially be used to reduce mean kinship within the herd (less relatedness), or to increase the proportion of reproductively capable females. Selection factors that could be used to improve overall population health characteristics include reproductive status, age, sex, lineage, and genetic attributes.

Table 2.1 Comparative Summary of Alternatives

	Alternative A: No- Action	**Alternative B: One-time Capture and Removal**	**Alternative C: Intensive Contraception**	**Alternative D: Intensive Contraception with Periodic Removals/Additions**
Objectives in Taking Action				
Adopt a new herd size goal that improves barrier island health, ecosystem function and biodiversity while protecting feral horse population health.	Herd size would remain at around 150 horses. Ecological effects of feral horses on the island would not decrease. Ecosystem health would most likely experience a further decline.	New herd size goal of 80-100 would be adopted. Ecological impacts of feral horses would be reduced and would improve barrier island health, ecosystem function, and biodiversity.	New herd size goal of 80-100 would be adopted. Ecological impacts of feral horses would be reduced and would improve barrier island health, ecosystem function, and biodiversity.	New herd size goal of 80-100 would be adopted. Ecological impacts of feral horses would be reduced and would improve barrier island health, ecosystem function, and biodiversity.

	Alternative A: No- Action	**Alternative B: One-time Capture and Removal**	**Alternative C: Intensive Contraception**	**Alternative D: Intensive Contraception with Periodic Removals/Additions**
Protect the long-term health and viability of the feral horse population.	Because the Park would not be able to prevent a decline in ecosystem health, the decline in quality of feral horses' habitat would jeopardize the long-term health and viability of the herd.	One-time capture and removal would allow a break in contraception which would enhance the long-term viability of the herd. Park would continue to monitor ecosystem and feral horse genetic and demographic parameters as a means of assessing health.	Continuing an intensive contraception program might require mitigation measures to ensure the long-term health and viability of the herd. Park management would continue to monitor ecosystem and feral horse genetic and demographic parameters as a means of assessing health.	Park management would periodically capture and remove from, as well as add select individuals to the herd to ensure long-term feral horse population health. The Park would continue to monitor ecosystem and feral horse genetic and demographic parameters as a means of assessing health.
Protect the free-roaming nature, and social and behavioral character of the feral horses.	Park management would protect the free-roaming and wild nature of the feral horses.	Same as No-Action.	Same as No-Action.	Same as No-Action.
Develop and implement an appropriate strategy for reducing the size of the herd that is efficient and humane, that minimizes the duration and intensity of feral horse impacts, which safeguards the welfare of affected feral horses, and allows ASIS to achieve its mission.	No new strategy for reducing the size of the herd would be developed.	One-time capture and removal strategy would reduce the size of the herd efficiently and humanely. Project need would be met in 2 years thus minimizing the duration and intensity of feral horse impacts, Alternative B safeguards the welfare of affected feral horses, and allows ASIS to achieve its mission.	Current strategy of intensive contraception program would eventually reduce the size of the herd; strategy is humane. Project need would be met in 5-8 years, prolonging the duration and intensity of feral horse impacts. Alternative C safeguards the welfare of affected feral horses, and allows ASIS to achieve its mission.	Periodic capture and removals and additions to the herd would reduce the size of the herd efficiently and humanely. Project need would be met in 5-8 years, prolonging the duration and intensity of feral horse impacts. Alternative D safeguards the welfare of affected feral horses, and allows ASIS to achieve its mission

2.10 Summary of Environmental Consequences/Impacts Comparison Table

Table 2.2 provides a summary of the environmental consequences related to each alternative. A more detailed explanation of the impacts, including cumulative impacts, is presented in Chapter 4 – Environmental Consequences.

Table 2.2 Summary of Environmental Consequences of each Alternative Considered
ST = Short-Term; LT = Long-Term

Impact Topic	Alternative A: No-Action	Alternative B: One-time Capture and Removal	Alternative C: Intensive Contraception	Alternative D: Intensive Contraception with Periodic Removals/Additions
Soils, Topography, Geology	ST moderate adverse impact LT moderate adverse impact Alternative contributes a moderate amount to a moderate adverse cumulative impact.	ST moderate beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to minor adverse cumulative impact.	ST negligible beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to minor adverse cumulative impact.	ST negligible beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to minor adverse cumulative impact.
Vegetation	ST moderate adverse impact LT moderate adverse impact Alternative contributes a moderate amount to a moderate adverse cumulative impact.	ST moderate beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to a minor beneficial cumulative impact.	ST negligible beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to a minor beneficial cumulative impact.	ST negligible beneficial LT moderate beneficial impact Alternative contributes a moderate amount to a minor beneficial cumulative impact.
Wetlands	ST moderate adverse impact LT moderate adverse impact Alternative contributes a moderate amount to a moderate adverse cumulative impact.	ST moderate beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to a minor adverse cumulative impact.	ST negligible beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to a minor adverse cumulative impact.	ST negligible beneficial LT moderate beneficial Alternative contributes a moderate amount to a minor adverse cumulative impact.

Impact Topic	Alternative A: No-Action	Alternative B: One-time Capture and Removal	Alternative C: Intensive Contraception	Alternative D: Intensive Contraception with Periodic Removals/Additions
Feral Horses	Demographics: ST negligible adverse LT moderate adverse Genetics: ST negligible beneficial LT minor adverse Behavior, health, social organization: ST negligible beneficial LT negligible beneficial Alternative contributes a negligible amount to a negligible adverse cumulative impact.	Demographics: ST moderate beneficial LT moderate adverse Genetics: ST moderate beneficial LT minor adverse Behavior, health, social organization: ST moderate adverse LT minor beneficial Alternative contributes a minor amount to a minor adverse cumulative impact.	Demographics: ST minor adverse LT moderate adverse Genetics: ST negligible adverse LT minor adverse Behavior, health, social organization: ST negligible beneficial LT negligible beneficial Alternative contributes a minor amount to a minor adverse cumulative impact.	Demographics: ST minor adverse LT minor beneficial Genetics: ST minor adverse LT moderate beneficial Behavior, health, social organization: ST negligible beneficial LT negligible adverse Alternative contributes a moderate amount to a minor beneficial cumulative impact.
Other Wildlife and Wildlife Habitat	ST moderate adverse impact LT moderate adverse impact Alternative contributes a moderate amount to a moderate adverse cumulative impact.	ST minor beneficial impact LT moderate beneficial impact Alternative contributes a moderate amount to a minor beneficial cumulative impact.	ST negligible beneficial impact LT moderate beneficial impact Alternative contributes a minor - moderate amount to a minor beneficial cumulative impact.	ST negligible beneficial impact LT moderate beneficial impact Alternative contributes a minor - moderate amount to a minor beneficial cumulative impact.
Threatened and Endangered Species	ST moderate adverse impact LT minor to moderate adverse impact Alternative contributes a minor amount to a minor adverse cumulative impact.	ST moderate beneficial impact LT minor to moderate beneficial impact Alternative contributes a minor amount to a minor beneficial cumulative impact.	ST minor adverse impact LT minor to moderate beneficial impact Alternative contributes a minor amount to a minor beneficial cumulative impact.	ST minor adverse impact LT minor to moderate beneficial impact Alternative contributes a minor amount to a minor beneficial cumulative impact.

Impact Topic	Alternative A: No-Action	Alternative B: One-time Capture and Removal	Alternative C: Intensive Contraception	Alternative D: Intensive Contraception with Periodic Removals/Additions
Park Operations and Administration	ST negligible beneficial impact LT negligible beneficial impact Alternative contributes a negligible amount to a negligible cumulative impact.	ST moderate adverse impact LT minor beneficial impact Alternative contributes a minor amount to a minor beneficial cumulative impact.	ST negligible adverse impact LT minor beneficial impact Alternative contributes a minor amount to a minor beneficial cumulative impact.	ST negligible adverse impact LT negligible beneficial impact Alternative contributes a minor amount to a minor beneficial cumulative impact.
Visitor Use and Experience (including health and safety**)**	ST negligible beneficial impact LT negligible beneficial impact Alternative contributes a negligible amount to a negligible beneficial cumulative impact.	ST minor adverse/ beneficial impact LT negligible/ minor beneficial impact Alternative contributes a negligible amount to a negligible beneficial cumulative impact.	ST negligible/minor beneficial impact LT negligible/minor beneficial impact Alternative contributes a negligible amount to a negligible beneficial cumulative impact.	ST negligible/minor beneficial impact LT negligible/minor beneficial impact Alternative contributes a negligible amount to a negligible beneficial cumulative impact.

Chapter 3 – Affected Environment

This chapter describes the existing environmental conditions at ASIS. Organized by resource topic, then impact topic, this chapter discusses the resources that have the potential of being impacted by the proposed alternatives. Natural and physical resources examined in detail include soils, topography and geology, vegetation, wetlands, wildlife and wildlife habitat, threatened and endangered species and feral horses. As discussed in Chapter 1 – Purpose of and Need for the Proposed Action, no cultural resources would be impacted by the proposed action. Park operations and administration, and visitor use and experience were also examined.

3.1 Description of Project Location

Located along the Atlantic coast of Maryland and Virginia, Assateague Island National Seashore comprises approximately 48,700 acres, receives over two million visitors each year, and is home to a variety of natural resources and habitats. See Figure 1.1 in Chapter 1 for a Location Map of Assateague Island National Seashore.

Natural and physical resources at ASIS include soils, topography and geology, vegetation, wetlands, wildlife and wildlife habitat, threatened and endangered species and feral horses. Resources dismissed from further consideration were discussed in Chapter 1 – Purpose of and Need for the Proposed Action and include surface and ground waters, floodplains, air quality, soundscapes, and visual resources. Note, however, that a characterization of existing surface water quality conditions is included in the wetlands section.

3.2 Soils, Topography and Geology

Barrier islands like Assateague are highly dynamic places, with waves, wind, tides, currents and storms working to continuously reshape the landform. Winds can transport large amounts of sand, building the dunes and raising island elevation. Though alongshore currents change direction with seasons and winds, the net alongshore sand transport each year is southward. Winter waves move sand from upper beaches, depositing it into offshore sand bars and reducing beach width. This process is reversed during milder summer weather, as gentler wave action moves sand back onshore and widens the beaches.

As a barrier island, Assateague Island consists of unconsolidated sediments (i.e., sand, mud) with varying amounts of shells and occasional outcroppings of peat. No hard rock outcrops occur on Assateague Island. The majority of the island, including the beaches, dunes and interior sections, generally is composed of medium-sized quartz sand grains that are white to tan in color. These soils are nutrient-poor and do not retain water very well (USACE 1998). The soils of the bayside portion of the island are wetland soils (i.e., tidal marsh) that are black or gray and finer in grain size, containing high proportions of mud, clay and/or silt. The tidal marsh soils are hydric, remaining wet for long enough during the growing season to support wetland vegetation (e.g., *Spartina* spp.).

Assateague Island is typically low in elevation, with dunes the only noteworthy topographic features. The topography changes with the seasons and with storms, with the latter creating low, flat overwash fans on the interior of the island. In very large storms, overwash can reach across the entire island to the bayside, depositing sand that can raise elevation, bury vegetation and tidal marsh soils and create new land on the bay side of the island.

ASIS maintains an artificial dune along the ocean side of the Maryland district's developed zone (approximately 2 miles). The dune is intended to protect the Seashore's visitor services facilities from the effects of mild to moderate storms. The dune maintenance program previously relied heavily upon plantings of American beachgrass (*Ammophila breviligulata*), as the extensive root system of this grass is very important in stabilizing sand dunes and controlling erosion by stimulating sand accumulation and initiating dune formation (Seliskar 1997). However, because feral horses were grazing on these plantings and ultimately causing the dune area to become mostly devoid of beachgrass, the Park currently uses a dune fence along the length of the constructed primary dune as a means of protecting it from horse herbivory, allowing the dune stabilization process to occur. Without the extensive root and rhizome system of American beachgrass and other dune vegetation to hold sand in place, the dunes become vulnerable to erosion. The ASP also maintains a 2-mile long section of dune with beachgrass and electric fencing to protect it from herbivory. Other than these two sections of dune (totaling approximately 4 miles) that are managed by the NPS and ASP, dunes, including remnants of artificially stabilized dunes built in the 1960s, are allowed to form, move and erode naturally at ASIS.

In 1998, to prevent a potential breach resulting from strong northeaster storms that overwashed the sediment-starved north end of the island, the U.S. Army Corps of Engineers (USACE) and NPS constructed an 'emergency storm berm'. Approximately 200,000 cubic yards (cy) of sediment dredged from offshore shoals was placed along a 1.6 mile section of northern ASIS to create a low, dune-like feature intended to reduce (but not eliminate) storm overwash. Since its construction, however, the berm has failed to perform as expected and curtailed all overwash, thereby stimulating the unnatural expansion of vegetation communities in adjacent areas.

In September 2002, the USACE and NPS constructed the first phase of the *North End Restoration Project*, which placed 1.8 million cubic yards (mcy) of sand along 5.6 miles of Assateague Island's northern beaches, including the rebuilding of the 1998 emergency berm in approximately the same location and elevation. This sediment was intended to replace some of the sediment lost since stabilization of the Ocean City Inlet, which interrupted sand transport to Assateague Island. Since 2004, mechanical sand bypassing has occurred twice each year to restore a natural sediment supply to the island. Sand is dredged from the tidal deltas of Ocean City Inlet and moved around the jetties to Assateague; the project intends to restore roughly 190,000 cy of sediment per year to the Assateague Island system, placing the dredged material offshore in approximately 6 to 10 feet (2 to 3 m) water depth (USACE 1998).

During the winter of 2004-2005, 'notches' were cut in the constructed berm at the north end of Assateague to lower the elevation in select locations so that overwash would be more likely to occur. The absence of major storm activity during 2005 or 2006 led to the construction of additional berm notches at a lower elevation during the winter of 2006 – 2007; again, with the intent of allowing natural overwash processes at the north end to be maintained.

3.3 Vegetation

ASIS is part of a narrow barrier island located between the Atlantic Ocean and Sinepuxent and Chincoteague Bays. Assateague hosts a wide variety of vegetative communities. These communities occur along an east to west habitat gradient that typically begins with sandy beach communities which then transition into dune, shrubland / herbaceous, maritime forest and finally salt marsh communities on the western bayside of the island. A diverse array of environmental conditions shape the island's vegetative communities, these include elevation, the presence of fresh or salt water, distance from the ocean, constant sand movement both by wind and water, less frequent but influential storms events, topography and distance to the groundwater table, soil types which range from sand to loamy mud and peat, tides, and salt spray.

Studies to identify and inventory the flora on the Maryland side of Assateague Island were conducted by Higgins et al. (1971) and Hill (1986). More recently a study was completed by The Nature Conservancy (TNC) in 1995 during which ASIS' vegetative communities were described using the National Biological Survey (NBS)/ NPS Standardized National Vegetation Classification System (NRCS) (1994). This study identified 25 communities, which can be further broken down into one sparsely vegetated, five forest, eight shrubland, and eleven herbaceous vegetative communities. See Figure 3.1 and Figure 3.2 for the distribution of these vegetative communities on ASIS.

The plant life of Assateague Island creates a rich diversity of habitats, which play a variety of roles in the island ecosystem. Plants living on the beach and dunes must withstand extremely harsh conditions. Frequent exposure to strong, salt-laden winds, constantly shifting sands, low soil moisture, and intense summer heat all contribute to a landscape that is less than 1% vegetated. Nonetheless, plants like sea rocket (*Cakile edentula*) can withstand, and even thrive in this harsh environment. Higher up the dunes, American beachgrass adapts to shifting sands by growing additional stems when buried, thus helping to bind the substrate and reduce erosion. Assateague Island's open sand flats and fans develop primarily under the influence of storm overwash events while ASIS' primary dunes develop and are maintained by wind transported sand that becomes trapped and stabilized by vegetation such as American beachgrass. Feral horse grazing has been shown to lower the abundance of American beachgrass on Assateague Island and reduce its capacity to form and stabilize dunes (Seliskar 1997, De Stoppelaire 2002).

In the sheltered zone beyond the primary dunes, where fresh water is more plentiful, vegetative cover increases considerably and is predominantly characterized by less salt-tolerant shrubs and thickets. Here, typically tall, woody plant species are frequently stunted and deformed, the result of exposure to salt winds blowing over the dunes which act to limit their growth. Common species in these areas include wax myrtle (*Morella cerifera*) and northern bayberry (*M. pennsylvanica*). Other species commonly found among the shrub thickets include broomsedge (*Andropogon virginicus*), switch grass (*Panicum virgatum*) and poison ivy (*Toxicodendron radicans*). In these habitats the abundance of American beachgrass has also been shown to be reduced by feral horse grazing (Sturm 2007b).

Figure 3.1 Assateague Island National Seashore Vegetation Map. Showing sparsely vegetated, forest, shrubland, herbaceous vegetation and water habitats from kilometers 0 through 20 as measured from the Ocean City Inlet.

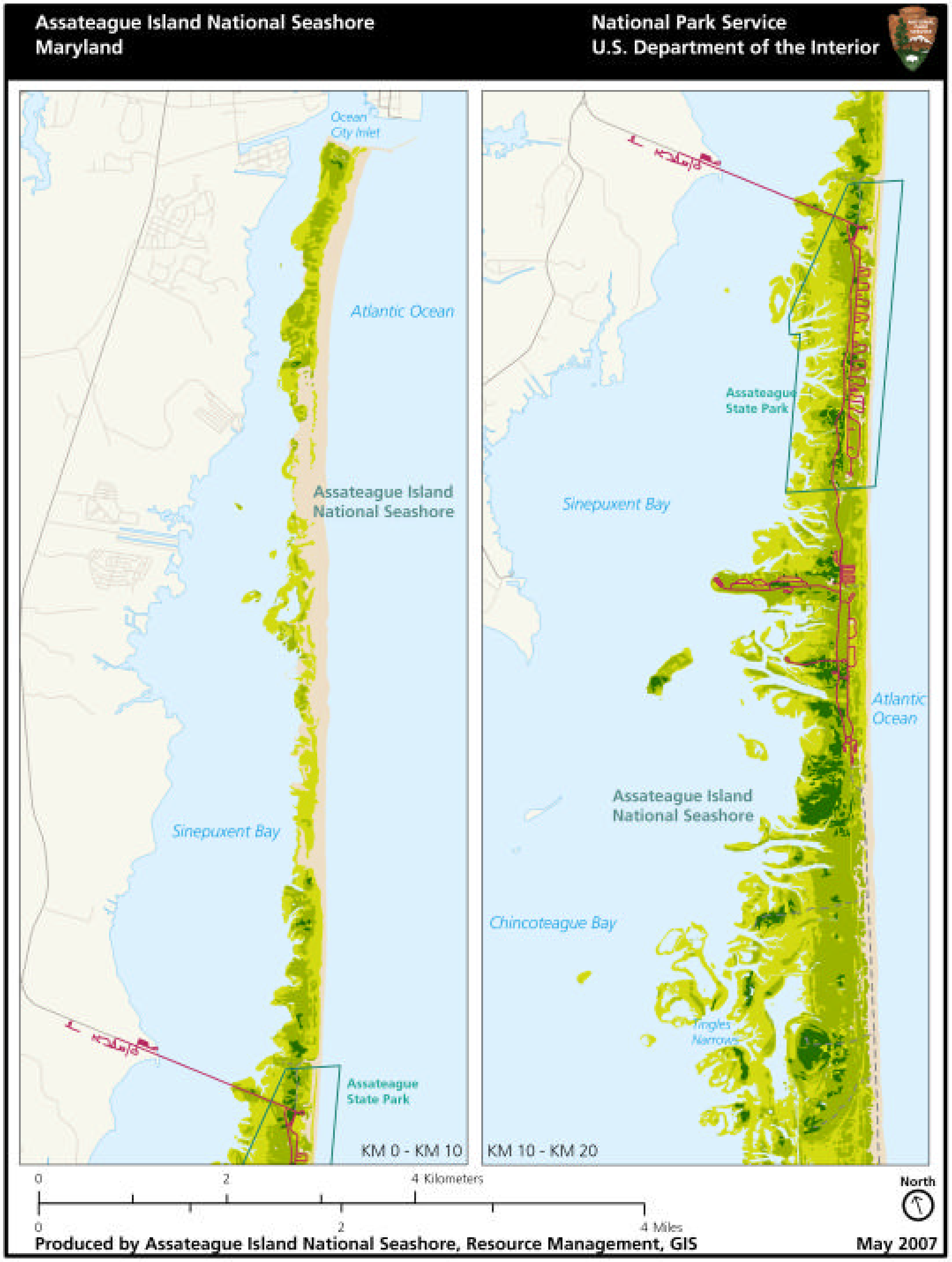
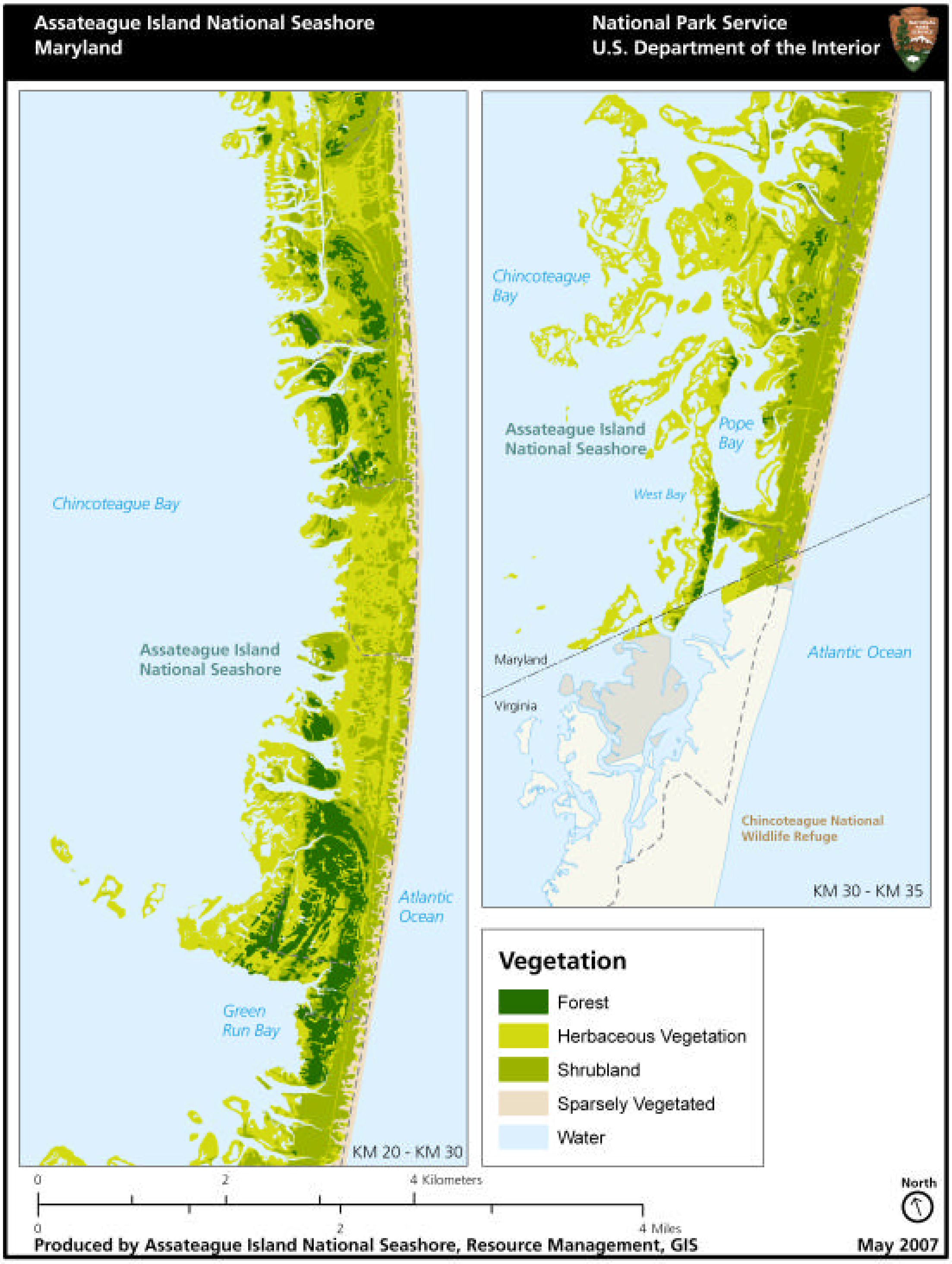


Figure 3.2 Assateague Island National Seashore Vegetation Map. Showing sparsely vegetated, forest, shrubland, herbaceous vegetation and water habitats from kilometers 20 through 35 as measured from the Ocean City Inlet.



Where the island is wide enough to allow sufficient protection from the ocean's salt spray and overwash, trees are able to establish a foothold and maritime forests and woodlands develop. Assateague Island's forests are predominantly composed of loblolly pine (*Pinus taeda*) while red maple (*Acer rubrum*), greenbrier (*Smilax rotundifolia*), and muscadine grape (*Vitis rotunifolia*) also commonly occur. It has recently been learned that feral horses reduce plant diversity in Assateague Island's maritime forest habitats (Sturm 2007b).

On the western side of the island adjacent to the bay, one can find large areas of salt marsh communities dominated by salt marsh cordgrass (*Spartina alterniflora*), a plant species that can tolerate frequent flooding by brackish water by releasing salt through its leaves. The feral horses spend a considerable portion their time grazing in these salt marsh communities. As a result, these communities are discussed in greater detail in the following Wetlands section.

Within the waters of the bay itself, beds of eel grass (*Zostera marina*) and other submerged aquatic vegetation provide shelter and spawning areas for aquatic animals.

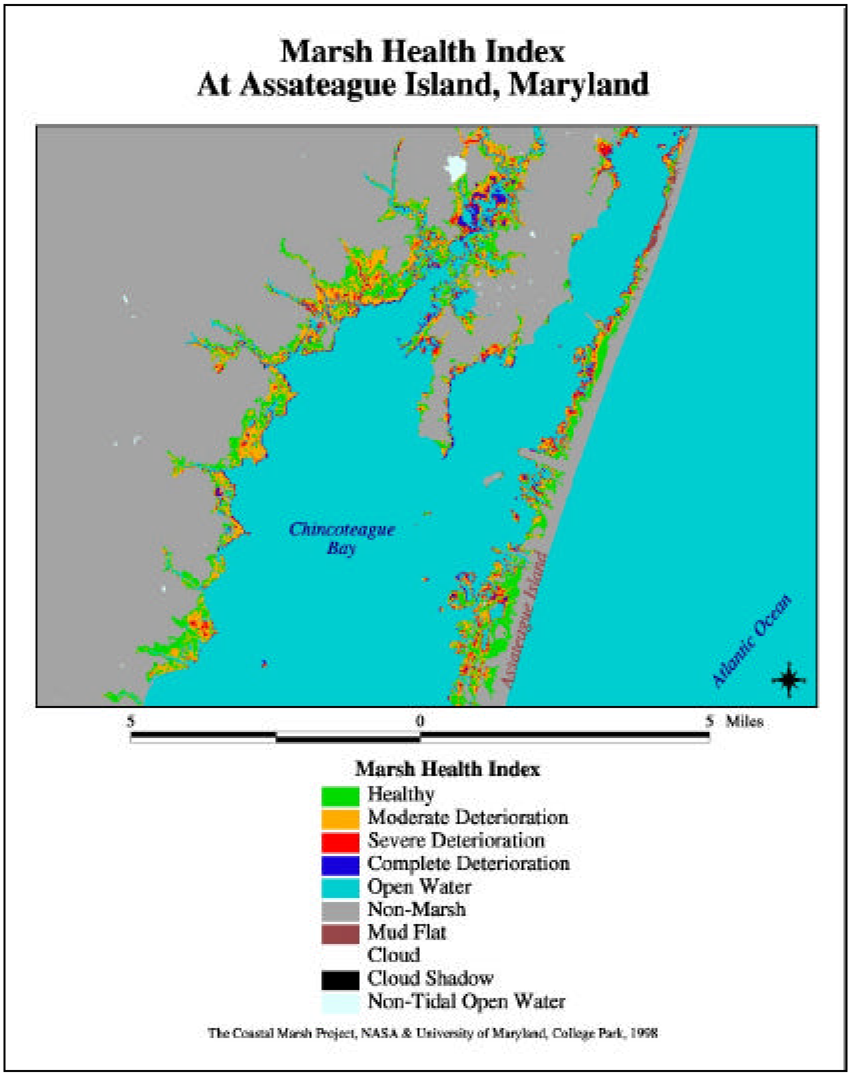
3.4 Wetlands

Assateague Island National Seashore includes approximately 4,700 acres of freshwater and saltwater wetlands, and vernal pools. In Figures 3.1 and 3.2 the distribution and abundance of wetlands on ASIS largely coincides with the areas labeled as herbaceous vegetation.

Regardless of the specific type of wetland, they all share the commonality of being delicate ecosystems that contain diverse populations of flora and fauna, many of which cannot be found elsewhere. The Coastal Marsh Project was a survey completed in 1998 by the University of Maryland and the National Aeronautics and Space Administration (NASA) that identified and categorized the health of wetland habitats found on Assateague Island, among other areas along the east coast. As is illustrated in Figure 3.3, in 1998 the Marsh Health Index classification of wetlands within Assateague Island National Seashore ranged from healthy to completely deteriorated.

Estuarine wetlands are systems consisting of salt and brackish tidal waters and contiguous wetlands where ocean water intermittently dilutes the freshwater runoff from the surrounding land. Approximately 16,600 acres of estuarine wetlands are found along most of ASIS's western bayside areas, which includes the estuarine waters adjacent to the island (USACE 1998). The salinity of this type of system changes with tides throughout the day, and the differences in salinity as well as tidal flooding have a substantial effect on the distribution of these wetland systems, as well as the species that can survive and thrive in them. Bayside marshes include a low salt marsh and a high salt marsh, usually differentiated by elevation and vegetation. ASIS' estuarine wetlands include an estimated 4,100 acres of these salt marsh habitats. The low salt marsh grasses include mostly *Spartina alterniflora* and *Juncus romerianus*, and the high salt marsh grasses include mostly *Distichlis spicata* and *Spartina patens*.

Figure 3.3 Marsh Health Index



Salt marsh wetlands include areas that are regularly flooded each tidal cycle, and areas that are only irregularly flooded during high tidal cycles. The former of these are known as regularly flooded salt marshes, the latter of these are known as irregularly flooded salt marshes (USACE 1998). Interruption of inlet formation and cross-island overwash events by man-made dune lines may be preventing regular, increased-amplitude tidal flushing of salt marshes.

Freshwater wetlands, classified as palustrine wetlands, comprise a much smaller total percentage of wetland habitats on ASIS, comprising an estimated 1,600 acres. These freshwater wetlands lack flowing water, but occasionally might contain some ocean or bay derived salinity (USACE 1998). Freshwater wetlands on Assateague are associated with high water tables and intermittent or vernal ponds that result from rainfall. The majority of these types of wetlands are found between the ocean and the bayside of the seashore.

The freshwater ponds that occur on Assateague Island play a central role in supporting biological diversity by providing habitat for obligate freshwater plant and animal species, and the sole source of freshwater for terrestrial organisms. Flora and fauna closely linked to these systems include most of the island's amphibian population, aquatic reptiles, breeding and migratory waterfowl, aquatic plants intolerant of salt water, and communities of fish and insects.

The ponds are widely scattered throughout the Seashore, often located in close proximity to brackish or tidally influenced saltwater bodies. Many are ephemeral in nature, responding to changes in rainfall, temperature-driven evapotranspiration, and fluctuations in the shallow groundwater aquifer. Storm-driven overwash of ocean waters also influences the quality of waters, resulting in periodic transitions from fresh to brackish conditions.

Salt marshes and freshwater wetlands naturally perform numerous functions that benefit fish and other wildlife, and are critical to maintaining good environmental quality. Salt marshes serve as nurseries for juveniles of many commercial and recreational fish species, and provide essential habitat for wildlife such as waterfowl. Salt marshes provide storm protection and erosion control for adjacent uplands. Salt marshes help maintain good water quality by transforming some pollutants into harmless materials, and serve as a sink for fine-grained sediments to which pollutants adhere. But perhaps of greatest importance is that salt marshes are some of the most productive ecosystems on earth. They produce a tremendous amount of organic material (primarily salt marsh plants) that supports the estuarine foodweb. The magnitude of the beneficial functions performed by salt marsh ecosystems is largely dependent upon their health and spatial coverage. Similarly, healthy freshwater wetlands possess the ability to sequester and transform pollutants, ameliorate agricultural runoff, provide plant and wildlife habitat, and regulate nutrient exchange between terrestrial and aquatic ecosystems.

Research has documented the detrimental effects of feral horses on Assateague Island's salt marsh communities (Stribling 1989, Furbish and Albano 1994). For example, Furbish and Albano concluded that feral horse grazing was responsible for the increased presence of *D. spicata* and *S. patens* in Assateague Island's low salt marshes. Normally, in the absence of horse grazing, these high salt marsh grasses would be out-competed in low salt marsh environments by *S. alterniflora*. The increased abundance of high salt marsh species in low salt marsh areas threatens the health and longevity of Assateague Island's low salt marshes because high marsh species do not tolerate prolonged periods of inundation by salt water. Thus when they die, as a result of inundation they denude areas that would otherwise be occupied and protected from erosion by *S. alterniflora*. Once a threshold of exposed marsh habitat is reached, expansive areas begin to erode and turn into open mud flats or pools. As a result, these areas cease to provide suitable habitat for the fish, crustacean, bird and mammal communities that require abundant low salt marsh habitats and once gone these areas are costly and difficult to restore.

Other factors, such as sea level rise, have also begun to affect the health of Assateague Island's low salt marsh communities. During 2006 a die-back of low salt marsh vegetation occurred which coincided with a prolonged inundation period resulting from a series of heavy rain events and wind-driven high tides during late summer. Low salt marsh monitoring data from the fall of 2006 revealed that at three out of four sites, areas that were protected from feral horse grazing tolerated this prolonged inundation event better than horse grazed areas. This recent event highlights the continued need for long-term monitoring of Assateague Island's low salt marsh communities and reveals that in addition to limiting low salt marsh productivity and altering its plant and animal community composition, feral horse grazing also acts to lower the low salt marsh's ability to withstand other ecosystem stressors.

Marine wetland systems occur from the extreme high water line on the island and extend out many miles to the edge of the continental shelf. The entire Atlantic coastline of Assateague Island is representative of this type of system.

Water Quality

Overall, water quality in the open waters of the coastal bays formed by Assateague Island is reasonably good (USACE 1998) although long-term trend data indicate a worsening of water quality since 2000 (Wazniak et al. 2007). Water quality problems are known to exist in a number of the tidal tributaries and artificial lagoons associated with coastal development on the adjacent mainland. Although conditions in Chincoteague Bay are generally better than waters adjacent to more heavily populated areas, northern portions of the system are being affected by pollutants entering from Newport Bay, one of the most degraded tributaries in the coastal bays system (USACE 1998, Wazniak et al. 2007).

The primary factors affecting water quality are unnaturally high levels of nutrients, which can cause excess algal production leading to eutrophication. Several parameters are of importance in evaluating water quality, including dissolved oxygen, total nitrogen (TN), total phosphorus (TP), and chlorophyll (a measure of water column algae concentration). TN and TP concentrations are increasing as a consequence of human activities in the watershed such as agricultural runoff and the use of septic systems for waste disposal). In turn, high nutrient loads stimulate algae productivity leading to low dissolved oxygen concentrations in the water column and a loss of habitat value for finfish and shellfish, which require oxygen to breathe.

Two species of submerged aquatic vegetation (SAV) occur in the coastal bays: eel grass *(Zostera marina*) and widgeon grass *(Ruppia maritima*) (USACE 1998). SAV that occurs in patches with high percent bottom cover (density) are considered "beds". SAV beds provide important spawning, nursery, feeding, and refuge habitat for numerous species of finfish and shellfish, as well as providing food for migratory waterfowl. SAV also positively impacts water quality by cycling nutrients and increasing sediment stability, thereby increasing water clarity. The Virginia Institute of Marine Science (VIMS) has systematically been mapping SAV within the coastal bays adjacent to Assateague Island since 1986.

A review of existing information (USACE 1998) determined that there were no major water quality problems in the ocean waters adjacent to Assateague Island. The State of Maryland has designated all of its coastal waters (i.e., to the 3- mile limit) as Use II, shellfish harvesting waters. No activities or water quality impacts that would threaten this designation have been reported.

3.5 Feral Horses

The feral horses of Assateague Island are probably the Park's best-known species and represent one of a small number of free-ranging horse populations that can provide long-term longitudinal study in a natural setting. These horses have served as a valuable research resource for decades. The development of new technologies, such as remote pregnancy testing, fetal health evaluation, and ovarian endocrine function in large free-ranging wildlife, immunocontraception, and fecal DNA analysis in free-ranging horses all began with the Assateague horses. The scientific legacy of Assateague wild horse research now extends worldwide and across hundreds of species.

Abundance and Distribution

The number of feral horses inhabiting ASIS grew from an initial population of approximately 28 in 1968 when the NPS first acquired ownership, to a peak of 175 horses in 2001. Since then, the population has decreased to its current size of approximately 140 in response to the ongoing contraception program first initiated in 1994 (See Table 3.1 Historical Trends, Events and Population Sizes of Feral Horses at ASIS).

The feral horses are currently organized in 26 harem bands, although that number fluctuates throughout the year. Harem bands usually consist of one stallion, several mares and their offspring. These bands are matriarchal and dominant mares lead their bands through daily routines of foraging, resting and trips to water (Keiper 1976). Some bands stay in one general location for the year while others move to different areas during the summer. The degree of summer movement is believed to be related to biting insect densities and vary annually, and is described in Keiper and Berger (1982), Rutberg (1987), and Powell et al. (2006). Half (13) of the current harem bands occupied single year-round ranges during 2006, while the bands that migrated moved from 3 to 12 kilometers between their summer and winter ranges. Half of the bands that migrated (6) moved 10 or more kilometers. Eight bands live year-round in the developed area or north end, with 10 more bands moving in to these areas for the summer (NPS staff, ASIS, pers. comm.). See Figure 3.4 for examples of summer and winter harem band distribution on ASIS.

Nutrition and Reproduction

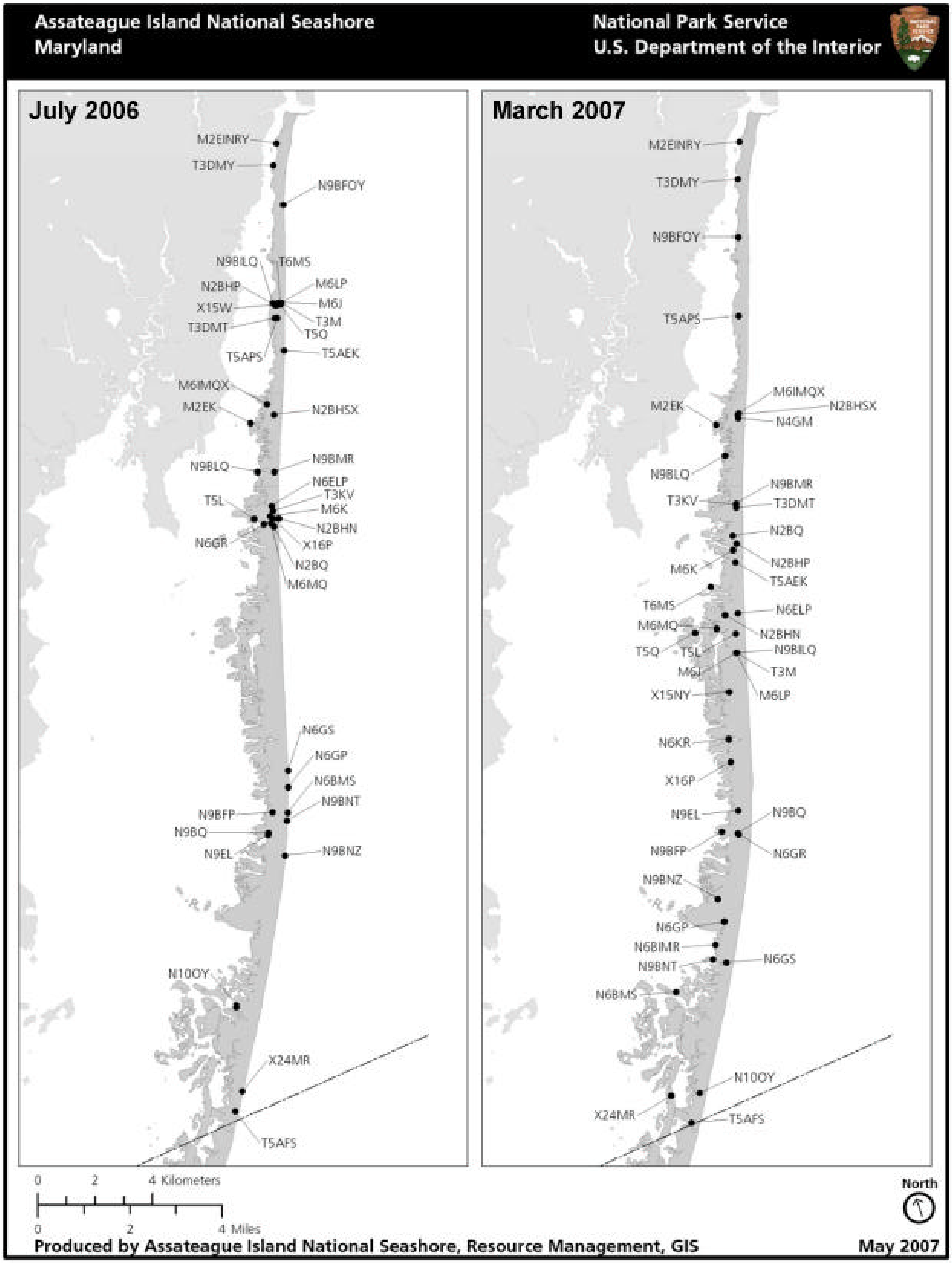
The feral horses on ASIS forage primarily on low salt marsh cordgrass along the bay and American beachgrass on the oceanside dunes, usually spending more time grazing in the salt marsh. During the summer, bands exhibit a daily movement pattern of grazing on the dunes during the early morning hours and then moving toward the bay and into the marshes by late afternoon, however this pattern was not observed during the winter months, when the herds would graze a given habitat throughout the entire day (Zervanos and Keiper 1979). In the summer, they graze 61% of the time in the salt marsh and up to 34% of the time on the dunes (Zervanos 1978). In the winter, they graze up to 40% of the time in the salt marsh and up to 26% of the time on the dunes (Zervanos and Keiper 1979).

Table 3.1 Historical Trends, Events and Population Sizes of Feral Horses at ASIS

YEAR	SPRING HERD	HAREM BANDS	FOALS	KNOWN DEATHS	EEE/ STORMS	TRANSFER	Treat w/ PZP (% of mares)	
1961	9							
1966	10+							
1967	21							
1968	28							
1969	35							
1970								
1971	50				EEE			
1972								
1973								
1974					EEE			
1975	44		10	1				
1976	42		9	0				
1977	51		12	0				
1978	57	6	15	2				
1979	62		9	1				
1980	68		19	1		1		
1981	78	8	18	2				
1982	86		18	10				
1983	104		26	5				
1984	115		24	2		3		
1985	125	12	25	5				
1986	140		25	9		7		
1987	155		27	5				
1988	129		35	14		12	28	
1989	129		17	32	7+ EEE	7	18	
1990	142	22	26	33	7+ EEE		10	
1991	143	25	25	11		1	10	
1992	143	25	30	24	12 storm		30	
1993	156	26	22	13	1 EEE		16	
1994	166	29	22	6		13	76	95%
1995	166	28	10	6			68	83%
1996	171	29	5	9			72	84%
1997	166	28	7	4			54	59%
1998	171	29	3	6		2	49	52%
1999	168	30	7	4			48	52%
2000	170	30	11	7			64	68%
2001	175	33	5	6			75	79%
2002	172	32	7	5			66	69%
2003	173	29	5	8		1	66	70%
2004	166	29	5	15		1	74	76%
2005	158	29	9	14			69	71%
2006	143	27	4	20			65	71%
2007	137	26	1	5			55	69%

NOTES: Foals were counted from original Keiper field sheets; some were never ID'd, so numbers are sometimes slightly larger than counts pulled from other sources.

Figure 3.4 Feral Horse Harem Band Locations on Assateague Island National Seashore



Drinking water is obtained from fresh water ponds located in the island interior and daily travel usually includes much of the island width. The salty diet requires the intake of large volumes of fresh water, which results in the bloated look of many of the horses.

Gender, habitat, and reproductive status appear to have an effect on feral horse body condition (Rudman and Keiper 1991). Body condition of stallions is better than that of mares, and lactating mares have lower body condition scores than non-lactating mares (Keiper and Houpt 1984, Rudman and Keiper 1991). The poorer body condition of lactating mares could result from the combined effects of habitat and reproductive requirements. In lactating mares, milk production during the first 12 weeks following parturition is equivalent to 3% of a mare's body weight. These lactating mares appear unable to ingest enough food for the demands of peak lactation and they lose weight during this period (Keiper and Houpt 1984, Rudman and Keiper 1991).

Nutritional limitations also appear to affect reproductive potential. Keiper and Houpt (1984) found the foaling rate of the feral horse population averaged only 57%, which they attributed to nutritional stress imposed on pregnant and lactating mares by the poor quality forage. Broken down by age, before contraceptive management, the foaling rate of 3-year-old mares was 23%, that of 4-year-old mares was 46%, that of 5-year-old mares was 53%, and 6-year-old mares was 69%. For the Assateague horses, the weaning period is one to three years depending upon foaling frequency (Kirkpatrick and Turner 1991). Because of the energetic costs associated with lactation, mares that are unable to wean their offspring within a year are generally incapable of ovulation.

Breeding activity is at its highest during the late spring and early summer months, and gestation is 11.5 months. Births have been documented in every month, but foaling occurs primarily in April, May and June. From 1975-1982, 88% of foals were born between April and June, and 53% of foals were female (Keiper and Houpt 1984). During this same period (prior to the use of contraceptives) the feral horse population grew by more than 10% each year (Keiper and Houpt 1984).

Life Expectancy

The feral horses on ASIS have no natural predators. Foals and yearlings have a survival rate of 88%, and animals over two have a greater than 90% survival rate (Keiper and Houpt 1984). Prior to the institution of birth control, life expectancy was around 17 years for both sexes. The use of immunocontraceptives has apparently improved the health of breeding aged mares, resulting in an increased life span of up to 5-10 years, but the age of mortality for stallions has remained constant (Turner and Kirkpatrick 2002).

Disease and Mortality

Disease can influence the ASIS feral horse population. Most noteworthy are the periodic outbreaks of the mosquito-borne virus Eastern Equine Encephalitis (EEE) that have impacted the feral horse population on several occasions in the past (See the sixth column in Table 3.1 Historical Trends, Events and Population Sizes of Feral Horses at ASIS). West Nile Virus

(WNV) also has the potential to cause substantial mortality although the death rate of infected horses is much lower than that caused by EEE infection. No evidence of WNV related mortality has been documented at ASIS.

Moderate to high internal parasite loads might influence the health and fitness of feral horses. A casual observation of fecal egg counts of gastrointestinal parasites was made in 1986 (Howard unpublished data). Counts from 4 species were low to moderate, but the species observed have the potential to cause serious infections. An undergraduate study completed in 2002 reported similar results, with low to moderate parasite levels observed in most of the Assateague horses sampled (McCulloh unpublished data).

External parasites consist largely of ticks. A survey of the Lyme disease spirochete *(Borrelia burgdorferi)* and Ixodes (deer) ticks was made on island mammals (Oliver 1988). Some 15% of the feral horses sampled were seropositive for Lyme disease, but the effect of this bacterium is only speculative.

Major injuries to individual feral horses are generally rare, but occasionally result from social interactions (e.g., fights between stallions) or normal activities. Most severe injuries result from impacts with motor vehicles, claiming an average of one horse per year.

Other catastrophic events, like major landscape altering storms, are unpredictable and relatively rare along the Mid-Atlantic coast. The long-term impact of storms on the Assateague feral horse population is not known, although there have been documented mortalities associated with decadal-scale storms as occurred during a powerful northeaster in 1992. (See the sixth column in Table 3.1 Historical Trends, Events and Population Sizes of Feral Horses at ASIS).

Social Organization

Dominance is determined by observing aggressive interactions between pairs of individuals. Dominant horses have priority access to resources, but no correlation between rank and physical condition has been found. Observing changes in hierarchies over time revealed that age apparently correlates with dominance rank, although kinship does not appear to have an effect on rank (Keiper and Sambraus 1986). Band stallions were not the highest-ranking animals of any band, and usually are located farther away from their nearest neighbors for a greater percentage of time than other band members (Keiper and Sambraus 1986).

Generally, older mares dominate younger mares, and larger mares dominate smaller mares. A study by Rutberg and Greenberg (1990) revealed that when age was controlled, large mares initiated aggression more often than small mares, but surprisingly, when size was controlled, older mares initiated aggression less often than younger mares. Mares peak in aggressiveness fairly soon after achieving full size and then, while maintaining or improving their rank in the dominance hierarchy, progressively reduce their involvement in aggression as they grow older. Aggression was shown to be directed more frequently than expected at subordinate mares that were nursing, and also occurred more frequently than expected at water holes (Rutberg and Greenberg 1990)

An investigation of the relationship between female rank and reproductive success suggests that high-ranking females are more likely to foal than low-ranking mares (Seligsohn 1987). Although another study found that mares with foals did not rank any higher in the hierarchies than mares without foals, subordinate mares with foals received aggression more often than subordinate mares without foals (Keiper and Sambraus 1986, Rutberg and Greenberg 1990). The high frequency of aggression associated with foals and nursing suggest that interference with reproduction of subordinate mares is an important mode of competition between mares (Rutberg and Greenberg 1990).

Immunocontraception (PZP)

Since 1994, mares on Assateague Island National Seashore have been treated with the porcine zona pellucida (PZP) immunocontraceptive vaccine as a management tool to inhibit reproduction (NPS 1994). Trained personnel deliver inoculations by dart. All mares aged 2 years and older are treated with the immunocontraceptive (PZP) for three consecutive years and are then removed from treatment until they foal.

Contraceptive management of publicly valued wildlife species requires safeguards to ensure that these populations are preserved in a healthy state. In addition, reversibility of contraceptive effects and safety in pregnant animals are major concerns.

From 1986 to 1994, Kirkpatrick (1995) conducted research at ASIS in order to develop methods of managing feral horses using fertility control. Immunocontraception using the PZP vaccine was found to successfully prevent contraception in mares, however it did not interfere with pregnancies in progress and furthermore did not interfere with social organization. A single annual booster was adequate to continue contraception and after 120 mare-years of PZP contraception, only four foals were born (Kirkpatrick 1995). Reversal of contraception action was documented in mares after 1, 2, 3 and 4 years of consecutive treatment. In addition, methods were developed for the detection of pregnancy in uncaptured feral horses using urinary and fecal estrogen metabolites, progesterone metabolites, and fecal total estrogens. These methods were used to assess the effects of seven consecutive years of PZP immunocontraception upon ovarian function (Kirkpatrick et al. 1995).

This research showed that all mares vaccinated for one or two consecutive years became fertile again, and 69% of mares treated for three consecutive years returned to fertility (Kirkpatrick and Turner 2002). Mares treated for four or five consecutive years also returned to fertility, but over longer periods of time, and mares treated for seven consecutive years did not return to fertility during the study period. Mares treated for seven consecutive years failed to ovulate and had depressed estrogen concentrations. However, no other side effects were noted (Kirkpatrick and Turner 1992, Kirkpatrick et al. 1995).

There have been no observed long-term adverse effects of immunocontraception on the biology or the social organization of the feral horses (Kirkpatrick et al. 1992). There is no difference in survival rates between foals born to treated and untreated mares, and PZP treatment of pregnant mares does not affect subsequent fertility of their female offspring (Kirkpatrick and Turner 2003).

A study evaluating the effects of PZP immunocontraception on the behavior and reproductive physiology of feral horses on ASIS was conducted in order to determine if contraception has an effect on the dominance structure of bands. No differences were found between treated and untreated mares in their foraging activity, sexual behavior, aggressive behavior or spatial relationships (Powell 1999).

Population Genetics

The Smithsonian Institution conducted an assessment of the genetic status of the feral horse population of ASIS. Using genotype data acquired from all horses living on the island during the study, existing maternal pedigrees developed by the NPS through long-term monitoring were affirmed and amended, and inferred for individuals that were born when records were incomplete. Genetically-verified pedigree data was used to conduct genetic and demographic condition analyses, including assessments of the effects of selective culling. The study found that there is less mitochondrial DNA diversity within the Assateague population than has been found in other established breeds, suggesting that the population derived from a limited founder population and has evolved in relative isolation. Levels of nuclear diversity were relatively high and comparable to that found in established breeds (Eggert et al. 2005). Preliminary results suggest that the Assateague feral horses might be somewhat genetically different from other breeds worldwide (Eggert et al. 2005).

Human–Feral Horse Interaction and Safety

On Assateague, interactions between feral horses and humans result from both the feral horse's curious nature and the propensity for people to, intentionally or through lack of knowledge, interact with them. Most interactions involve the horse's attraction to human foods. The extent to which a feral horse is conditioned to humans and their food can influence its behavior and the level of management needed to prevent harmful interactions with people. The Park has defined the behavioral levels resulting from habituation to humans and food, and describes the actions needed to ensure the safety of both horses and humans in the *Response Protocol for Field Personnel for Dealing with Problem Horses* (NPS 2003a).

A problem horse displays behavior that is described as being beyond severely habituated. Some of the behaviors seen in past problem horses include: biting visitors or their clothing if the visitor is carrying bags or eating food, pushing people out of the way to get at food or containers, refusing to move from a food location (e.g., tent, picnic table), and destroying property (e.g., tents, coolers) to get at food. The NPS has periodically removed problem horses from the Park to protect visitor safety, generally by transferring them to the CNWR herd.

Between 1980 and 2004, a total of 48 horses have been captured and removed from ASIS to reduce visitor/horse conflicts in the campgrounds and developed areas. Most of these removals occurred in 1988 and 1994, when groups of severely habituated and problematic horses were moved from the Park to the Virginia end of Assateague Island and ownership transferred to the Chincoteague Volunteer Fire Department. Beginning in 1995, the Park adopted new measures to reduce adverse human-horse interactions and prevent horses from becoming problematic.

Programs such as the Volunteer Pony Patrol and more stringent food storage requirements have successfully reduced the frequency of harmful interactions and the number of horses developing problematic behavior. See Table 3.1 Historical Trends, Events and Population Sizes of Feral Horses at ASIS for information regarding removals of feral horses throughout the history of ASIS.

3.6 Other Wildlife and Wildlife Habitat

Assateague Island is one of several barrier island National Parks that protect unique coastal habitats along the Atlantic seaboard. Assateague hosts a myriad of wildlife including spring and fall migrants as well as many species that breed or live on the island year-round. Many of the wildlife species breeding or residing on the island are dependent on specific host species or communities that are only found on coastal barriers. Due to their habitat requirements, some of these species are not found elsewhere in Maryland. As the only natural barrier beach remaining in Maryland and for much of the Delmarva Peninsula, the island serves as a critical component in support of the local occupation by these species, and a vital link bridging other remaining population nodes along the East Coast.

By wildlife groups, there are generally more species found on the Maryland mainland than the island. Several factors are thought to account for this discrepancy. Harsh environmental conditions, limited opportunities for immigration, as well as restrictions on range size and habitat patchiness, probably restrict the species that can successfully survive on Assateague.

Fish and Invertebrates

The sheltered, nutrient rich waters of the estuary formed by Assateague Island provide ideal breeding and spawning habitat for many aquatic species, some of which, like the blue crab (*Callinectes sapidus*), are commercially important to the local area. Each spring a variety of fish, including spot (*Leiostomus xanthrurus*), Atlantic menhaden (*Brevoortia tyrannus*) and summer flounder (*Paralichthys dentatus*) migrate into the estuary to breed. Some of the more common species within the coastal bays include black drum, bluefish, winter flounder, menhaden, spot, Atlantic croaker, weakfish, mullet, and spotted sea trout (USFWS 1993b).

A recent assessment of Maryland's coastal bays evaluated the overall health and condition of the region's estuarine ecosystems, including the waters adjacent to Assateague Island. The analysis included results from the Coastal Bays Fisheries Investigation Program (1986-2004) and a Shellfish Program Molluscan Inventory (1993-1996) conducted by the Maryland Department of Natural Resources (Wazniak and Hall 2005). These inventories included status reviews of finfish, shellfish, and benthic invertebrate communities including blue crabs and horseshoe crabs. The ecosystem assessment combined several indicators to measure the overall health of the coastal bays and concluded that Sinepuxent Bay was in the best health of all the Maryland Coastal Bays. Chincoteague Bay was rated as being in good condition.

Elsewhere within the Maryland Coastal Bays, the condition of local fisheries has deteriorated since the 1980's, corresponding to a generalized decline of both habitat and water quality conditions (Wazniak et al. 2007). One noticeable trend has been the decline in abundance of recreational and commercial fish species, including summer flounder, bluefish, Atlantic croaker, spot and American eel. Other observations include a shift in community composition towards more pollution-tolerant forage fish species (Wazniak and Hall 2005).

The 1996 Magnuson-Steven Act requires cooperation among the National Marine Fisheries Service (NMFS), fishing participants, and other federal and state agencies to protect, conserve, and enhance essential fish habitats. Essential fish habitat is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 USC 1802(10)). Essential fish habitat for various life stages of fish species including red hake, winter flounder, witch flounder, windowpane flounder, Atlantic sea herring, bluefish, Atlantic butterfish, summer flounder, scup, black sea bass, whiting, king mackerel, Spanish mackerel, cobia, sand tiger shark, dusky shark, and sandbar shark occur in the vicinity of the ASIS (NPS 2002b).

The aquatic environments surrounding Assateague Island also provide ideal habitat for a diverse marine invertebrate community including, but not limited to, mollusks, crustaceans, annelids, arthropods, sponges, corals, bryozoans, nematodes and tunicates. Two hundred ninety-eight species representing 131 families were documented during a benthic invertebrate inventory study conducted between 1994 and 1996 (Prezant and Counts 2002).

Once the lifeblood of local communities, commercial harvesting of oysters, clams and bay scallops in Maryland's coastal bays has declined dramatically over the past century due to over-harvesting, disease, predation, and changes in habitat conditions. At present, only the commercial clam fishery remains viable. In 1996 the MD DNR Shellfish Monitoring Program investigated restoring the Atlantic bay scallop in Chincoteague Bay, and transplanted over a half million seed bay scallops to Chincoteague Bay. In the summer of 2000 Maryland DNR and the Virginia Institute of Marine Science discovered "wild" bay scallops in Chincoteague Bay, marking the return of this ecologically important species to Chincoteague Bay although not to levels capable of supporting commercial harvest (Wazniak and Hall 2005).

Because shellfish are highly susceptible to pollutants from untreated sewage (fecal coliform bacteria) and stormwater runoff, the state of Maryland monitors fecal bacteria contamination levels within the coastal bays. To protect human health, safety zones, from which no shellfish are allowed be taken, are established around possible pollution source areas such as marinas, wastewater treatment plants and wastewater pumping stations. There are no shellfish closures within the water boundary of the National Seashore.

Until recently, the terrestrial invertebrate communities inhabiting Assateague Island were poorly documented and understood. An ongoing baseline inventory of selected insect groups has, however, begun to shed light on this important component of the island ecosystem. The study is developing species occurrence data for odonates (dragonflies and damselflies), lepidopterans (butterflies and macro-moths), orthopterans (grasshoppers, katydids and crickets), hymenopterans (bees and wasps), and leaf beetles. The study is also generating habitat-based inventories of the arthropod communities utilizing freshwater ponds and salt marshes. As of 2006, more than 450 insect species have been documented (Orr 2006).

Reptiles and Amphibians

Assateague Island and the surrounding waters provide habitat supporting 19 species of reptiles and 7 species of amphibians (Mitchell 1994, Brotherton 2005). The most recent surveys of the reptile and amphibian community were conducted in 2004-2005 by Brotherton, during which a total of 18 species were recorded. Several of the species historically documented as occurring within ASIS have been found only in the Virginia portion of the island where artificially created water impoundments have increased habitat diversity. For a list of all reptiles and amphibians known to occur at ASIS, see Table 3.2.

Table 3.2 Reptiles and Amphibians known to occur at ASIS

Scientific Name	Common Name
Amphibians	
Bufo woodhousii fowleri	Fowler's toad
Hyla cinerea	green treefrog
Pseudacris triseriata kalmi Harper	New Jersey chorus frog
Hyla versicolor	gray treefrog
Rana catesbeiana Shaw	bullfrog
Rana clamitans melanota	green frog
Rana sphenocephala Cope	southern leopard frog
Reptiles	
Caretta caretta	loggerhead sea turtle
Chelonia mydas mydas	Atlantic green turtle
Lepidochelys kempi	Kemp’s Ridley turtle
Dermochelys coriacea	leatherback sea turtle
Chelydra serpentina serpentina (Linnaeus)	common snapping turtle
Chrysemys picta picta	eastern painted turtle
Clemmys guttata	spotted turtle
Malaclemys terrapin terrapin	northern diamondback terrapin
Terrapene carolina Carolina	eastern box turtle
Pseudemys rubriventris	northern red-bellied cooter
Kinosternon subrubrum subrubrum	eastern mud turtle
Sceloporus undulates hyacinthinus	northern fence lizard
Coluber constrictor constrictor	northern black racer
Elaphe obsolete obsolete	black rat snake
Heterodon platirhinos	eastern hognose snake
Nerodia sipedon sipedon	northern water snake
Opheodrys aestivus aestivus	northern rough green snake
Storeria dekayi dekayi	northern brown snake
Thamnophis sirtalis sirtalis	northern garter snake

Of the 18 species most recently observed within the Maryland portion of ASIS, eleven appear to be stable in terms of their population trends, seven are more common than previously reported, and the remaining five species have experienced decline. Much of the decline seems to involve species that were uncommon or rare to begin with. Their apparent disappearance from ASIS is likely due to their intolerance to the barrier island environment along with the Park's geographic isolation (Brotherton 2005).

Eleven species of turtles have been observed at ASIS, all but one of which are dependent on aquatic habitats. Five of these species occur exclusively in the island's freshwater habitats: eastern mud turtle (*Kinosternon s. subrubrum*), common snapping turtle *(Chelydra serpentine)*, spotted turtle (*Clemmys guttata*), eastern painted turtle (*Chrysemys picta*), and northern red-bellied cooter (*Pseudemys rubriventris*). The sole terrestrial species, the eastern box turtle *(Terrapene c. carolina)* is relatively uncommon.

The northern diamondback terrapin (*Malaclemys t. terrapin*), the official Maryland State reptile, is an estuarine dependant species occurring primarily in the protected bays and marshes on the western side of Assateague. Terrapins appear to be fairly abundant around Assateague Island although there is thought to be considerable mortality associated with by-catch from commercial crabbing. In response to a perceived statewide decline, the state of Maryland recently closed the commercial terrapin fishery.

Northern diamondback terrapins depend on dry, sandy substrates for nesting such as that found in secondary dune habitats on Assateague. NPS anecdotal observations suggest that heavy nest depredation is occurring, primarily by fox and raccoons. Feral horses regularly traverse across and forage within these interior dunes, but it is uncertain whether trampling of eggs and nests is adding to the stress on the terrapin population.

Four species of marine sea turtles have been documented within ASIS waters including the Atlantic loggerhead *(Caretta carett*a), green sea turtle *(Chelonia mydas)*, leatherback turtle *(Dermochelys coriacea)*, and Kemp's Ridley sea turtle (*Lepidochelys kempi*). All of these species are federally listed as either threatened or endangered. Loggerheads occasionally nest on Assateague, primarily on the southern end of the island, and single events of leatherback and green sea turtle nests have been documented. Most observations occur as strandings, when sea turtles killed by boat collisions, commercial fishing gear or through natural causes wash ashore on the island. Ninety percent of sea turtle strandings are loggerheads.

Only one species of lizard has been documented on Assateague Island, the northern fence lizard *(Sceloporus undulates hyacinthinus)*. This very uncommon species occurs in forested and shrub-thicket habitats.

Of the nineteen species of snakes living on the neighboring mainland of the Delmarva Peninsula, only seven have been found on Assateague Island, all of which are non-venomous. Some of the most wide-ranging species like the black rat snake *(Elaphe obsolete obsoleta)* can be found in most of the island's habitat types. The eastern hognose snake *(Heterodon platirhinos)*, which is often mistaken for the venomous copperhead, prefers beaches, dunes, and grassy, open areas, while the northern water snake *(Nerodia sipedon)* prefers salt marshes and fresh or brackish ponds.

Environmental factors, such as scarcity of freshwater habitat, high levels of salinity, and the absence of a connection to the mainland play a major role in limiting the diversity of amphibians on Assateague. While six species of frogs and toads have been identified on the Maryland portion of Assateague Island, by comparison, 23 species of amphibians have been recorded on the neighboring mainland. Despite the limited number of species present, amphibians play a key role in the ecosystem, preying on a wide variety of insects and helping to maintain a balance in population levels. The most abundant amphibian on Assateague Island is the Fowler's toad (*Bufo woodhousii fowleri*). Like all amphibians, the Fowler's toad is dependent on the island's freshwater ponds and wetlands for reproduction.

Birds

Assateague Island is one of the few remaining undeveloped barrier islands in the Mid-Atlantic coastal region and, as such, provides natural habitat for a broad range of birds. At least 338 species (Hoffman, MD DNR, pers. comm.) of migratory and resident birds have been observed at ASIS including shorebirds, songbirds, raptors, waterfowl, and wading birds. Seasonal residents include waterfowl such as brant (*Branta bernicla*) and snow geese (*Chen caerulescens*) in the winter, and the brown pelican (*Pelecanus occidentalis*) in the summer. Other summer residents include colonial nesting waterbirds like least terns (*Sterna antillarum*) and common terns (*Sterna hirundo*), and breeding shorebirds such as the American oystercatcher (*Haemantopus palliatus*) and willet (*Catoptrophorus semipalmatus*).

Owing to its location along the coast, Assateague Island is important part of the Atlantic Flyway for migratory birds. Seasonal migrations include impressive passages such as the spring movement of whimbrels (*Numebius phaeopus*) from South America, pausing to rest at Assateague on their way to breeding grounds in the Alaskan tundra, and the fall migration of peregrine falcons (*Falco peregrinus*) on their way from the Artic to wintering grounds in the Southern Hemisphere. Because of its importance to migratory birds, Assateague Island has been designated a Globally Important Bird Area by the Audubon Society and is a component of the Western Hemisphere Shorebird Reserve Network.

To complete their annual intercontinental treks, migratory species require protected habitat for resting and feeding of the types occurring on Assateague Island and other natural barrier islands. Habitat quality, particularly on the open ocean beaches, can be compromised by human activities and disturbance by feral horses during the migratory periods.

The most recent landbird inventory was conducted in 1992 by the Maryland Department of Natural Resources, Wildlife Heritage Service (McCann 1992). The Chincoteague National Wildlife Refuge keeps an ongoing bird check list on their website of birds that visit, nest, and breed on Assateague Island. See Table 3.3 for Chincoteague National Wildlife Refuge list of birds occurring on Assateague Island (<http://www.fws.gov/northeast/chinco/birdlist.htm>).

Table 3.3 Birds known to occur on Assateague Island, prepared by Chincoteague National Wildlife Refuge.

JAEGERS-GULLS	**BITTERNS-HERONS**	**GROUSE-QUAIL-**
-TERNS-AUKS	**-IBISES**	**TURKEY**
laughing gull	American bittern	northern bobwhite
black-headed gull*	least bittern	
Bonaparte's gull	great blue heron	**RAILS-CRANES**
ring-billed gull	great egret	yellow rail*
herring gull	snowy egret	black rail*
lesser black-backed gull*	little blue heron	clapper rail
great black-backed gull	tricolored heron	king rail
gull-billed tern	cattle egret	Virginia rail
Caspian tern	green heron	sora
royal tern	black-crowned night-heron	Purple gallinule*
sandwich tern	yellow-crowned night-heron	common moorhen
roseate tern	white ibis*	American coot
common tern	glossy ibis	
arctic tern*		**PLOVERS-SANDPIPERS**
Forster's tern	**SWANS-GEESE-DUCKS**	black-bellied plover
least tern	tundra swan	American golden-plover
black tern	mute swan	Wilson's plover
black skimmer	greater white-fronted	semipalmated plover
	goose*	piping plover
GANNET-PELICANS-	greater snow goose	killdeer
CORMORANTS	brant	American oystercatcher
northern gannet	Canada goose	black-necked stilt
American white pelican	wood duck	American avocet
brown pelican	green-winged teal	greater yellowlegs
great cormorant*	American black duck	lesser yellowlegs
double-crested cormorant	mallard	solitary sandpiper
	northern pintail	willet
SHEARWATERS-STORM-	blue-winged teal	spotted sandpiper
PETRELS	northern shoveler	upland sandpiper*
Cory's shearwater*	gadwall	whimbrel
greater shearwater*	Eurasian wigeon	hudsonian godwit
sooty shearwater*	American wigeon	marbled godwit
Wilson's storm-petrel*	canvasback	ruddy turnstone
	redhead	red knot
LOONS – GREBES	ring-necked duck	sanderling
red-throated loon	greater scaup	semipalmated sandpiper
common loon	lesser scaup	western sandpiper
piled-billed grebe	common eider	least sandpiper
horned grebe	oldsquaw	white-rumped sandpiper
red-necked grebe	black scoter	Baird's sandpiper
eared grebe*	surf scoter	pectoral sandpiper
	white-winged scoter	dunlin

WOODPECKERS -FLYCATCHERS red-headed woodpecker red-bellied woodpecker yellow-bellied sapsucker downy woodpecker hairy woodpecker northern flicker pileated woodpecker* olive-sided flycatcher* eastern wood-pewee yellow-bellied flycatcher* Acadian flycatcher willow flycatcher* least flycatcher* eastern phoebe great crested flycatcher western kingbird* eastern kingbird **LARKS-SWALLOWS -JAYS-CROWS** horned lark purple martin tree swallow northern rough-winged swallow* bank swallow* barn swallow blue jay American crow fish crow **VULTURES-HAWKS-FALCONS** black vulture turkey vulture osprey bald eagle northern harrier sharp-shinned hawk Cooper's hawk red-shouldered hawk red-tailed hawk rough-legged hawk American kestrel	common goldeneye bufflehead hooded merganser common merganser* red-breasted merganser ruddy duck **WAXWINGS-SHRIKES -STARLINGS** American pipit cedar waxwing European starling **KINGLETS-THRUSHES - THRASHERS** golden-crowned kinglet ruby-crowned kinglet blue-gray gnatcatcher eastern bluebird veery Bicknell's thrush Swainson's thrush hermit thrush wood thrush American robin gray catbird northern mockingbird brown thrasher **TITMICE-NUTHATCHES-WRENS** Carolina chickadee tufted titmouse red-breasted nuthatch white-breasted nuthatch brown-headed nuthatch brown creeper Carolina wren house wren winter wren* sedge wren marsh wren **VIREOS-WOOD WARBLERS** white-eyed vireo	curlew sandpiper* stilt sandpiper buff-breasted sandpiper* ruff* short-billed dowitcher long-billed dowitcher common snipe American woodcock Wilson's phalarope red-necked phalarope **DOVES-CUCKOOS -OWLS-SWIFTS -HUMMINGBIRDS** rock dove mourning dove black-billed cuckoo yellow-billed cuckoo barn owl* eastern screech-owl great horned owl snowy owl* long-eared owl* short-eared owl common nighthawk chuck-will's widow chimney swift ruby-throated hummingbird belted kingfisher **BLACKBIRDS-FINCHES** bobolink* red-winged blackbird eastern meadowlark yellow-headed blackbird* rusty blackbird* boat-tailed grackle common grackle brown-headed cowbird orchard oriole Baltimore oriole purple finch house finch red crossbill* common redpoll* pine siskin*

merlin peregrine falcon **TANAGERS-SPARROWS** summer tanager scarlet tanager northern cardinal rose-breasted grosbeak blue grosbeak indigo bunting dickcissel* eastern towhee American tree sparrow* chipping sparrow clay-colored sparrow* field sparrow vesper sparrow* lark sparrow* savannah sparrow grasshopper sparrow* Henslow's sparrow* saltmarsh sharp-tailed sparrow Nelson's sharp-tailed sparrow* seaside sparrow fox sparrow song sparrow Lincoln's sparrow swamp sparrow white-throated sparrow white-crowned sparrow* dark-eyed junco lapland longspur snow bunting	solitary vireo yellow-throated vireo warbling vireo Philadelphia vireo red-eyed vireo blue-winged warbler golden-winged warbler Tennessee warbler orange-crowned warbler Nashville warbler northern parula yellow warbler chestnut-sided warbler magnolia warbler Cape May warbler black-throated blue warbler yellow-rumped warbler black-throated green warbler Blackburnian warbler yellow-throated warbler pine warbler prairie warbler palm warbler bay-breasted warbler blackpoll warbler cerulean warbler black-and-white warbler American redstart prothonotary warbler worm-eating warbler Swainson's warbler ovenbird northern waterthrush Louisiana waterthrush Kentucky warbler Connecticut warbler common yellowthroat hooded warbler Wilson's warbler Canada warbler yellow-breasted chat	American goldfinch evening grosbeak* **ACCIDENTAL SPECIES (These additional 30 species have been seen only once or twice on the refuge.)** white-faced ibis Ross' goose fulvous whistling duck broad-winged hawk Swainson's hawk golden eagle mountain plover sharp-tailed sandpiper purple sandpiper pomarine jaeger parasitic jaeger long-tailed jaeger little gull Iceland gull glaucous gull elegant tern dovekie Atlantic puffin common ground dove ash-throated flycatcher gray kingbird scissor-tailed flycatcher northern rough-winged swallow cliff swallow northern wheatear northern shrike black-headed grosbeak Le Conte's sparrow chestnut-collared longspur house sparrow
* = Very rare species on Assateague Island/ Chincoteague National Wildlife Refuge		

The salt marshes on the bay side of the island are home to a diversity of birds, including great egrets (*Casmerodius albus*), clapper rails (*Rallus longirostris*), red-winged blackbirds (*Agelaius* *phoeniceus*), and northern harriers (*Circus cyaneus*). The Assateague salt marshes are, however, degraded by feral horse grazing which reduces the height and density of marshes grasses, and the abundance of marsh invertebrates. As a result, habitat value for many avian species is greatly reduced, particularly for obligate marsh-dwelling species such as rails and several species of sparrows.

Many birds also inhabit the forests, including the ruby-crowned kinglet (*Regulus calendula*), downy woodpecker (*Picoides pubescens*), white-eyed vireo (*Vireo griseus*), and owls, including both the great horned owl (*Bubo virginianus*), one of North America's largest species of owl, and the northern saw-whet owl (*Aegolius acadicus*). Although this diminutive owl (only one-third the size of the great horned owl) overwinters at Assateague, little is known about the species and the island serves as the site of scientific studies on its migratory habits.

Some of the most important habitats on Assateague Island for breeding birds are the sparsely vegetated upper beaches and overwash flats created and maintained by storm events. Unique to barrier islands, these early successional habitats are used by a variety of rare ground-nesting shorebirds and colonial waterbirds. Shorebirds like the piping plover (*Charadrius melodus*) and American oystercatcher (*Haematopus palliatus*), and colonial waterbirds such as the least tern (*Sterna antillarum*) breed at ASIS every summer. Common terns (*Sterna hirundo*) and black skimmers (*Rynchops niger*) historically nested on the beaches of ASIS but have not successfully bred in recent years, largely due to predation pressure of red fox (*Vulpes vulpes*). Ground nesting species are also subject to disturbance by feral horses, and occasionally direct mortality of eggs and chicks.

Mammals

The feral horses (*Equus caballus*) of Assateague Island are the Park's most well know resident, and are discussed in more detail in the preceding Feral Horse section. However, ASIS also provides habitat for a variety of other mammalian species, ranging from small rodents to large marine mammals. See Table 3.4 for a list of the mammals, including marine species, known to occur on the island or in the waters around ASIS; the marine mammal list was provided by Maryland MD DNR Cooperative Oxford Laboratory.

Rodents such as the meadow jumping mouse *(Zapus hudsonicus*) and meadow vole *(Microtus pennsylvanicus)* live in grassy areas bordering salt and freshwater wetlands and feed on seeds, wetland plants, and, in the case of the jumping mouse, insects. Though rarely seen, river otters *(Lutra canadensis)* and muskrat *(Ondatra zibethica)* also make their homes in the island's marsh habitats and adjacent waterways.

Red fox *(Vulpes vulpes)* build their dens in sand dunes and roam the island hunting for mice, birds, insects, and berries, and are known to be one of the most influential predators of ground nesting birds. Opossum *(Didelphis marsupialis)* provide the important environmental service of waste removal, feeding primarily upon the island's carrion. The only marsupial found in North America, the opossum gives birth to premature young who then complete their development inside of the pouch found on the outside of the mother's body. Raccoons *(Procyon lotor)* scavenge the crustaceans, fish, and other organic material washed ashore by tidal action, and also exert pressure on ground nesting bird species.

Besides the feral horses, two other large herbivores occur on Assateague Island, the native white-tailed deer (*Odocoileus virginianus*) and the non-native sika deer (*Cervus nippon*). The sika deer, a diminutive species of elk native to the orient, was introduced to Assateague in the 1920's and has since become well established throughout the island. 2006 estimates of the sika and white-tailed deer populations within the Maryland portion of Assateague Island are 342 and 116, respectively. Both sika deer and white-tailed deer are currently managed though the Park's annual public hunting program to achieve stable populations.

Cetaceans are active in the waters surrounding ASIS year-round. Several species of dolphin, each occurring in family pods, forage in both ocean and bay during the summer months. While the bottlenose dolphin (*Tursiops truncates*) is the most common species during the summer, harbor porpoises (*Phocoena phocoena*) occur more frequently during winter months. The area at the mouth of the Chesapeake Bay is a popular wintering location for immature Right (*Eubalaena glacialis*) and humpbacked whales (*Megaptera novaeangliae*), and it is not uncommon to see them passing along the ocean side of Assateague. During the fall, as the north Atlantic begins to cool down, dolphins migrate south from the New England coast following schools of migratory fish. During the peak of the fall migration, a near continuous column of dolphins numbering in the thousands can be seen from the beaches of Assateague.

Table 3.4 List of the Mammals, including Marine Species, known to occur on Assateague Island or in Adjacent Waters.

Scientific Name	Common Name
Didelphis marsupialis	opossum
Cryptotis parva	least shrew
Myotis lucifugus	little brown myotis
Lasionycteris noctivagans	silver-haired bat
Lasiurus borealis	red bat
Procyon lotor	raccoon
Mustela frenata	longtail weasel
Lutra Canadensis	river otter
Vulpes fulva	red fox
Sciurus carolinensis	gray squirrel
Sciurus niger cenereus	Delmarva fox squirrel(probably only occurring in VA)
Microtus pennsylvanicus	meadow vole
Oryzomys palustris	rice rat
Rattus norvegicus	Norway rat
Mus musculus	house mouse
Peromyscus leucopus	white-footed mouse
Zapus hudsonius	meadow jumping mouse
Ondatra zibethica	muskrat
Myocastor coypus	nutria
Sylvilagus floridanus	cottontail rabbit
Equus caballus	feral horse

Scientific Name	Common Name
Odocoileus virginianus	white-tailed deer
Cervus nippon	sika deer
Marine Mammals (provided by Maryland MD DNR Cooperative Oxford Laboratory 2006)	
Phoca vitulina	harbor seal
Phoca groenlandica	harp seal
Cystophora cristata	hooded seal
Halichoerus grypus	gray seal
Megaptera novaeangliae	humpback whale
Balaenoptera physalus	fin whale
Balaenoptera acutorostrata	minke whale
Eubalaena glacialis	northern right whale
Tursiops truncatus	bottlenose dolphin
Phocoena phocoena	harbor porpoise
Delphinus delphis	common dolphin
Stenella frontalis	Atlantic spotted dolphin
Stenella coeruleoalba	striped dolphin
Lagenorhynchus acutus	Atlantic white-sided dolphin
Grampus griseus	Risso's dolphin
Ziphius cavirostris	Cuvier's beaked whale
Mesoplodon mirus	True's beaked whale
Kogia breviceps	pygmy sperm whale
Kogia simus	dwarf sperm whale
Physeter catodon	sperm whale
Orcinus orca	killer whale
Globicephala melas	long-finned pilot whale
Globicephala macrorhynchus	short-finned pilot whale
Peponocephala electra	melon-headed whale
Trichechus manatus	manatee

3.7 Threatened and Endangered Species

Eight federally listed threatened or endangered plant and animal species are known to occur within ASIS. Most, however, occur as transients, utilizing Park habitats only occasionally or during seasonal migrations. Four species are known to reproduce on the island, including piping plover (*Charadrius melodus*), loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), green sea turtle (*Dermochelys coriacea*) and the sole listed plant, seabeach amaranth (*Amaranthus pumilus*). Of these, only the piping plover and seabeach amaranth are regular breeders and/or residents. Table 3.5 provides a complete list of all federal threatened or endangered species occurring within ASIS.

The Park also provides suitable habitat for a number of state-listed species, including plants, birds, and two beach-dwelling insects. See Table 3.7 for lists of state-listed animals and Table 3.8 for lists of state-listed and rare plant species.

Table 3.5 Federally Listed Threatened and Endangered Species occurring within ASIS.

Scientific Name	Common Name	Status
Amaranthus pumilus	seabeach amaranth	Threatened
Megaptera novaeangliae	humpback whale	Endangered
Eubalaenas glacialis	northern right whale	Endangered
Physeter catodon	sperm whale	Endangered
Caretta caretta	loggerhead sea turtle	Threatened
Dermochelys coriacea	leatherback sea turtle	Endangered
Chelonia mydas	green sea turtle	Threatened
Charadrius melodus	piping plover	Threatened

3.7.1 Piping Plover

In early spring, piping plovers (*Charadrius melodus*) arrive at Assateague and begin to perform their elaborate territorial and courtship displays. This federally threatened species is attracted to the island's sandy, storm washed beaches which they use to both nest and feed. After spending the summer months hatching and fledging their chicks, the plovers depart in late summer for their wintering grounds in the southeastern United States and Caribbean. ASIS also provides stop-over habitat for migrating piping plovers as they move south for the winter. Piping plovers winter as far north as North Carolina.

The recovery plan for the Atlantic coast population of the piping plover (USFWS 1996a) delineates four recovery units or geographic subpopulations within the population: Atlantic Canada, New England, New York-New Jersey, and Southern (Delaware, Maryland, Virginia, and North Carolina). Recovery criteria established within the recovery plan defined population and productivity goals for each recovery unit, as well as for the population as a whole. The plan states: “A premise of this plan is that the overall security of the Atlantic Coast piping plover population is profoundly dependent upon attainment and maintenance of the minimum population levels for the four recovery units. Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population” (USFWS 1996a).

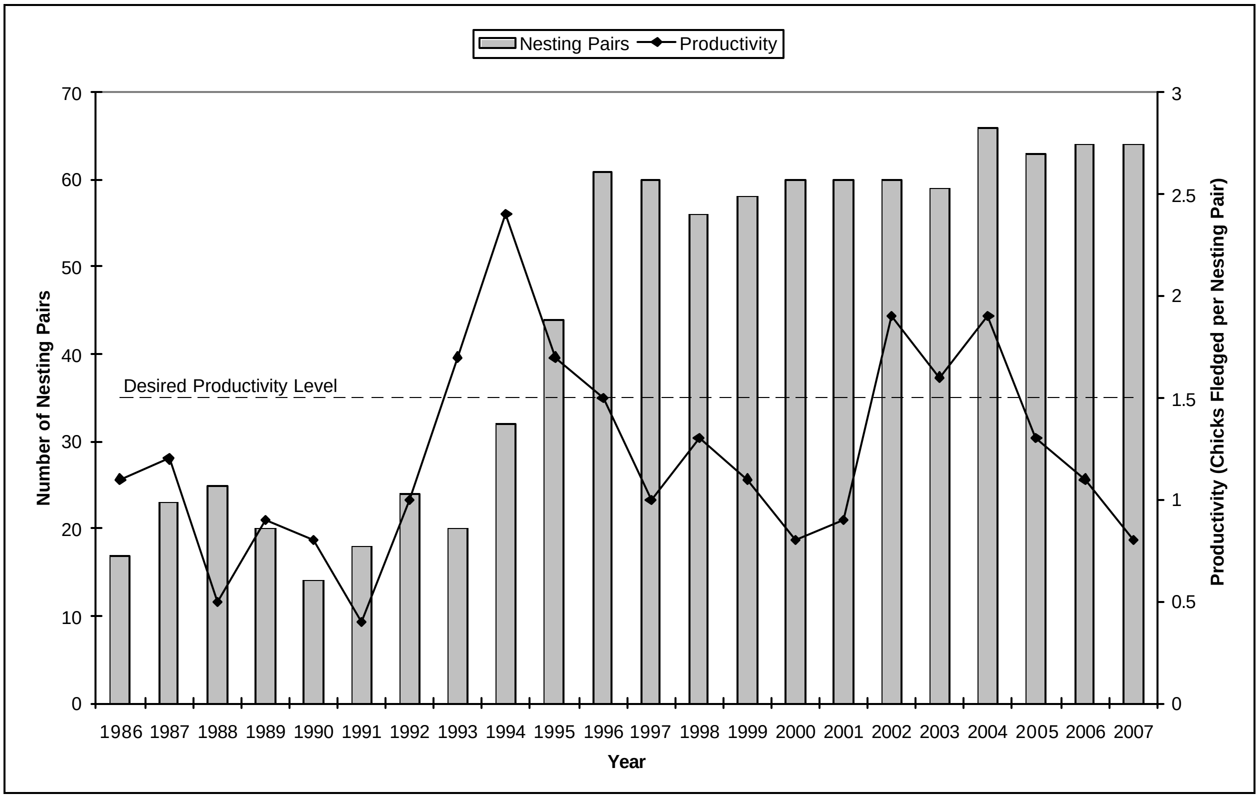
Assateague Island National Seashore falls within the Southern Recovery Unit, which has a population goal of 400 pairs (maintained for 5 years) and a five-year average productivity goal of 1.50 chicks fledged per pair (USFWS 1996a). The *U.S. Shorebird Conservation Plan* endorses these goals (Brown et al. 2001). The Partners In Flight program recommends a population target of 150 breeding pairs of piping plover for Virginia and Maryland combined (Watts 1999).

Assateague Island supports the only population of breeding piping plovers in Maryland, with up to 66 nesting pairs documented in the Maryland portion of the island in recent years (Figure 3.5). A large number of non-breeding piping plovers have also been observed at ASIS during the summer months in the last few years for unknown reasons, although it has been speculated that the phenomena is the result of limited habitat availability. Productivity has averaged 1.3 chicks/pair since 1989, meeting the USFWS Recovery Plan goal of 1.5 only from 1993 – 1996 and again from 2002 – 2004 (Figure 3.5). Overall, the ASIS population has met the Recovery

Plan goal only 7 of the past 21 breeding seasons. Despite this, the population utilizing ASIS has grown from a low of 14 breeding pairs in 1990 to a high of 66 in 2004.

Plovers are dependent on early-successional, disturbance habitats for both nesting and foraging. These types of habitats are created and maintained by ocean washover during major storm events. Adults and unfledged chicks use the low, moist interior sand flats and bayside habitats to forage, searching for invertebrate prey along inter-tidal flats and at pond edges. Piping plovers will also forage in the wrack and swash zone along the ocean, although this habitat is generally less productive on Assateague Island.

Figure 3.5 The number of nesting piping plovers at ASIS has been holding steady at around 60 pair since 1996, while productivity has fluctuated.



For the past 20 years for which the plovers have been federally listed, the northernmost 6 miles (9 kilometers) of Assateague Island have been the most susceptible to washover events and the creation and maintenance of plover habitat. As a result of prevailing habitat conditions, plovers have concentrated most of their breeding efforts on northern Assateague since monitoring began in 1986. A few breeding areas do, however, also occur in the 12 mile OSV zone in the central part of the island. Use of this area might increase as storms continue to alter that portion of the island and create conditions more favorable for plovers.

The last major washover events affecting Assateague Island occurred during a series of strong Northeasters in 1998. Vegetated communities were mapped following those events, and indicated that 74% of northern Assateague was in sparsely vegetated communities and potentially available for plover breeding. Vegetation succession has been largely following a natural course since the 1998 storms (except see discussion of the "emergency berm" in Geology section), and by 2006 only 41% of northern Assateague remained in sparsely vegetated communities. With these changes, plovers have been forced to concentrate their breeding activities into a steadily decreasing area and have begun to utilize the edges of the less preferred herbaceous communities for nesting and brood rearing.

Where plover habitat exists and is occupied by breeding birds, the fundamental influences on successful breeding are weather, depredation and other disturbances. Weather determines if insects will be plentiful and offer sufficient forage for chicks (cool, wet years), or if floods will destroy nests and reduce reproductive success. Depredation by a variety of naturally occurring predators has an influence on reproductive success although the effects of certain predators can be mitigated through non-lethal and lethal controls. Disturbance by humans can be effectively managed through proper education and appropriately marked area closures.

The vast open areas of northern Assateague lost between 1998 and 2006 have been replaced by a variety of herbaceous communities. These new growth areas are mostly free from biting insects and composed primarily of plants that horses find palatable. As these new forage areas have developed an increasing number of horses have begun to occupy areas in and adjacent to the primary plover breeding and foraging habitats. With the increased numbers of horses has come an increasing incidence of impacts on Piping plovers, including disturbance and, occasionally, direct mortality of eggs and chicks.

3.7.2 Seabeach Amaranth

Seabeach amaranth is an annual species with a fugitive lifestyle, meaning it shifts its distribution between patches of suitable habitat in any given year (USFWS 1996b). The USFWS Recovery Plan for the species describes the essential components to its habitat as consisting of a sandy substrate, a coastal environment with a nutrient supply from salt spray, minimal competition from other beach plants, and unstabilized dunes, upper beach and overwash flats (USFWS 1996b).

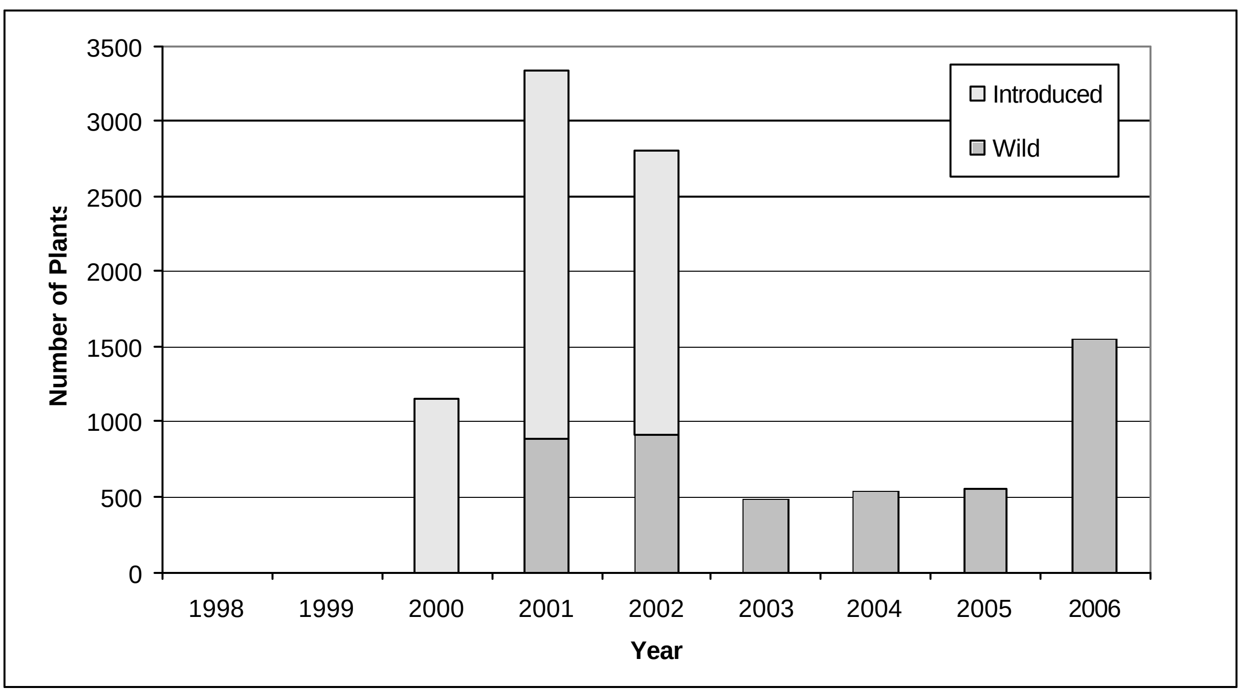
As an annual, individuals live only one season, during which plants must produce sufficient seeds in order for the population to successfully reproduce and survive. The species over-winters entirely as seeds. Germination of seedlings begins in April and continues at least through July. After germination, plants typically begin to branch profusely, forming low-growing mats. Seabeach amaranth's fleshy stems are pink, red, or reddish in color while the leaves are spinach-green, with a characteristic notch at the rounded tip (Weakley and Bucher 1992). Flowering and seed production typically commences in July or August and continues until the death of the plant. On Assateague senescence and death occur in late fall (Lea et al. 2003). As a result of predation and weather events, the flowering and fruiting period can be terminated as early as July (USFWS 1993a). Seabeach amaranth and its life history are further described by Weakley and Bucher (1992), USFWS (1996b), and Lea et al. (2003).

Seabeach amaranth was rediscovered on ASIS in 1998 when two plants were found on the north end of Assateague Island (Lea et al. 2003). Prior to this, seabeach amaranth's last known occurrence on Assateague Island was in 1967. Progeny of the rediscovered wild plants were propagated in greenhouses, and later trans-located to suitable habitats during a three-year restoration project, which took place from 2000 – 2002. Altogether, over 5,000 plants were transplanted on ASIS (Table 3.6). During this project Lea et al. (2003) found that the most likely habitats in which to find seabeach amaranth at ASIS were the upper beach and wash flat areas (i.e., areas of sparse vegetation that are heavily influenced by water-deposited sand yet above the mean high tide line on the ocean beach), and generally not within 100 ft (30 m) of the high tide line except where off-road vehicle disturbance is relatively light.

Table 3.6 Seabeach amaranth was rediscovered at ASIS in 1998 (last seen in 1967), reintroduced by the NPS and several partners in 2000-2002. Assateague Island is the only location in Maryland where seabeach amaranth occurs (Lea et al. 2003).

Year	Wild Plants	Reintroduced Plants	Year Totals
1998	2	0	**2**
1999	1	0	**1**
2000	4	1,156	**1,160**
2001	888	2,444	**3,332**
2002	912	1,881	**2,793**
2003	481	0	**481**
2004	533	0	**533**
2005	558	0	**558**
2006	1,552	0	**1,552**
2007	2,179	0	**2,179**

Figure 3.6 The number of wild seabeach amaranth plants (solid pattern bar) has steadily increased since the three-year Seabeach Amaranth Restoration Project reintroduced plants from 2000 to 2002 (diagonal pattern bars).



After the restoration project concluded, monitoring revealed that the number of wild plants declined dramatically, from a high around 900 during both 2001 and 2002 down to around 500 during 2003, 2004 and 2005 (see Table 3.6). In response to this precipitous decline, during 2004 a preliminary monitoring study was initiated which revealed that grazing considerably reduced seabeach amaranth survival, size and reproductive success. Given this new understanding regarding grazing effects on seabeach amaranth, during 2005, experimental cages were used for the first time in an attempt to protect a portion of the population. In response to these protective measures, the seabeach amaranth population rebounded during 2006 and 2007 increasing dramatically to a record 2,179 plants (Table 3.6, Figure 3.6). In 2006, it was found that feral horses were responsible for nearly half of the observed grazing impacts on seabeach amaranth (Sturm 2006).

3.7.3 State Listed Species

As the only natural barrier island in the state of Maryland, Assateague Island provides habitat for a number of state-listed plants and animals dependent on coastal environments. Table 3.7 lists the animal species listed by the state of Maryland as threatened and endangered species and known to occur at ASIS.

Table 3.7 State-listed Threatened and Endangered Wildlife Species known to occur at ASIS

Scientific Name	Common Name
Charadrius wilsonia	Wilson's plover
Circus cyaneua	northern harrier
Cistothorus platensis	sedge wren
Haliaeetus leucocephalus	bald eagle
Limnothlypis swainsonii	Swainson's warbler
Nyctanassa violacea	yellow-crowned night-heron
Podilymbus podiceps	pied-billed grebe
Rynchops niger	black skimmer
Sterna antillarum	least tern
Sterna maxima	royal tern
Sterna nilotica	gull-billed tern
Sterna sandvicensis	sandwich tern
Cicindela dorsalis media	white tiger beetle
Cicindela lepida	little white tiger beetle

Bald eagles have nested at a single location in the Maryland portion of Assateague Island in 2001, 2002, 2006 and 2007. Bald eagles have been removed from the federal endangered species list, however the state of Maryland lists them as a threatened species, and they are still under protection under the Golden and Bald Eagle Protection Act and the Migratory Bird Act. The island is also used by up to 30 bald eagles, including many juveniles, during the winter months.

Least terns, a colonial waterbird listed as threatened by the state of Maryland, historically nest at four colony sites at ASIS: within 1 km of the inlet, north end (1.0 – 9.5 km south of the inlet), Fox Levels (24 km south of the inlet), and at the Maryland-Virginia state line. Maryland DNR and NPS staff routinely monitor least tern nesting, and in 2006, 289 nesting pairs of least terns were observed at ASIS, with 86% occurring at the north end nesting colony. Predation by red fox and other predators is a major factor affecting productivity of least terns at ASIS, with the majority of breeding adults leaving ASIS soon after the monitoring census in 2006 and resulting in an unknown overall productivity (NPS 2006a).

Black skimmers, another state-threatened colonial waterbird, have historically nested at ASIS but have not successfully nested in the last few years, mainly due to heavy predation by fox and other predators. Gull-billed terns (state threatened) and Wilson's plover (state endangered), also nest on barrier islands, but none of these state-listed species have nested at ASIS in recent years. Gull-billed terns last nested at ASIS in the early 1990's in a colony of royal terns (state endangered). Wilson's plovers are rare at the Park, with the last documented breeding pair seen over five years ago.

The sedge wren, a small, brown songbird that is classified by the state as threatened, prefers marshes and wetland habitat. The species has been observed in the past in the Park, but it is unknown whether the bird breeds at ASIS. The deteriorated condition of the Park's salt marsh habitats might play a role in its limited occurrence.

Two species of rare, state-listed insects occur within ASIS, both of which depend on the ocean fronting beach and dune habitats. *Cicindela dorsalis media* is the rarer of the two species and found only on the north end of the island and a small area just north of the Maryland-Virginia state line. This species forages along the ocean high tide line and lays its eggs in the upper beach and primary dunes. The population has ranged between 14 and 698 individuals during the period 1985 to present (Knisley 2007).

Cicindela lepida occurs in interior dune habitats, seeming to prefer areas of dune blowouts and overwash channels and flats. This species is more widely distributed and abundant within ASIS, with population estimates ranging between 84 and 892 from 1990 to 2006 (Knisley 2007).

The status of state-listed plant species that occur at ASIS with a rank of rare or highly rare were reported by Lea et al. (2000) and are listed in Table 3.8. Several of the state-listed species in Table 3.7 primarily occur in habitat similar to that required by seabeach amaranth, (e.g., seaside sandplant, seaside knotweed, sea-purslane). Therefore if seabeach amaranth and its habitat is successfully managed and maintained at ASIS, these species will similarly benefit.

Table 3.8 State-listed Rare, Highly Rare, or Extirpated Plant Species occurring at ASIS (Lea et al. 2000)

Scientific Name	Common Name	Rank
Amaranthus pumilus Raf	seabeach amaranth	SH
Ammannia latifolia L.	Koehne's toothcup	S2
Aristida tuberculosa Nuttall	seabeach three-awn grass	S1
Borrichia frutescens (L.) DC	sea ox-eye	SH
Carex silicea Olney	seabeach sedge	S1
Centella erecta (L. f.) Fern	coinleaf	S3
Eleocharis albida Torrey	white spike-rush	S1

Scientific Name	Common Name	Rank
Eleocharis halophila Fern. & Brack.	salt-marsh spike-rush	SH/S1
Eleocharis rostellata Torrey	beaked spike-rush	S1
Eragrostis refracta (Muhl.) Scribn.	meadow lovegrass	S3/S4
Fimbristylis caroliniana (Lamb.) Fern.	Carolina fimbry	S1
Fuirena pumila Torrey	smooth fuirena	S1
Galium hispidulum Michx.	coast bedstraw	S1
Gymnopogon brevifolius Trin.	broad-leaved beardgrass	S1/SU
Honkenya peploides (L.) Ehrh.	seabeach sandwort	S1
Leptochloa fascicularis (Lam.) Gray	long-awned diplachne	SU
Persea borbonia (L.) Spreng.	red bay	S2
Platanthera cristata (Michx.) Lindl.	crested yellow orchid	S1
Polygonum glaucum Nuttall	seaside knotweed	S1
Prunus maritime Marsh.	beach plum	S1
Sacciolepis striata. (L.) Nash.	American cupscale	S1
Scleria verticillata. Muhl.	whorled nut-rush	S1
Sesuvium maritimum (Walt.) B.S.P.	sea-purslane	S1
Spiranthes praecox (Walt.) House	grass-leaved lady's-tresses	S1

Key to Ranks

S1 - Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.

S2 - Very rare; usually between 6 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.

S3 – Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances

S4 – Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats

SH - Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.

SU - Status uncertain, often because of low search effort or cryptic nature of the element.

Although a species' state listing does not require protection by federal agencies, ASIS strives to protect all state-listed species within its bounds in accordance with *NPS Management Policies* (NPS 2006b). Most state-listed plant species at ASIS are not targeted by specific management actions, with the exception of seabeach amaranth, however ASIS does perform periodic presence/absence monitoring of them and also occasionally provides some of them with a minimum level of protection against grazing whenever possible.

3.8 Park Operations and Administration

Assateague Island National Seashore operated with a $4.1 million operating budget in Fiscal Year 2006. The Park also received approximately $1.2 million in additional funding from several sources including recreational and special use fees collected at the Park (e.g., entrance, camping, and off-road vehicle use permit fees) and NPS special project funds. These supplemental funds were primarily used to manage and enhance recreational activities and infrastructure. In Fiscal

Year 2006, the Park had approximately 68 full time equivalencies (FTE) of permanent and temporary staff. The staff is divided amongst five general program areas:

- Law Enforcement and Visitor Use Management
- Resource Management
- Interpretation and Education
- Maintenance
- Management and Administration

Of the 10.8 FTE Resource Management staff, approximately 1.3 FTE are directly involved in management of the feral horses. Recurring activities include routine monitoring of the feral horse population (births, deaths, injuries, location, band composition, etc.), conducting the contraception program, monitoring the effects of horses on other natural resources, and mitigating problems associated with human-horse interactions. Law enforcement personnel enforce visitor use regulations associated with the horses and address related health and safety issues. The Park operates two Visitor Centers, from which NPS staff provides educational information for the public and school groups related to the feral horses. Maintenance personnel install and maintain horse-related infrastructure (e.g., fences, signs) and perform recurring activities to reduce the impacts of feral horses on visitor use. The Park also receives assistance and support in managing the horses from partners, including the Maryland Department of Natural Resources, Zoo Montana (contraception program), and the Humane Society of the United States.

In 2006, 5 volunteers contributed more than 1,000 hours of time assisting the Park in managing the feral horses (i.e., Volunteer Pony Patrol).

The Assateague Island National Seashore Foster Horse Program is managed by the Assateague Coastal Trust and provides a way for tourists and horse lovers to help manage and protect the herd, and the barrier island and coastal bay habitats on which they depend. The "foster parents" are allowed to choose their favorite feral horse from a photo album, and in return for a donation, they receive a photo and biography of their chosen feral horse, a certificate, and a newsletter. Any given feral horse might have more than one foster parent. All donations are used to manage and protect the Assateague horses, and the barrier islands and coastal bays habitats on which they depend.

3.9 Visitor Use and Experience

Assateague Island is a popular vacation destination and its natural setting and close proximity draws many city-dwellers from the Washington D.C., Baltimore, and Philadelphia metropolitan areas. ASIS receives over two million visitors each year, with approximately 60% of those visiting during the summer months between May and September, the peak season for the Park. Many visitors come to the Park for beach-related activities including swimming, sunbathing, beachcombing, bike riding, fishing, and picnicking, however the feral horses are by far the most widely known resource of the Park. Although the summer months receive the greatest number of total visits, attractions such as migratory bird watching and hunting contribute to visitation during what were once considered non-traditional visitation periods in the fall and spring.

The NPS operates a Barrier Island Visitor Center located just before the Verrazano Bridge that leads to the Park. The Visitor Center is open daily and features beachcombing exhibits, educational brochures, nature films, and a marine aquarium and touch tank.

Providing a safe and rewarding visitor experience is a goal of all units within the NPS and allowing visitors a safe opportunity to view and appreciate the feral horses is integral to ASIS. The Park strives to meet this goal by providing opportunities for forms of enjoyment that are uniquely suited and appropriate to the natural and cultural resources found on Assateague. Visitors usually want to see the feral horses in person and would not be satisfied with seeing feral horses only through videotape or live remote cameras. The majority of viewing opportunities occur in the developed area of the Park. The NPS currently offers visitors a variety of opportunities to experience the feral horses, which include roadside pull-offs, trails, and the pedestrian bridge, and other developed areas in the Park. The ASIS also permits over-sand vehicle (OSV) use and eco-tours that allow visitors into more remote feral horse habitats.

Although there has never been a fatality associated with the feral horses on ASIS, there have been many documented minor injuries. Physical hazards to both horses and humans occur when the horses stand in and near the road in search of handouts or congregate on the beaches, parking lots and other highly used areas. The Park relies on a combination of education and varying degrees of regulation enforcement to ensure safety for visitors and horses alike. Education initiatives include signage, brochures, interpretive materials, radio announcements, visitor contacts and the Volunteer Pony Patrol.

Chapter 4 – Environmental Consequences

The National Environmental Policy Act requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided should the proposed action be implemented. This chapter is organized by impact topic and analyzes the environmental impacts of the four alternatives on natural resources, including feral horses, park administration and operations, and visitor experience. These analyses provide the basis for comparing the effects of the alternatives. The NEPA requires consideration of context, intensity and duration of impacts, indirect impacts, cumulative impacts, and measures to mitigate for impacts. The area of potential effects includes the Maryland portion of Assateague Island, including both Assateague Island National Seashore and Assateague State Park (See Figure 1.1 for the location of ASIS and ASP).

Because the proposed alternatives do not meet the definition of an undertaking as defined by Section 106 of the National Historic Preservation Act, cultural resources were dismissed from detailed assessment as an impact topic in Chapter 1 – Purpose of and the Need for Action. As such, no cultural resource discussions are included here.

4.1 Methodology

The following definitions were used to evaluate the context, duration, intensity, and cumulative nature of impacts associated with project alternatives:

Context is the setting within which an impact is analyzed. In this EA, the intensity of impacts generally is evaluated within a local context (i.e., the Maryland portion of Assateague Island which includes both ASIS and ASP), while the intensity of the contribution of impacts to cumulative effects is analyzed in a regional context (i.e., the entirety of Assateague Island or for special status species, the federal recovery unit).

Duration is a measure of the time period over which the effects of an impact persist (short-term or long-term). In general, short-term effects are those effects caused during the initial implementation of a selected alternative, and long-term effects are those effects caused by an alternative after the action has been completed and/or after the action is in full and complete operation. For the purposes of this EA, **short-term** refers to the period from 1 – 5 years after implementation of the selected alternative and **long-term** refers to the period beyond 5 years.

Intensity is a measure of the severity of an impact. Because level of intensity definitions (negligible, minor, moderate, major) varies by impact topic, they are provided separately for each impact topic at the beginning of the corresponding subsections.

Type of impact

Beneficial: A positive change in the condition and appearance of the resource or a change that moves the resource toward a desired condition.

Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.

Direct: An impact that is caused by an action and occurs at the same time and place.

Indirect: An impact that is caused by an action but is later in time or farther removed in distance, but still reasonably foreseeable.

Cumulative Impact Scenario

Cumulative Impacts are defined by CEQ as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

NEPA requires that documents disclose the reasonably foreseeable environmental effects of proposed federal actions. "Reasonably foreseeable future actions" are defined as actions that are not speculative—they have been approved, are included in short to medium-term planning and budget documents prepared by government agencies or other entities, or are likely given trends (EPA 1999). As early as 1997, the Council on Environmental Quality issued a draft guidance paper indicating climate change was reasonably foreseeable and should be addressed in NEPA documents, especially for long-term federal actions. And last year, in *Massachussetts v. EPA (2007)* 127 S.Ct. 1438, the Supreme Court in a 5-4 decision, decided that a state has standing to bring an environmental lawsuit based on climate change effects of a federal action. This ruling has broad NEPA implications because the Supreme Court recognized that climate change is not speculative, but rather that "the harms associated with climate change are serious and well-recognized" (127 S.Ct. at 1455). It also means that citizens and environmental groups, as well as state and local governments, are more likely to have standing to bring NEPA lawsuits based on climate change challenges. For these reasons, climate change is included in the cumulative effects discussion.

Reasonably foreseeable future actions considered in this cumulative impacts analysis include:

- historic dune stabilization projects
- coastal engineering projects (Ocean City Inlet jetties, dredging, placement of dredged materials)
- recreational activities (off-road vehicle use)
- North End Restoration Project
- global climate change
- disease outbreaks, catastrophic storms
- accidental introductions of non-native species
- Volunteer Pony Patrol
- Foster Horse Program

Impairment Analysis

NPS *Management Policies* 2006 requires analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, established by the Organic Act (16 USC 1-4) and reaffirmed by the General Authorities Act of 1970, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values.

Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of fundamental park resources or values. An impact to any park resource or value might constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

1. necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
2. key to the natural or cultural integrity of the park; or
3. identified as a goal in the park's GMP or other relevant NPS planning documents.

Impairment might result from NPS activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park.

A determination on impairment is included in the Conclusion section of the impact analysis of each impact topic for each alternative. An impairment determination is made for all impact topics related to all natural resources and values. Impairment determinations are not made for health and safety, traffic and transportation, socioeconomic resources, or park operations and management because impairment findings relate back to park resources and values, and these impact areas are not generally considered to be park resources or values. Impairment determinations are not made for visitor use and experience because, according to the Organic Act, enjoyment cannot be impaired in the same way an action can impair park resources and values.

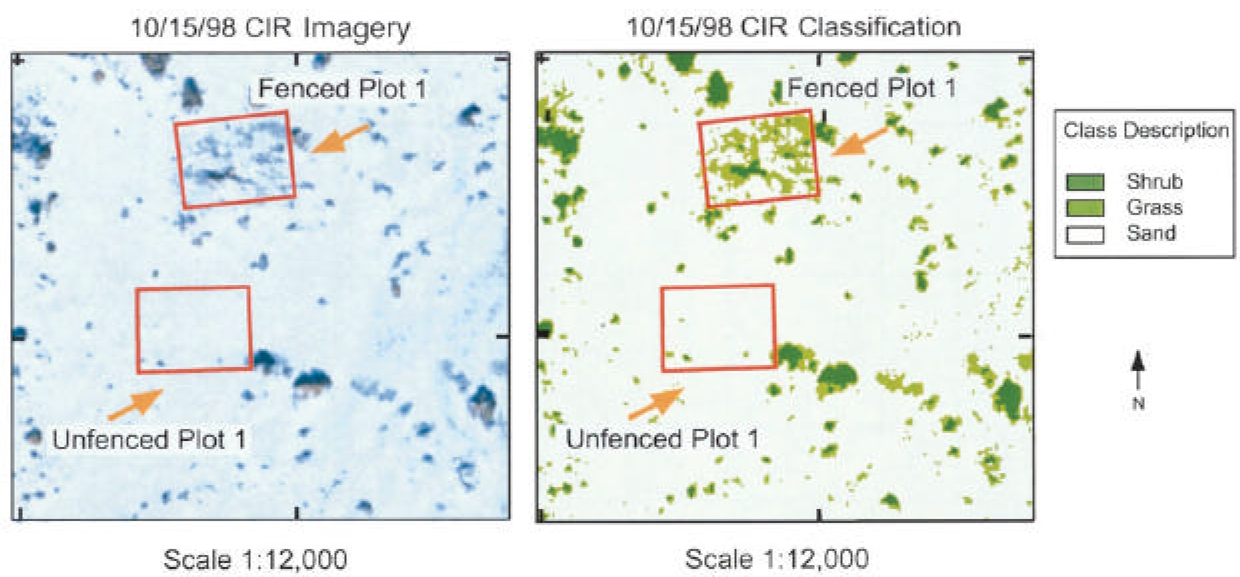
4.2 Impacts to Soils, Topography, and Geology by Alternative

Methodology

American beachgrass *(Ammophila brevigulata)* is crucial to dune formation and stabilization and is also preferred as forage by feral horses at ASIS (Furbish 1990). From April to September, feral horses were found to graze between 7% and 34% of the time in primary dune habitats, which typically form in the presence of American beachgrass (Zervanos 1978, Zervanos and Keiper 1979). Cooler temperatures, ocean breezes and fewer insects cause these habitats to be preferred by feral horses over inland and bayside habitats during the summer growing season. In the winter feral horses were found to spend 26% of their time in these dune habitats. Feral horse grazing in dune habitats has been shown to considerably reduce the growth, abundance, aboveground biomass, number of flowering stems and seed productivity of American beachgrass; this hastens erosion of the dunes, and alters the ecology of the island by altering the abundance, distribution and reproductive capacity of dominant dune vegetation (Seliskar 1997).

De Stoppelaire (2002) used Color Infrared photographs taken in 1998 and field measurements from 2001 to compare the effects of feral horse grazing on vegetative cover in paired fenced and unfenced plots constructed in primary dune habitats on ASIS between 1994 and 1996 (see Figure 4.1). This study found that plots exposed to feral horse grazing had considerably less vegetative cover.

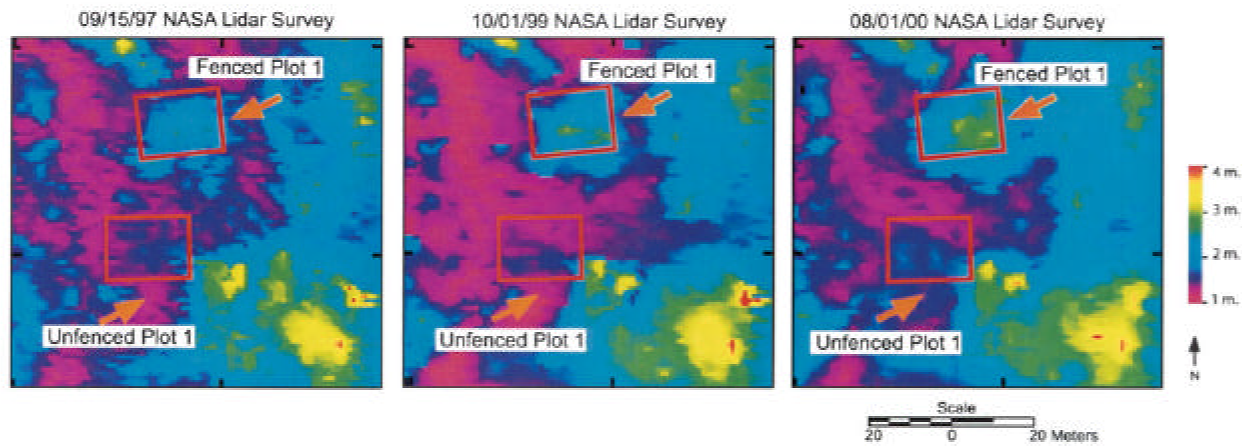
Figure 4.1 CIR image taken in 1998 and thematic classification of fenced and unfenced plot-pairs.



De Stoppelaire (2002) also used Light Detection and Ranging (LIDAR) surveys from 1997, 1999, and 2000 to analyze topographic differences between the fenced and unfenced plot-pairs. This analysis revealed that fenced areas had unquestionably higher elevations and exhibited natural dune formation and dune migration processes while the unfenced areas exhibited lower elevations and an erosive tendency of existing dune features. This study correlates feral horse grazing with interrupted dune formation and dune maintenance processes, and illustrates the direct effects feral horses have on dune stability via the reduction in abundance of dune-stabilizing grasses. Figure 4.2 illustrates the LIDAR survey showing digital elevation of topography between fenced and unfenced plot-pairs.

ASIS horses were also found to spend between 31% and 61% of the time in salt marsh habitats during the summer months (Zervanos 1978). Horse herbivory alters species community composition in salt marsh habitats by reducing the competitive advantage of *Spartina alterniflora* and favoring *Distichlis spicata* (Furbish 1990). *D. spicata* does not possess similar sedimentation and filtration properties as *S. alterniflora*. Consequently, its expansion in salt marsh habitats coupled with the soil disturbing effects of trampling and reduced vegetative cover (Sturm 2007a) contributes to an increased susceptibility to erosion.

Figure 4.2 LIDAR surveys from 1997, 1999, and 2000 showing digital elevation of topography for fenced and unfenced plot-pairs.



Intensity Definitions

The intensity of potential impacts to soils, topography and geology is defined as follows:

Negligible: Soils, topography, and geology would not be affected or the impacts would be below or at the lower levels of detection. Any effects would be slight and unlikely to be noticed.

Minor: The impact to soils, topography and geology would be detectable. Impacts, including soil disturbance and erosion would be relatively small and localized. Mitigation might be needed to offset adverse effects and would be relatively simple to implement and likely to be successful.

Moderate: The impact on soils, topography and geology would be readily apparent and result in a change to the soil character over a relatively wide area, impede dune formation and would cause erosion of dunes over a relatively wide area, or soil disturbance over a relatively wide area. Mitigation measures would be necessary to offset adverse effects and, although difficult, would likely be successful.

Major: The impacts on soils, topography and geology would be readily apparent and substantially change the character of the barrier island and dune formation over a large area; substantial erosion would occur resulting in a large amount of soils loss. Mitigation measures to offset adverse effects would be needed, would be extensive, and their success could not be guaranteed.

4.2.1 Alternative A: No-Action

The No-Action Alternative would not alter any of the current feral horse management practices or projects at ASIS. The population would continue to be managed to maintain a relatively stable population of about 150 horses. As a result, the detrimental impacts feral horses have on island dunes and salt marsh soils would continue, and the No-Action Alternative would have a direct moderate adverse impact to the soils, topography and geology of Assateague Island over both the short- and long-term.

Cumulative Impacts of Alternative A

The Intergovernmental Panel on Climate Change has projected that the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18- 0.59 m) by 2100 relative to 1980-1999. Sea level rising along much of the coast is predicted to exacerbate the impacts of shoreline erosion and storm impacts along the Atlantic Coast are likely to be more severe (IPCC 2007). In conjunction with the impacts of numerous historic and on-going coastal engineering projects, including the installation and maintenance of the Ocean City Inlet jetties, dredging of the inlet, construction of protective storm berms, and placement of dredged material in the nearshore of the island, the No-Action Alternative would have a moderate adverse cumulative impact on soils, topography and geology on ASIS.

Conclusion

Impacts to soils, topography, and geology that might result from implementation of Alternative A are adverse and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative A is moderate and adverse, with Alternative A contributing a moderate amount.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to soils, topography or geologic resources of Assateague Island National Seashore.

4.2.2 Alternative B: One-time Capture and Removal

Alternative B would have a moderate beneficial impact to the soils, topography or geology of ASIS over both the short-term and the long-term. Alternative B would reduce the feral horse population and corresponding grazing pressure in dune and salt marsh habitats, thereby helping to restore natural dune formation processes and reduce marsh erosion. The population reduction would occur quickly over the shortest period of time (~2 years). Previous research has estimated the percent of time feral horses spend in different habitats on ASIS and long-term monitoring has provided data relating to the amount of forage feral horses consume (Sturm 2007a). Using these data, ASIS managers have estimated that the implementation of Alternative B would result in a net benefit of approximately 350 ungrazed acres of dune habitats by 2015, when compared with the No-Action Alternative already present at ASIS (Sturm 2007a). Therefore Alternative B would have a moderate beneficial impact on dunes and salt marsh soils over the short- and long-term.

Cumulative Impacts of Alternative B

The Intergovernmental Panel on Climate Change has projected that the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18- 0.59 m) by 2100 relative to 1980-1999. Sea level rising along much of the coast is predicted to exacerbate the impacts of shoreline erosion and storm impacts along the Atlantic Coast are likely to be more severe (IPCC 2007). In conjunction with the impacts of numerous historic and on-going coastal engineering projects, including the installation and maintenance of the Ocean City Inlet jetties, dredging of the inlet, construction of protective storm berms, and placement of dredged material in the nearshore of the island, Alternative B would have a minor adverse cumulative impact on soils, topography and geology on ASIS.

Conclusion

Impacts to soils, topography, and geology that might result from implementation of Alternative B are beneficial and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative B is minor and adverse, with Alternative B making a moderate contribution.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to soils, topography or geologic resources of Assateague Island National Seashore.

4.2.3 Alternative C: Intensive Contraception

Alternative C would result in negligible beneficial impacts to the soils, topography or geology over the short-term at ASIS. Under Alternative C the feral horse population would be reduced to the proposed target range over a 5-8 year time period, resulting in a reduction of grazing pressure in dune habitats over the long-term. After achieving the new target population level, the remaining feral horses would continue to graze in dune habitats. Previous research has estimated the percent of time feral horses spend in different habitats on ASIS and long-term monitoring continues to provide data relating to the amount of forage feral horses consume. Using these data ASIS managers have estimated that the implementation of Alternative C would result in a net benefit of approximately 280 ungrazed acres of dune habitats by 2015, when compared with the No-Action Alternative (Sturm 2007a). A reduced herd size under Alternative C would have a moderate beneficial impact on dunes and salt marsh soils over the long-term.

Cumulative Impacts of Alternative C

The Intergovernmental Panel on Climate Change has projected that the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18- 0.59 m) by 2100 relative to 1980-1999. Sea level rising along much of the coast is predicted to exacerbate the impacts of shoreline erosion and storm impacts along the Atlantic Coast are likely to be more severe (IPCC 2007). In conjunction with the impacts of numerous historic and on-going coastal engineering projects, including the installation and maintenance of the Ocean City Inlet jetties, dredging of the inlet, construction of protective storm berms, and placement of dredged material in the nearshore of the island, Alternative C would have a minor adverse cumulative impact on soils, topography and geology on ASIS.

Conclusion

Impacts to soils, topography, and geology that might result from implementation of Alternative C are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative C is minor and adverse, with Alternative C making a moderate contribution.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to soils, topography or geologic resources of Assateague Island National Seashore.

4.2.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would have similar effects to those described under Alternative C. Alternative D would result in negligible beneficial impacts to the soils, topography or geology over the short-term at ASIS. Reducing the feral horse population size would reduce grazing pressure in dune habitats resulting in a greater probability of restoring natural dune formation processes to ASIS. Change would likely occur gradually over a longer period of time, as Alternative D would reduce the feral horse population over 5-8 years. After achieving the new target population proposed under Alternative D, the remaining feral horse population would continue to graze in dune habitats. ASIS managers estimate that the implementation of Alternative D would likely result in a net benefit of approximately 280 ungrazed acres of dune habitats by 2015, when compared with the No-Action Alternative (Sturm 2007a). A reduced herd size under Alternative D would have a moderate beneficial impact on dunes and salt marsh soils over the long-term.

Cumulative Impacts of Alternative D

The Intergovernmental Panel on Climate Change has projected that the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18- 0.59 m) by 2100 relative to 1980-1999. Sea level rising along much of the coast is predicted to exacerbate the impacts of shoreline erosion and storm impacts along the Atlantic Coast are likely to be more severe (IPCC 2007). In conjunction with the impacts of numerous historic and on-going coastal engineering projects, including the installation and maintenance of the Ocean City Inlet jetties, dredging of the inlet, construction of protective storm berms, and placement of dredged material in the nearshore of the island, Alternative D would have a minor adverse cumulative impact on soils, topography and geology on ASIS.

Conclusion

Impacts to soils, topography, and geology that might result from implementation of Alternative D are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative D is minor and adverse, with Alternative D making a moderate contribution.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to soils, topography or geologic resources of Assateague Island National Seashore.

4.3 Impacts to Vegetation by Alternative

Methodology

The ecological consequences of the feral horse population include direct impacts to vegetation resources of Assateague Island from grazing, trampling and rubbing (mortality or loss of vigor), and indirect impacts from the disruption of soils (breakup and/or compaction) and the effects of grazing on community composition and dynamics.

Feral horse grazing is causing a reduction in the amount of vegetation growing in several plant communities at ASIS. Direct grazing effects include plant mortality, interference with plant nutrient dynamics, and altered plant productivity and reproductive capacity. Preferential grazing by feral horses is also known to limit the abundance and reproductive potential of individual plant species. Indirect effects include alteration of plant community structure, changes in ecosystem function and energy flows, and a reduction in habitat value for animal species dependent upon these plant communities (Furbish 1990, Stribling 1989, Furbish and Albano 1994, Sturm 2007b).

During the mid 1970's, research was conducted to assess the population dynamics and ecological impacts of the feral horse herd within the National Seashore. The results of this effort included quantification of the feral horses' energetic (forage biomass) requirements, and preferred forage habitats within the Park. According to the results of this research, an adult feral horse requires approximately 21,115 kcal every day and averages 46.1% of its time foraging in low salt marshes and 20.7% in primary dune habitats (Zervanos 1978). In 1979, when the herd size consisted of only 62 individuals, it was concluded that the north end of Assateague Island was already showing signs of being overgrazed, while other island areas were observed to be experiencing only limited impacts (Keipter and Zervanos 1979).

Spartina alterniflora is the primary forage species for feral horses found in low marsh habitats on Assateague Island. Long-term low salt marsh monitoring from 1994 to 2006 (a period of historically high feral horse numbers on ASIS) has revealed that *S. alterniflora* responds to heavy grazing pressure by increasing the average number of stems per unit area but does not exhibit a compensatory increase in primary productivity. In fact, primary productivity has been reduced by an average of 45% in the monitoring plots; a reduction directly attributable to feral horse grazing (Sturm 2007a). Monitoring has also shown that feral horse grazing has reduced the average vegetative cover by approximately 30% compared to areas protected from grazing (Sturm 2007a).

Feral horses can alter the species composition of low salt marsh communities by preferentially grazing on *S. alterniflora*, thus providing other species with a competitive advantage. *D. spicata* is a high marsh plant species that typically does not occur at lower elevations since it is less tolerant of prolonged periods of inundation (Furbish 1990, Furbish and Albano 1994). However, simulated grazing experiments have shown that preferential grazing increases the abundance of *D. spicata* in low salt marsh (Furbish 1990). The increase of *D. spicata* in low salt marsh communities diminishes ecosystem functions such as water filtration and sedimentation, and lessens its habitat suitability for low salt marsh obligate fauna.

A recent 3-year study at ASIS used a series of exclosure treatments to assess the influence of feral horse herbivory on Assateague Island's shrub and forest habitats. The results indicate that feral horse herbivory is reducing species diversity in maritime forest habitats and altering vegetative community composition in both shrub and forest habitats (Sturm 2007b). The study revealed that feral horse herbivory also influences the abundance and average height of several native plant species occurring in these habitats.

As described in the previous section, feral horse grazing decreases the distribution, abundance and reproductive capacity of American beachgrass, the primary dune-building species on Assateague (Seliskar 1997). De Stoppelaire (2002) found that study plots exposed to feral horse grazing had considerably less vegetative cover than those protected, and exhibited both lower elevations and a greater tendency to be erosive. Feral horse grazing is also known to reduce the abundance of several rare beach-dwelling plants. The effects of grazing on seabeach amaranth, a federally listed threatened species, is discussed in greater detail in the Threatened and Endangered Species section. Other consequences to vegetation include impacts from trampling and rubbing, and indirect effects resulting from the disruption and/or compaction of soils.

Intensity Definitions

The intensity of potential impacts to vegetation is defined as follows:

Negligible: Changes in plant populations and/or communities would be at the lowest levels of detection. Any effects would be slight and unlikely to be noticed.

Minor: Changes in plant populations and/or communities would be small in scope, localized, and of relatively minor environmental consequence. Mitigation to offset adverse effects would be relatively simple to implement and likely to be effective.

Moderate: Impacts would cause clearly detectable changes in plant populations and/or communities. Impacts would remain relatively localized but could have appreciable effects on individual species and communities (i.e., abundance, distribution, or quality). Mitigation to offset adverse effects would be difficult, but likely to be successful.

Major: Impacts to plant populations and/or communities would occur over large areas and be substantial, highly noticeable and likely to persist over time. Mitigation measures to offset the adverse effects would be extensive and difficult, and the success of the mitigation measures could not be guaranteed.

4.3.1 Alternative A: No-Action

The No-Action Alternative would not alter any of the current management practices or conditions at ASIS related to the feral horses. The population would continue to be managed to maintain a relatively stable population of about 150 horses. As a result, the range of impacts to the island's plant populations and communities resulting from the feral horses would continue to occur at roughly the same magnitude and intensity. Feral horses would continue to reduce vegetative diversity and cover, alter community composition, diminish reproductive capacity, and disrupt plant succession processes. Impacts would occur throughout the Park, but would vary in scope and intensity depending upon area-specific feral horse density and/or patterns of habitat use. As a result, the No-Action Alternative would result in moderate adverse short- and long-term impacts.

Cumulative Impacts of Alternative A

The EPA (1997) predicts that over the next century, climate along the Atlantic Coast could experience changes. For example, based on projections made by the Intergovernmental Panel on Climate Change, the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18-0.59 m) by 2100 relative to 1980-1999. The rate of change associated with sea level rising will increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding and shoreline erosion. Storm impacts are likely to be more severe, especially along the Atlantic Coast (IPCC 2007). Coastal habitats and dependent species are threatened by sea-level rise and the associated changes in vegetation.

In addition, plant populations and communities would also continue to be adversely affected by non-native plant and animal species (e.g. *Phragmites*), recreational uses (off-road vehicle), and alterations to geologic processes caused by historic land use activities (e.g., dune stabilization). Coupled with the continued effects of the feral horses, the cumulative impacts of the No-Action Alternative on vegetation would be moderate and adverse.

Conclusion

Impacts to vegetation that might result from implementation of Alternative A are adverse and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative A is moderate and adverse, with Alternative A contributing a moderate amount to the intensity of the cumulative impacts.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to vegetation resources of Assateague Island National Seashore.

4.3.2 Alternative B: One-time Capture and Removal

Alternative B would have a moderate beneficial impact to the vegetation of ASIS over both the short- and the long-term. Reducing the herd to the target size of 80-100 horses would greatly reduce feral horse grazing and trampling effects in all island habitats. Since Alternative B would reduce the feral horse population over the shortest time period (~2 years) it would also provide impacted vegetation resources the earliest opportunity for recovery. Feral horses would continue to be present and influence plant populations and communities under Alternative B, but the intensity of impacts and extent of affected areas would be considerably reduced. Sturm (2007a) estimates that Alternative B would result in approximately 1,700 fewer acres being grazed by feral horses by 2015 when compared to current conditions and the No-Action Alternative. As a result, Alternative B would have a moderate beneficial impact, over both the short- and long-term, to the vegetation of Assateague Island.

Cumulative Impacts of Alternative B

The EPA (1997) predicts that over the next century, climate along the Atlantic Coast could experience changes. For example, based on projections made by the Intergovernmental Panel on Climate Change, the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18-0.59 m) by 2100 relative to 1980-1999. The rate of change associated with sea level rising will increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding and shoreline erosion. Storm impacts are likely to be more severe, especially along the Atlantic Coast (IPCC 2007). Coastal habitats and dependent species are threatened by sea-level rise and the associated changes in vegetation.

In addition, plant populations and communities would also continue to be adversely affected by non-native plant and animal species (e.g. *Phragmites*), recreational uses (off-road vehicle), and alterations to geologic processes caused by historic land use activities (e.g., dune stabilization). Mitigated by the reduced impacts of a smaller feral horse population, the cumulative impacts of Alternative B would be minor and beneficial.

Conclusion

Impacts to vegetation that might result from implementation of Alternative B are beneficial and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative B is minor and beneficial, with Alternative B making a moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to vegetation resources of Assateague Island National Seashore.

4.3.3 Alternative C: Intensive Contraception

Alternative C would result in negligible beneficial impacts to vegetation resources over the short-term. Reducing the feral horse population size to the target range would reduce detrimental feral horse grazing effects island-wide, but the benefits would occur gradually over 5-8 years. In the short-term (< 5 years), the feral horse population would steadily decline, but continue to be larger than the upper limit of the target range and adversely impact vegetation resources. However, in the long-term the impact would be similar to that described under Alternative B. Sturm (2007a) estimates that by 2015 this gradual reduction of the herd would result in approximately 1,350 fewer acres grazed by feral horses when compared to the No-Action Alternative. As a result, Alternative C would have a moderate beneficial impact to plant populations and communities over the long-term in comparison to the impacts that would occur under the No-Action Alternative.

Cumulative Impacts of Alternative C

Cumulative impacts would be similar to those described under Alternative B, where the continuing impacts to vegetation resources from other sources (climate change, non-native species, recreation, altered geologic processes) would be somewhat mitigated by the smaller feral horse population.

Conclusion

Impacts to vegetation that might result from implementation of Alternative C are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative C is minor and beneficial, with Alternative C making a moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to vegetation resources of Assateague Island National Seashore.

4.3.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would have essentially the same effects as those detailed under Alternative C. Alternative D can be expected to result in negligible beneficial impacts to plant populations and communities over the short-term, and moderate beneficial impacts over the long-term. Alternative D would reduce the number of feral horses gradually, over a 5-8 year period, after which the remaining population would be managed within the target range of 80-100. The smaller population would continue to graze throughout the island and continue to affect vegetation resources, but with considerably reduced impacts as compared to the No-Action Alternative.

Cumulative Impacts of Alternative D

Cumulative impacts would be similar to those described under Alternative B, where the continuing impacts to vegetation resources from other sources (climate change, non-native species, recreation, altered geologic processes) would be somewhat mitigated by the smaller feral horse population.

Conclusion

Impacts to vegetation that might result from implementation of Alternative D are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative D is minor and beneficial, with Alternative D making a moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to vegetation resources of Assateague Island National Seashore.

4.4 Impacts to Wetlands by Alternative

Methodology

Physical, chemical and biological factors such as climate, landscape topology, geology, vegetation, and the movement and abundance of water help to determine wetland characteristics. On Assateague Island, wetlands are found in many forms, including freshwater, brackish, and inter-tidal. By acreage, the inter-tidal or salt marsh wetlands are the most abundant wetland type on Assateague. While the feral horses are thought to affect wetlands throughout the island, most research and assessment activities have focused on salt marsh wetlands. Due to the lack of information describing interactions between feral horses and the island's interior freshwater and brackish wetlands, the impact analysis in this section focuses on the island's salt marsh wetlands.

Feral horses are known to spend considerable time grazing in Assateague's salt marsh habitats. During the summer, ASIS feral horses were found to spend between 31% and 61% of the time in salt marsh habitats (Zervanos 1978). Overall, salt marsh cord grass, *Spartina alterniflora,* is a better nutrient and energy source than dune grasses for the feral horses and explains their greater utilization of this habitat.

The effects of feral horse grazing in the salt marshes of ASIS have been well documented. Even at low feral horse densities (~ 1.2 horses/km^2) the primary productivity of *S. alterniflora*, the dominant low salt marsh species, was found to be reduced (Furbish 1990, Furbish and Albano 1994). Data from long-term marsh monitoring (1994 to 2006, a period of historically high feral horse numbers on ASIS) suggest that *S. alterniflora* does not exhibit compensatory growth after exposure to feral horse herbivory, and revealed an average reduction in primary productivity of approximately 45% directly attributable to feral horse grazing. On a per unit area basis this is reflective of a reduction in low salt marsh primary productivity of an estimated 1950 pounds per acre per year (Sturm 2007a).

Stribling (1989) found that feral horse grazing interferes with nutrient transfer and storage in *S. alterniflora* and concluded that overgrazing by feral horses was likely to have resulted in the short phenotypic expression and high stem density of *S. alterniflora* found in her study site. In addition, long-term salt marsh monitoring data (Sturm 2007a) has shown that feral horse grazing has reduced the average percent cover of vegetation (i.e., available forage) by approximately 30% compared to areas where horse grazing was removed during in the 1990's.

Grazing affects the distribution of *S. alterniflora* and can alter species composition in salt marsh plant communities (Furbish 1990, Furbish and Albano 1994). *Distichlis spicata*, a species generally uncommon in low salt marsh habitats, has been shown not to be preferred by feral horses and is in fact avoided during grazing (Furbish 1990). Preferential herbivory on *S. alterniflora* by the feral horses causes the competitive relationship of these grasses to favor *D. spicata*. Due to prolonged exposure to feral horse grazing, *D. spicata* has increased in abundance in Assateague's low salt marshes.

Furbish and Albano (1994) found that feral horse grazing in low salt marshes reduced the density of fiddler crabs (*Uca* ssp.) and other invertebrate fauna when compared to salt marshes along the mainland, except for bayside shoreline areas experiencing new sediment inputs. The primary difference between sampled locations was that the Assateague marshes were exposed to feral horse grazing. Reduced invertebrate prey coupled with altered structural conditions is believed to account for the decrease in secretive marsh birds observed on Assateague (Hoffman, MD DNR, pers. comm.). Breeding Bird Survey data from 1983-1987 and 2002-2006 indicate that keystone avian species of the low salt marsh/intertidal marsh habitat (rails) and high salt marsh/grassland species (seaside and sharp-tailed sparrows) have declined on Assateague during that time period (Hoffman, MD DNR, pers. comm.).

Overall, feral horse grazing in the low salt marshes of ASIS has reduced vegetative cover, altered the nutrient dynamics, morphology, primary productivity and reproductive capacity of the dominant species, *Spartina alterniflora*, and influenced composition of the salt marsh community. As a result, the health and functionality of the system has been diminished. Heavily grazed marshes are thought to be less efficient in filtering water and trapping sediment, and to export fewer nutrients to the surrounding estuarine waters. Structural changes resulting from heavy grazing have altered the marsh's habitat characteristics and decreased their value for wildlife. Heavily grazed salt marshes are less robust and resilient, which could increase their vulnerability to other stressors such as accelerating rates of sea level rise.

Intensity Definitions

The intensity of potential impacts to wetlands is defined as follows:

Negligible: Impacts to wetlands would be at or below the lower levels of detection and would be unlikely to produce noticeable changes in ecological functionality, habitat value or water quality in the system.

Minor: Impacts to wetlands would be detectable, but relatively limited in terms of the affected area and environmental consequences. The action could result in a change or disruption of at least one but not all wetlands values or processes. Mitigation measures, if needed to offset the adverse effects, would be relatively simple and successful.

Moderate: Impacts to wetlands would be readily apparent over relatively large areas, but the overall functionality of wetland systems would remain largely intact. The action could have measurable impacts on plant or wildlife species within the wetlands, but the species would remain viable. Mitigation measures, if needed to offset adverse effects, would be extensive but likely to be successful.

Major: Impacts to wetlands would be readily apparent over the majority of the affected area. The action would compromise multiple wetlands values or processes, and plant and/or animal species would be at risk of extirpation from the area. Mitigation measures to offset the adverse effects would be extensive and difficult, and success could not be guaranteed.

4.4.1 Alternative A: No-Action

The No-Action Alternative would not alter any of the current management practices or conditions at ASIS. The population would continue to be managed to maintain a relatively stable population of about 150 horses. As a result, the current range of impacts to the island's wetlands caused by the feral horses would continue unabated at a similar scope and intensity. The impacts vary spatially, ranging from areas minimally grazed and lacking any obvious effects to heavily grazed areas exhibiting substantial alterations. The No-Action Alternative would continue the current trend of declining functionality and diminished ecological values in wetlands on ASIS. As a result, the No-Action Alternative would have moderate adverse impacts in both the short- and long-term.

Cumulative Impacts of Alternative A

Cumulative impacts on Assateague Island's wetlands include the effects of non-native species (e.g. *Phragmites*), global climate change and historic dune stabilization programs. An accelerated rate of sea level rise has the potential to exceed the capacity of Assateague's salt marshes to respond and persist. This vulnerability is exacerbated by the residual effects of historic dune stabilization activities, which for several decades prevented new sediment inputs to salt marsh habitats by storm overwash processes. The EPA (1997) predicts that the rate of change associated with sea level rising will increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding and shoreline erosion. Up to 21% of the remaining coastal wetlands in the U.S. mid- Atlantic region are potentially at risk of inundation between 2000 and 2100. Rates of coastal wetland loss, in Chesapeake Bay and elsewhere, will increase with accelerated sea-level rise, in part due to 'coastal squeeze'. Cumulatively, the impacts to Assateague's wetlands are considered to be moderate and adverse, owing to the uncertainty associated with future rates of sea level rise and the ongoing resumption of natural storm overwash processes throughout the island.

Conclusion

Impacts to wetlands that might result from implementation of Alternative A are adverse and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative A is moderate and adverse, with Alternative A contributing a moderate amount to the overall intensity level.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to wetland resources of Assateague Island National Seashore.

4.4.2 Alternative B: One-time Capture and Removal

Alternative B would have a moderate beneficial impact to wetlands on ASIS in both the short- and long-term. Reducing the feral horse population to the target size of 80-100 individuals would considerably reduce the grazing pressure in low salt marsh habitats resulting in greater fitness, productivity and abundance of *S. alterniflora*. This, in turn, would help to increase the functionality and value of salt marsh wetlands by increasing sedimentation and filtering capacity, increasing nutrient export and resistance to erosion, and improving habitat characteristics for fish and wildlife. The improvements in marsh health would occur rather quickly, as Alternative B would reduce the feral horse population over a short period of time (~2 years). Under Alternative B, a smaller feral horse population would continue to graze in Assateague Island's salt marsh habitats; however Sturm (2007a) estimates that by 2015 this smaller herd size would reduce the total grazed area of salt marsh habitats by approximately 780 acres in comparison to the No-Action Alternative.

Cumulative Impacts of Alternative B

Cumulative impacts on Assateague Island's wetlands include the effects of non-native species (e.g. *Phragmites*), global climate change and historic dune stabilization programs. An accelerated rate of sea level rise has the potential to exceed the capacity of Assateague's salt marshes to respond and persist. This vulnerability is exacerbated by the residual effects of historic dune stabilization activities, which for several decades prevented new sediment inputs to salt marsh habitats by storm overwash processes. The EPA (1997) predicts that the rate of change associated with sea level rising will increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding and shoreline erosion. Up to 21% of the remaining coastal wetlands in the U.S. mid- Atlantic region are potentially at risk of inundation between 2000 and 2100. Rates of coastal wetland loss, in Chesapeake Bay and elsewhere, will increase with accelerated sea-level rise, in part due to 'coastal squeeze'. Cumulative impacts to wetlands would be reduced as grazing pressure is decreased under Alternative B, but would remain minor and adverse owing to the threats associated with accelerated sea level rise and the impacts to marsh sedimentation processes from historic dune building activities.

Conclusion

Impacts to wetlands that might result from implementation of Alternative B are beneficial and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative B is minor and adverse, with Alternative B making a moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to wetland resources of Assateague Island National Seashore.

4.4.3 Alternative C: Intensive Contraception

Alternative C would result in negligible beneficial impacts to wetlands over the short-term. Reducing the size of the feral horse population would reduce grazing pressure in salt marsh habitats resulting in higher fitness, productivity and abundance of *S. alterniflora*, but the resulting improvements in wetland functionality and values would occur more slowly as Alternative C would reduce the feral horse population gradually over 5-8 years. In the long-term as the population is maintained within the target range of 80-100 horses, the benefits associated with reduced grazing in wetlands would manifest and be similar to those under Alternative B. Sturm (2007a) used ASIS marsh monitoring data to estimate that by 2015 under Alternative C, approximately 620 acres of salt marsh habitat would not be grazed that would otherwise be grazed under the No-Action Alternative. As a result, Alternative C would have a moderate beneficial impact to the salt marshes over the long-term.

Cumulative Impacts of Alternative C

Cumulative impacts on Assateague Island's wetlands include the effects of non-native species (e.g. *Phragmites*), global climate change and historic dune stabilization programs. An accelerated rate of sea level rise has the potential to exceed the capacity of Assateague's salt marshes to respond and persist. This vulnerability is exacerbated by the residual effects of historic dune stabilization activities, which for several decades prevented new sediment inputs to salt marsh habitats by storm overwash processes. The EPA (1997) predicts that the rate of change associated with sea level rising will increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding and shoreline erosion. Up to 21% of the remaining coastal wetlands in the U.S. mid- Atlantic region are potentially at risk of inundation between 2000 and 2100. Rates of coastal wetland loss, in Chesapeake Bay and elsewhere, will increase with accelerated sea-level rise, in part due to 'coastal squeeze'. Cumulative impacts to wetlands would decrease under Alternative C as compared to the No-Action Alternative, but remain minor and adverse owing to the threats from accelerated sea level rise and impacts to marsh sedimentation processes from historic dune building activities.

Conclusion

Impacts to wetlands that might result from implementation of Alternative C are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative C is minor and adverse, with Alternative C making a moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to wetland resources of Assateague Island National Seashore.

4.4.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would have impacts similar to those detailed under Alternative C. Alternative D is expected to result in negligible beneficial impacts to salt marsh habitats over the short-term as the feral horse population would only be reduced gradually, over a 5-8 year period. The slow reduction of grazing would allow some recovery of wetland functionality and values in the short-term, but most benefits would accrue in the long-term. The smaller herd size (80-100) would continue to graze in wetland habitats, but the associated impacts would be greatly reduced. As such, Alternative D would have a moderate beneficial impact on wetland habitats over the long-term.

Cumulative Impacts of Alternative D

Cumulative impacts would be similar to those described under Alternative C, where the continuing impacts to wetlands from other sources (climate change, non-native species, altered geologic processes) would be somewhat mitigated by the smaller feral horse population. The cumulative impacts to wetlands resulting from Alternative D would be minor and adverse.

Conclusion

Impacts to wetlands that might result from implementation of Alternative D are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative D is minor and adverse, with Alternative D making a moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to wetland resources of Assateague Island National Seashore.

4.5 Impacts to Feral Horses by Alternative

Methodology

At present, the NPS administers contraceptives to approximately 70% of reproductive age mares in the feral horse population each year using the porcine zona pellucida (PZP) immunocontraceptive vaccine in order to manage feral horse reproduction and limit the population to no more than 150 horses. Under the No-Action Alternative, mares meeting the criteria for contraception would continue to be treated annually, and the current practice of limiting reproductive output to one live and standing foal per mare would continue.

Every mare begins contraceptive treatments at two years of age and is then treated for three consecutive years. At that point the mare is allowed to produce one live and standing foal, after which she is returned to annual contraceptive treatments for life. Because mares are limited to one successful foaling they no longer expend the energy associated with recurring pregnancies and lactation. This has improved the health of breeding age mares, and resulted in an increased life span of approximately 5-10 years. However, because the age of mortality for stallions has remained constant, the sex ratio within the population has shifted to roughly 60:40, female to male. The age structure of the herd has also changed from mostly young horses to primarily middle-aged.

> ***NOTE:*** *The impacts of the action alternatives to the feral horse population were analyzed in three general categories: 1) population demographics, 2) genetic characteristics, and 3) individual horse health, behavior and social organization. It should be noted that an impact to the first two categories could have the opposite effect to the latter category. For example, an action that would be considered adverse to population demographics or genetic diversity (i.e., smaller herd size) might actually be beneficial to the health and behavior of the individual horses (more available resources and habitat). A table depicting these predicted impacts is included in the text of each alternative listed below.*

Intensity Definitions

The intensity of potential impacts to feral horses is defined as follows:

Negligible: Impacts to the long-term health and viability of the feral horse population as assessed by genetic and demographic factors would be unlikely to be observed or measurable.

Minor: Impacts to the long-term health and viability of the feral horse population as assessed by changes in genetic or demographic factors would be observable, and could result in limited, largely short-term changes in population age structure, sex ratio, genetic variability or other population attributes.

Moderate: Impacts to the long-term health and viability of the feral horse population as assessed by changes in genetic or demographic factors would be observable, and would be expected to result in both short- and some long-term changes in population age structure, sex ratio, genetic variability or other population attributes. Mitigation measures, if needed to offset adverse effects, would likely be successful.

Major: Impacts to the long-term health and viability of the feral horse population as assessed by changes in genetic or demographic factors would be readily observable, and would be expected to result in both long-term and/or permanent changes in population age structure, sex ratio, genetic variability or other population attributes. Mitigation measures would be needed to offset adverse effects and their success could not be guaranteed.

4.5.1 Alternative A: No-Action

The No-Action Alternative would not alter any of the current management practices or projects at ASIS. As a result, the feral horse population would continue to be managed using immunocontraceptives indefinitely to maintain a relatively stable population of about 150 horses. This is expected to have a negligible adverse impact on the population demographics of the herd over the short-term, and a moderate adverse impact over the long-term. Long-term contraception is expected to result in a shifting of age structure from the typical skewed-right distribution (more young horses) to a roughly equal distribution among all age classes, and to alter the sex ratio of the herd. Because long-term immunocontraception ultimately renders mares infertile, the increase in older age classes would also reduce the reproductive capacity of the population. This, in turn, could increase vulnerability to potential catastrophic events (i.e., mortality from disease and storms) by limiting the herd's capacity for high reproductive output. The No-Action Alternative is expected to result in negligible short-term beneficial impacts and minor long-term adverse impacts to genetic diversity. While the No-Action Alternative would maintain the existing good genetic diversity in the short-term, the expected reduction in reproductive capacity has some potential to reduce diversity in the long-term.

The No-Action Alternative would have negligible beneficial impacts on individual horse health, behavior, and social organization of the herd over both the short- and long-term, as existing resources (i.e., food, water, and cover) are more than sufficient to support the existing population size.

Cumulative Impacts of Alternative A

Cumulative impacts on the feral horses on ASIS include catastrophic events such as disease outbreaks and storm related mortality. In consideration of the potential for catastrophic events, the cumulative impacts to the feral horse population under the No-Action Alternative would be negligible and adverse.

Conclusion

Impacts to demographics, genetics, and behavior, health and social organization of the feral horses that might result from implementation of Alternative A are detailed in Table 4.1. The total cumulative impact of other events plus Alternative A is negligible and adverse, with Alternative A making a negligible contribution.

Table 4.1 Summary of Predicted Impacts to the Feral Horse Population under the No-Action Alternative

Category	Causative Factors	Impact
Effects on population demographics (age structure, reproductive potential, sex ratio)	Increased longevity of mares and reduced reproductive rates resulting from contraception	ST negligible adverse LT moderate adverse
Effects on genetic diversity	Decline in reproductive capacity; catastrophic events (storms, disease)	ST negligible beneficial LT minor adverse
Effects on behavior and social organization (band dynamics, distribution, interactions; effects on individual horse health	No change in population size or competition for resources (food, water, cover)	ST negligible beneficial LT negligible beneficial

Key: ST = short-term ` LT = long-term

Implementation of Alternative A is not likely to result in impairment of park resources or values related to the feral horses of Assateague Island National Seashore.

4.5.2 Alternative B: One-time Capture and Removal

Under Alternative B, a one-time capture and removal would impact the behavior, social organization, and health of the feral horses, both individually and collectively, in several ways. The removal process would impact the selected horses due to the stresses of roundup, transportation, quarantine, handling and veterinary treatment, and acclimation to a new environment. For the population remaining on the island, the removal would affect band organization, social hierarchies, and the home range of some bands. Overall, the short-term impacts are expected to be moderately adverse. Horses are highly adaptable animals and can be expected to adjust to the changed conditions within a relatively short period of time. As such, the perturbations resulting from the removal would be relatively short-lived. Once the removal has been completed, the long-term impacts are expected to be minor and beneficial to both the feral horses removed from the island and those that remain. For those feral horses removed, the conditions and care received in either an adoptive home or sanctuary would provide a more benign environment than that experienced on the island, with a resultant increase in individual horse health. For the feral horses that remain on the island, a smaller population would reduce competition for basic resources, and potentially decrease inter-band aggression.

Alternative B would have a moderate beneficial impact to the population demographics and genetic diversity of the feral horse population over the short-term. The removal of horses provides an opportunity to adjust the composition of the herd and thereby enhance several measures of genetic and demographic health. Selection factors that could be used to improve overall population characteristics include reproductive status, age, sex, lineage, and genetic attributes. Additionally, by reducing the population to the lower end of the target range, the remaining herd could be allowed, for a time, to reproduce more freely than under the current intensive contraception regime, and thereby increase the proportion of younger animals and reproductive capacity of the population. In the long-term, as the need for more intensive contraception to maintain the population within the desired range increases, demographic impacts similar to those described in the No-Action Alternative would be expected. This would be exacerbated by the smaller overall population size, but somewhat offset by the demographic improvements achieved through the removal of selected horses. Genetic analyses (Eggert et al. 2005) and the results of a population and habitat viability assessment (Zimmerman et al. 2006) both suggest that a herd size of between 80-100 provides adequate protection against the potentially deleterious genetic consequences of a smaller population.

Cumulative Impacts of Alternative B

Cumulative impacts on the feral horses on ASIS include catastrophic events such as disease outbreaks and storm related mortality. In consideration of the potential for catastrophic events, the cumulative impacts to the feral horse population under Alternative B are expected to be minor and adverse.

Conclusion

Impacts to demographics, genetics, and behavior, health and social organization of the feral horses that might result from implementation of Alternative B are detailed in Table 4.2. The total cumulative impact of other events plus Alternative B is minor and adverse, with Alternative B making a minor contribution towards the overall intensity level.

Table 4.2 Summary of Predicted Impacts to the Feral Horse Population under Alternative B

Category	Causative Factor	Impact
Effects on population demographics (age structure, reproductive potential, sex ratio)	Removal of select horses; reduction to smaller population size, increased longevity of mares and reduced reproductive rates resulting from contraception	ST moderate beneficial LT moderate adverse
Effects on genetic diversity	Reduction to smaller population size; removal of select horses; catastrophic events (storms, disease); contraception	ST moderate beneficial LT minor adverse

Effects on behavior and social organization (band dynamics, distribution, interactions); effects on individual horse health	Reduction to smaller population size; removal of select horses	ST moderate adverse LT minor beneficial

Key: ST = short-term LT = long-term

Implementation of Alternative B is not likely to result in impairment of park resources or values related to the feral horses of Assateague Island National Seashore.

4.5.3 Alternative C: Intensive Contraception

Under Alternative C, the feral horse population would be subject to an additional 5-8 years of intensive contraception to prevent new births while natural mortality slowly reduces the herd to the target population size. Alternative C would have negligible beneficial impacts on the behavior and social organization of the herd over both the short- and long-term as competition for resources decreases with the reduction in population size. The intensive contraception regime is expected to result in minor adverse impacts to population demographics over the short-term as age structure, sex ratio and reproductive capacity are altered in ways similar to the No-Action Alternative, but more importantly due to the declining population size. Once the target population is reached, the intensity of contraception treatment would be reduced, but given the smaller size of the population, the long-term impacts of Alternative C on population demographics would be magnified and are expected to be moderately adverse. The impacts would result from the limits placed on reproduction needed to maintain the population at the target range and the associated effects on sex ratio (contracepted females live longer than males), age structure (more older horses) and reproductive capacity (fewer horses capable of reproducing).

The smaller population size achieved under Alternative C is expected to result in negligible short-term and minor long-term adverse impacts to the genetic health and diversity of the horse population. Genetic analyses and population modeling of the ASIS herd indicate that the target range of 80-100 feral horses has a low probability of encountering problems resulting from inbreeding or loss of genetic diversity for at least the next 50 years (Zimmerman et al. 2006).

Cumulative Impacts of Alternative C

Cumulative impacts on the feral horses on ASIS include catastrophic events such as disease outbreaks and storm related mortality. In consideration of the potential for catastrophic events, the cumulative impacts to the feral horse population resulting from the implementation of Alternative C are expected to be minor and adverse.

Conclusion

Impacts to demographics, genetics, and behavior, health and social organization of the feral horses that might result from implementation of Alternative C are detailed in Table 4.3. The total cumulative impact of other events plus Alternative C is minor and adverse, with Alternative C making a minor contribution towards the overall intensity level.

Table 4.3 Summary of Predicted Impacts to the Feral Horse Population under Alternative C

Category	Causative Factor	Impact
Effects on population demographics (age structure, reproductive potential, sex ratio)	Increased longevity of mares and reduced reproductive rates resulting from contraception; reduction to smaller population size	ST minor adverse LT moderate adverse
Effects on genetic diversity	Reduction to smaller population size; catastrophic events (storms, disease); contraception	ST negligible adverse LT minor adverse
Effects on behavior and social organization (band dynamics, distribution, interactions); effects on individual horse health	Reduction to smaller population size	ST negligible beneficial LT negligible beneficial

Key: ST = short-term LT = long-term

Implementation of Alternative C is not likely to result in impairment of park resources or values related to the feral horses of Assateague Island National Seashore.

4.5.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would implement actions similar to those occurring under Alternative C, except that in the long-term, there would be periodic additions and removals of small numbers of select feral horses to and from the population. Under Alternative D, the feral horse population would be subject to intensive contraception in order to reduce the herd to the target population size. It is estimated that it would take 5-8 years to achieve the target herd size. Similar to Alternative C, the actions occurring under this alternative are not expected to result in notable perturbations to the structure of the herd, and would decrease competition for basic resources, as the population grows smaller. However, in the long term there are likely to be short lived effects of limited scope on social organization associated with the periodic removals/additions of feral horses. These are expected to be minimal and unlikely to influence overall conditions. Individual feral horses removed from the population would face short-term adverse impacts associated with the stresses of capture and re-location, but would experience a more benign living environment in the long-term. Overall, Alternative D can be expected to result in negligible beneficial impacts on the behavior and social organization of the herd over the short-term, and negligible adverse impacts in the long-term.

The effects of an additional 5-8 years of intensive contraceptive on population demographics would be adverse over the short-term. This minor adverse impact is due to both a high number of non-reproductive, older horses currently in the population, and younger mares that would not foal again as a result of treatment criteria required to reduce population size. Contraception alters the sex ratio, is creating an atypical age structure that eventually would be roughly equally distributed through all age classes instead of a more typical skewed-right distribution, and is reducing the proportion of reproductively capable mares. After reaching the target range, immunocontraceptives would continue to be used to manage herd size, and continue to have an adverse impact on population demographics and reproductive capacity. However, the ability to manipulate the demographics of the population afforded by periodic small removals/additions of feral horses would mitigate the adverse effects of long-term contraception and result in an overall minor beneficial impact.

The impacts of Alternative D on the genetic condition of the population would be similar to the effects on demographics, whereby periodic additions/removals of select feral horses would mitigate the potential for adverse impacts associated with continued contraception and a smaller population size. Population modeling suggests that periodic additions of new feral horses would considerably reduce the probability of extinction by increasing genetic diversity and reducing the potential for inbreeding. Because of the positive effects of periodic removals on genetic characteristics, Alternative D would result in moderate long-term beneficial impacts.

Cumulative Impacts of Alternative D

Cumulative impacts on the feral horses on ASIS include catastrophic events such as disease outbreaks and storm related mortality. Alternative D would reduce the susceptibility of the feral horse population to potential impacts from catastrophic events by providing a means to rebuild the population should such an event occur. As such, the cumulative impacts to the feral horse population resulting from the implementation of Alternative D are expected to be minor and beneficial.

Conclusion

Impacts to demographics, genetics, and behavior, health and social organization of the feral horses that may result from implementation of Alternative D are detailed in Table 4.4. The total cumulative impact of other events plus Alternative D is minor and beneficial, with Alternative D making a moderate contribution towards the overall intensity level.

Table 4.4 Summary of Predicted Impacts to the Feral Horse Population under Alternative D

Category	Causative Factor	Impact
Effects on population demographics (age structure, reproductive potential, sex ratio)	Increased longevity of mares and reduced reproductive rates resulting from contraception; removal of select horses; reduction to smaller population size; addition of horses	ST minor adverse LT minor beneficial
Effects on genetic diversity	Reduction to smaller population size; removal of select horses; addition of horses; catastrophic events (storms, disease); contraception	ST minor adverse LT moderate beneficial
Effects on behavior and social organization (band dynamics, distribution, interactions); effects on individual horse health	Reduction to smaller population size; removal of select horses; addition of horses.	ST negligible beneficial LT negligible adverse

Key: ST = short-term LT = long-term

Implementation of Alternative D is not likely to result in impairment of park resources or values related to the feral horses of Assateague Island National Seashore.

4.6 Impacts to Wildlife and Wildlife Habitat by Alternative

Methodology

Impacts to wildlife habitat and wildlife by the feral horses occur in most terrestrial habitats on Assateague Island. As summarized in Chapter 3 – Affected Environment, and further described in the impact analyses for Soils, Topography and Geology, Vegetation, and Wetlands, the feral horses are known to have a broad range of effects on the Assateague environment. Specific, habitat-altering effects include changes in physical and biogeochemical processes, and the distribution, structure, and functionality of vegetation communities – all of which influence the quality and availability of wildlife habitat. Most native species have specific habitat requirements, or niches, on which they depend for survival and reproductive success. When critical components of a habitat are altered or compromised, both direct and indirect impacts can cascade through the dependant wildlife communities.

Existing feral horse impacts on wildlife and wildlife habitats are related to both the number of feral horses currently present in the Park, as well as their patterns of habitat use. While nearly all island habitats are susceptible, impacts have been most frequently documented and appear to be most pressing in sparsely vegetated habitats (including the ocean beaches) and in salt marsh habitats.

Assateague's ocean beach habitats are intensively used by migratory shorebirds during the annual spring and fall migration periods. The quality and availability of these habitats is influenced by recreational activities, off-road vehicle use (Morton 1996), administrative operations, and the presence of feral horses (Kumer, ASIS, pers. comm.).

Interactions between feral horses and migratory birds occur in certain years when early hatches of biting insects force feral horses onto the ocean beach for relief. When large insect hatches occur, the feral horses move en-masse and pace along the ocean beach, both day and night, whenever they are not foraging or watering. The 2006 herd was comprised of 29 harem bands and several bachelor bands, each with its own territory, occupying the entire length of the island. When the movement of feral horses occurs during the critical period for migrating shorebirds, species utilizing Assateague beaches for resting or foraging experience disturbance. Although this interaction does not occur every year, most of the shorebird species in question are undergoing dramatic population declines (Brown et al. 2001) and the loss of a critical stopover beach habitat prior to the breeding season reduces a bird's energy resources and may influence reproductive success.

ASIS staff conducts monitoring programs for rare species on Assateague, and concludes that the sparsely vegetated habitat associated with and maintained by tidal overwash events support a majority of the island's rare species (Sturm and Kumer, ASIS, pers. comm.). Sparsely vegetated habitats are utilized as travel corridors, nesting/breeding medium, hunting/foraging areas, and resting locations for a variety of wildlife from all major groups: mammals, reptiles, amphibians, birds, and invertebrates (Kumer, ASIS, pers. comm.).

Sparsely vegetated habitats are used extensively by feral horses as unobstructed travel routes and foraging habitat, after vegetation succession begins. Feral horse bands often alter their winter and summer primary foraging ranges to capitalize on transitioning habitat (Kumer, ASIS, pers. comm.). The combined use of sparsely vegetated areas for travel and foraging by feral horses results in harassment and displacement of native species utilizing this habitat. The most frequently observed effects, as noted by NPS staff, occur to avian species that are subject to interrupted nesting, roosting and courtship activities, crushed or damaged nest sites, egg losses resulting after adults flee nests, forced displacement of young chicks from preferred foraging and hiding areas, and crushed chicks (Kumer, ASIS, pers. comm.). The most affected avian species include least terns, black skimmers, oystercatchers, gull-billed terns (all state-listed species), killdeer, horned larks, and common terns.

Feral horse-crushed reptiles, reptile nests, and invertebrates have also been documented in the sparsely vegetated habitat. This anecdotal, or chance, documentation results from the amount of time resource monitoring staff spends observing rare species in this habitat type and because observations are more obvious when the ground is not covered with vegetation. Harassment of other avian species in grasslands and woodlands has also been occasionally noted, but those observations are infrequent.

Feral horse grazing in salt marsh habitats affects a wide diversity of resident wildlife species dependent upon the Assateague salt marshes. Furbish and Albano (1994) found that feral horse grazing in the *S. alterniflora* salt marsh reduced the density of fiddler crabs (*Uca* ssp.) when compared to salt marshes along the mainland, except for small areas along Assateague's bay shoreline with an active input of new sediment. Impacts to the mud snail, (*Melampus bidentatus*), another keystone salt marsh species, varied by sample site and were thought to be related to the intensity of feral horse grazing. Fiddler crab colonies continue to exist only in small patches of ungrazed or lightly grazed *S. alterniflora* marshland on Assateague, as observed by Kumer (ASIS, pers. comm.).

A comparison of Breeding Bird Survey data from 1983-1987, which coincides with the first five years that the feral horse population was over 100 individuals, and the 2002-2006 data, indicate that keystone avian species of the low salt marsh/intertidal marsh habitat (rails), and high salt marsh grassland species (seaside and sharp-tailed sparrows) have declined on Assateague (Hoffman, MD DNR, pers. comm.). These same species have maintained their presence in coastal marshes on the mainland across from Assateague and even in the isolated salt marshes behind Ocean City. Hoffman reports that the primary difference between active rail areas and areas without rails is the condition or robustness of the salt marsh vegetation, and the presence or absence of infauna on which the rails forage. The decline in sparrows is most likely due to disturbance and the condition of the high marsh vegetation (Hoffman, MD DNR, pers. comm.). Grassland sparrows prefer grasses that have adequate height and density to support safe nesting, and reproducing plants to support foraging.

In the 1970's, 13 bay salt marsh islands supported 11 species of colonial breeding birds, when feral horse use of these islands was infrequent (Brinker et al. 2007). During the 1980's, when the number of feral horse bands increased on ASIS, the feral horses began to utilize six of these islands on a regular basis, and all were eventually abandoned by the resident colonial bird species. This includes the last breeding site within ASIS used by sandwich terns, a Maryland Species of Concern, and the last breeding colony of laughing gulls in the State of Maryland (abandoned in 1986). NPS staff observed use of that island by feral horses and harassment of the gulls during the final two breeding seasons (Kumer, ASIS, pers. comm.). Feral horses continue to utilize these islands, as well as others, to the extent that new breeding bird colonies are unlikely to form due to feral horse grazing and the resultant alteration of plant structure (Brinker et al. 2007).

Intensity Definitions

The intensity of potential impacts to wildlife and wildlife habitat is defined as follows:

Negligible: Impacts to native species, their habitats, or the natural processes sustaining them would be at the lowest levels of detection. Changes would be minimal and well within the range of natural variation.

Minor: Impacts to native species, their habitats, or the natural processes sustaining them would be detectable, but short-term and/or spatially limited in scope. Changes would not be expected to greatly exceed the range of natural variability. Mitigation measures, if needed to offset adverse effects, would be relatively easy to implement and likely to be successful.

Moderate: Impacts to native species, their habitats, or the natural processes sustaining them would be readily detectable over relatively wide areas of the Park. Impacts could result in direct mortality and/or interference with activities necessary for survival, but would not be expected to threaten the continued existence of the species in the Park unit. Mitigation measures, if needed to offset adverse effects, would be extensive and difficult to implement, but likely to be successful.

Major: Impacts on native species, their habitats, or the natural processes sustaining them would be readily detectable over most areas of the Park, and outside the range of natural variability for long periods of time or be permanent. Direct impacts or habitat alterations could affect the viability of at least some native species. Extensive and difficult mitigation measures would be needed to offset adverse effects and their success could not be guaranteed.

4.6.1 Alternative A: No-Action

The No-Action Alternative would not alter any of the current management practices or conditions at ASIS. The population would continue to be managed to maintain a relatively stable population of about 150 horses. As a result, the existing impacts on wildlife and wildlife habitats caused by the feral horses would continue. Feral horse grazing and trampling would continue to degrade habitat quality and functionality, and disturbance by feral horses would continue to cause both direct and indirect impacts on native wildlife. Existing impacts are known to include direct mortality, reduced fitness and reproductive success, and increased susceptibility to depredation and competition. As a consequence, certain wildlife species have been displaced from some parts of the island, while others are experiencing population declines. The No-Action Alternative therefore would have moderate adverse short- and long-term impacts on wildlife and wildlife habitat on Assateague Island.

Cumulative Impacts of Alternative A

Cumulative impacts to wildlife and wildlife habitat include global climate change, competition by non-native plant and animal species, disturbance from recreational activities, and habitat degradation from historic land use (e.g., dune stabilization). Coupled with the continued effects of the feral horses, the cumulative impacts of the No-Action Alternative on wildlife would be moderate and adverse.

Conclusion

Impacts to wildlife that might result from implementation of Alternative A are adverse and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative A is moderate and adverse, with Alternative A contributing a moderate amount to the overall intensity level.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to wildlife resources of Assateague Island National Seashore.

4.6.2 Alternative B: One-time Capture and Removal

Alternative B would have a minor beneficial impact to wildlife and wildlife habitat on ASIS over the short-term and a moderate beneficial impact over the long-term. Reducing the feral horse population size to the target range within a short amount of time (~ 2 years) would quickly reduce the amount of disturbance to wildlife currently occurring, but be unlikely to result in substantial improvements in the quality or functionality of impacted habitats in the short-term. The benefits would result from both the overall reduction in the number of feral horses, as well as changes in the distribution of bands and occupied territories. Wildlife populations are expected to respond positively to improvements in habitat condition once vegetation communities successfully recover from grazing and tramping damage, but, at this point, it is unclear exactly how quickly impacted habitats would recover. The assumption is that in the long-term, the affected vegetation communities would ultimately recover from feral horse impacts, and that recovery would likely result in increased biodiversity and wildlife community health. This reduction in disturbance and improvement in habitat quality would occur more quickly than other alternatives, as Alternative B would reduce the feral horse population over the shortest period of time.

Cumulative Impacts of Alternative B

Cumulative impacts to wildlife and wildlife habitat include global climate change, competition by non-native plant and animal species, disturbance from recreational activities, and habitat degradation from historic land use (e.g., dune stabilization). Mitigated by the reduced impacts of a smaller feral horse population, the cumulative impacts of Alternative B would be minor and beneficial.

Conclusion

Impacts to wildlife and wildlife habitat that might result from implementation of Alternative B are beneficial and of minor intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative B is minor and beneficial, with Alternative B making a moderate contribution towards mitigation the intensity of the cumulative impacts.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to wildlife resources of Assateague Island National Seashore.

4.6.3 Alternative C: Intensive Contraception

Alternative C is expected to result in negligible beneficial impacts to wildlife and wildlife habitat over the short-term, and moderate beneficial impacts in the long-term on ASIS. Under Alternative C, the feral horse population would not reach the target range for 5-8 years. As a result, the amount of wildlife disturbance by feral horses would begin to diminish during the short-term, but impacted habitats would be unlikely to recover to any substantial degree. Over the long-term, Alternative C would result in considerably reduced disturbance as the population reaches and is maintained at the target size. Over time, habitats impacted by feral horse grazing and trampling would be expected to recover, resulting in positive benefits similar to alternative B, although more slowly. Depending on the wildlife habitat or species in question, the response might occur more rapidly to some species than others. In the short-term (< 5 years), the feral horse population would steadily decline, but continue to be larger than the upper limit of the target range and adversely impact vegetation resources and habitat quality. However, in the long-term the impact would be similar to that described under Alternative B.

Cumulative Impacts of Alternative C

Cumulative impacts would be similar to those described under Alternative B (minor and beneficial), where the continuing impacts to wildlife from other sources (climate change, non-native species, recreation, land use activities) would be somewhat mitigated by the smaller feral horse population.

Conclusion

Impacts to wildlife and wildlife habitat that might result from implementation of Alternative C are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative C is minor and beneficial, with Alternative C making a minor to moderate contribution towards mitigation the intensity of the cumulative impacts.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to wildlife resources of Assateague Island National Seashore.

4.6.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would have the same effects as detailed under Alternative C. The positive benefits resulting from a reduced population of feral horses would occur more slowly than in Alternative B, and would not be expected to manifest for at least 5-8 years. However, ultimately, Alternative D would be expected to result in long-term moderate benefits similar to Alternatives B and C. Disturbance to wildlife would be greatly reduced, and as impacted habitats recover, wildlife populations would become more diverse and robust. As in Alternatives B and C, the timing and extent of recovery would likely vary by habitat and species.

Cumulative Impacts of Alternative D

Cumulative impacts would be similar to those described under Alternative B (minor and beneficial), where the continuing impacts to wildlife from other sources (climate change, non-native species, recreation, land use activities) would be somewhat mitigated by the smaller feral horse population.

Conclusion

Impacts to wildlife and wildlife habitat that might result from implementation of Alternative D are beneficial and of negligible intensity over the short-term, and of moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative D is minor and beneficial, with Alternative D making a minor to moderate contribution towards mitigating the intensity of the cumulative impacts.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to wildlife resources of Assateague Island National Seashore.

4.7 Impacts to Threatened and Endangered Species by Alternative

Intensity Definitions

The intensity of potential impacts to threatened and endangered species is defined as follows:

Negligible: Listed species would not be affected or the change would be so small as to not be of any measurable consequence to the population. Negligible effects would equate with a “may effect, not likely to adversely affect” determination in U.S. Fish and Wildlife Service terms under the Endangered Species Act.

Minor: There would be a measurable effect on one or more listed species or their habitats, but the change would be small and relatively localized. Minor effect would equate with a “may effect” determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of “likely” or “not likely to adversely affect” the species.

Moderate: A noticeable effect to a population of a listed species. The effect would be of consequence to populations or habitats. Moderate effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely" or "not likely to adversely affect" the species.

Major: Noticeable effect with severe consequences or exceptional benefit to populations or habitats of listed species. Major effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely" or "not likely to adversely affect" the species or habitat.

4.7.1 Piping Plover

Methodology

Piping plovers are federally threatened due primarily to habitat loss and degradation associated with human activities including recreational use, development, and the alteration of natural coastal processes and shoreline conditions. Maintaining the remaining population is hampered by disturbance by humans and pets using the coastal habitats required by piping plovers, and the bird's susceptibility to natural depredation and naturally fluctuating habitat conditions (USFWS 2002).

On Assateague Island, plover habitat has been degraded by both historic and current land use practices, primarily dune and berm building, which have interrupted the formation and maintenance of overwash channels and other sparsely vegetated habitats in certain areas of the Park (Mackintosh 1982, NPS 2006a). However, plover habitat has also been created in discrete areas by storm events such as those that occurred in 1991, 1992 and 1998. The resulting habitat changes from both of those events improved plover breeding success and resulted in population increases (NPS 2006a).

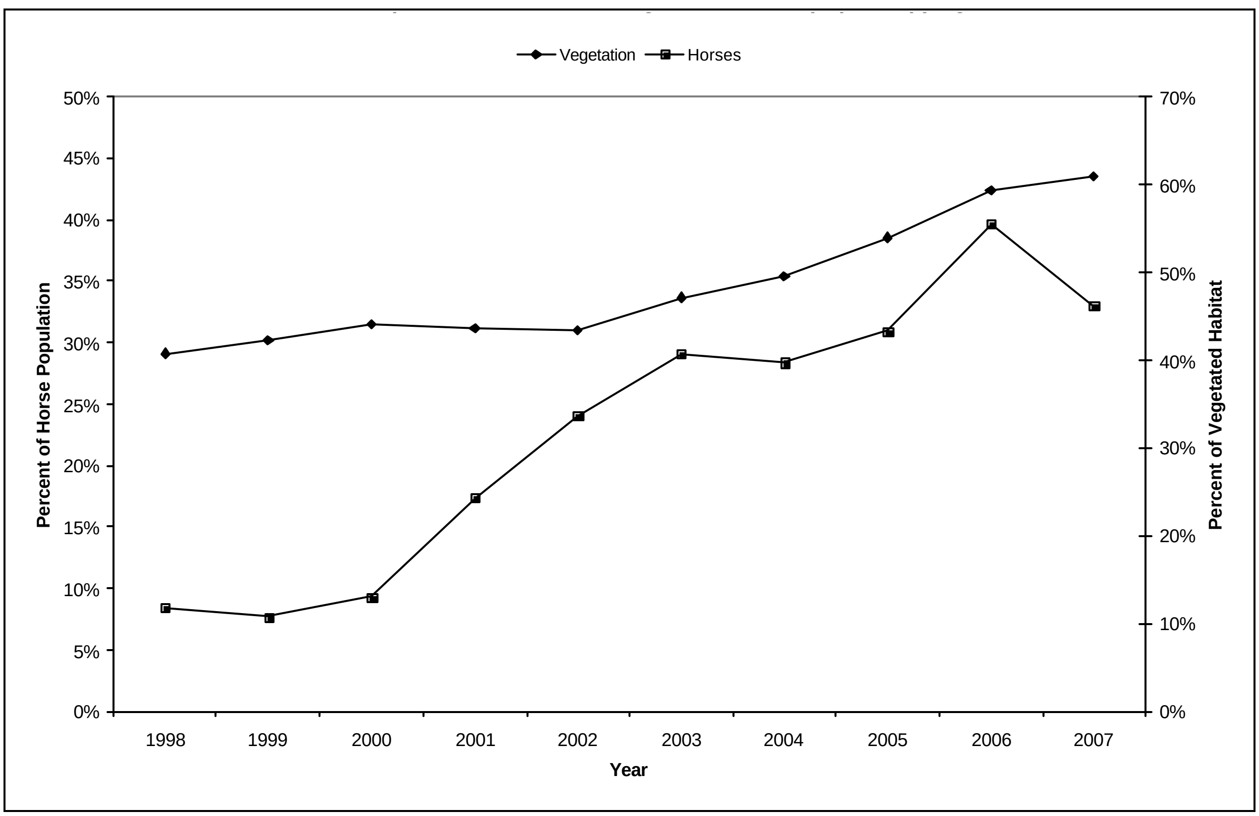
Patterson (1988) made the first quantitative assessment of plover disturbance by feral horses on ASIS, with 8% of all recorded nest disturbances being caused by feral horses. Disturbance (primarily human) was found by Loegering (1992) to be a major limiting factor in successful plover nesting, and disturbance was also linked to chick mortality along the beach where harassment of the chicks compounded the stress of the poor foraging capacity of the ocean beach habitat. Loegering (1992) determined that the greatest mean flush distance (from inter-species disturbance) was 175 meters, with an additional agitation distance of 50 meters. Current management practices enforce a 200 meter buffer zone to protect plovers from disturbance by humans and pets, but there is no strategy to reduce harassment from free-roaming horses.

NPS plover monitoring staff have reported feral horse impacts to plovers annually from 1991 through the present. Impacts occur to plovers during courtship, nesting and brood rearing. The type of impacts include interruption of breeding behaviors, disruption to egg incubation, displacement of incubating adults leading to egg depredation, destruction of predator exclosure cages constructed around nests, harassment of chicks and displacement from preferred foraging areas, and direct chick mortality by crushing (Kumer, ASIS, pers. comm.).

The existing sparsely vegetated habitat used for plover brood foraging is subject to disturbance by feral horses, as discussed in the Wildlife and Wildlife Habitat section. These areas have not been subject to overwash since 1998 and have experienced a consequential expansion of herbaceous vegetation (Sturm 2004). Sturm (2007b) found that feral horse grazing increases *S. pungens* abundance, one of the major colonizers of sparsely vegetated habitats. In the absence of overwash events, feral horse grazing has contributed to an accelerated colonization of large areas by *S. pungens* within previously existing sparsely vegetated habitats.

From 1996 through 2002, the average number of feral horses with summer home ranges on the north end was sixteen (see Figure 4.3). In 2003, this number nearly tripled to 43 feral horses and by the spring of 2006 approximately 40% of the entire herd moved seasonally to the densest breeding area of the primary plover habitat to graze on new forage in an area with a lower density of biting insects. The effect on plovers was compounded by the fact that when large numbers of feral horse bands congregate in a communal area, interactions between dominant animals frequently result in chases and stampedes, increasing the risk of disturbance and direct impacts. Until the island is subjected to major storm activity that creates new sparsely vegetated habitat, conflicts between feral horses and plovers on ASIS will continue in those areas where suitable habitat remains.

Figure 4.3 The percent of feral horses using the north end of Assateague Island has increased in recent years as the habitat has shifted from open, sparsely vegetated communities to more densely vegetated communities attractive to feral horses for foraging.



4.7.1.1 Alternative A: No-Action

The short- and long-term impacts of the No-Action Alternative on piping plovers at ASIS are expected to be moderate adverse and minor adverse, respectively, resulting from occasional direct mortality of eggs and chicks, and indirect impacts resulting from the interruption of breeding activities, disturbance of incubating adults and associated loss of eggs from exposure and depredation, and the harassment of chicks and displacement from preferred foraging habitats. It is assumed that in the long-term, feral horse impacts would diminish as future storm activity improves the quality and availability of plover habitat and mitigates some of the existing conflicts between feral horses and plovers. Ultimately, the frequency and severity of storm tides will dictate the extent and location of overwash channels and sparsely vegetated habitat available for plovers, which is considered a much more potent influence on plover success.

Cumulative Impacts of Alternative A

The cumulative impacts of the No-Action Alternative would be moderate adverse, resulting from the effects of ongoing habitat-altering activities (e.g., Ocean City Inlet jetties, North End Restoration Project), historic manipulations of the landscape (i.e., artificial dune building and maintenance), disturbance from public off-road vehicle use in certain parts of the Park, reduced habitat availability due to natural vegetation succession in the absence of major storms, and disturbance from humans and other wildlife (including predators).

Conclusion

Impacts to piping plovers that might result from implementation of Alternative A are adverse and of moderate intensity over the short-term and of minor to moderate intensity over the long-term. The total cumulative impact of other projects plus Alternative A is moderate and adverse, with Alternative A contributing a negligible to minor amount.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to piping plovers of Assateague Island National Seashore.

4.7.1.2 Alternative B: One-time Capture and Removal

Alternative B is expected to have a moderate beneficial impact in the short-term and a minor beneficial impact in the long-term on piping plovers at ASIS. Under Alternative B, the feral horse population, and potentially the number of bands, would be reduced, lessening the magnitude of disturbance, displacement and mortality to piping plovers. Feral horses would remain free-roaming and continue to share habitat with breeding piping plovers and their unfledged chicks, but the number of feral horses potentially impacting piping plovers would be considerably reduced as compared to the No-Action Alternative. The reduction of impacts would be more considerable in the short-term as future storm effects and resultant habitat improvements lessen the importance of the feral horses as a negative influence on plover success.

Cumulative Impacts of Alternative B

The cumulative impacts of Alternative B would be the same as those described under the No-Action Alternative (moderate and adverse) since the feral horses are not one of the dominant threats to this species at ASIS.

Conclusion

Impacts to piping plovers that might result from implementation of Alternative B are beneficial and of moderate intensity over the short-term, and of minor intensity over the long-term. The total cumulative impact of other projects plus Alternative B is moderate and adverse, with Alternative B contributing a negligible to minor amount towards the overall intensity level.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to piping plovers of Assateague Island National Seashore.

4.7.1.3 Alternative C: Intensive Contraception

Alternative C is expected to have short-term minor adverse impacts on piping plovers at ASIS, because the feral horse population would slowly be reduced to a level where there would be a notable reduction in existing impacts to piping plover. Once the feral horse population is reduced to the target range of 80-100 (in 5-8 years), Alternative C would result in minor long-term beneficial impacts as long as the short-term impacts by feral horses do not cause a consequential reduction in breeding pairs. Feral horses would remain free-roaming and have access to plover breeding and foraging habitats, but the number of feral horses potentially impacting piping plovers would be greatly reduced as compared to the No-Action Alternative.

Cumulative Impacts of Alternative C

The cumulative impacts of Alternative C would be the same as those described under the No-Action Alternative (moderate and adverse) since the feral horses are not one of the dominant threats to this species at ASIS.

Conclusion

Impacts to piping plovers that might result from implementation of Alternative C are adverse and minor over the short-term, and beneficial and minor over the long-term. The total cumulative impact of other projects plus Alternative C is moderate and adverse, with Alternative C contributing a negligible to minor amount towards the overall intensity level.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to piping plovers of Assateague Island National Seashore.

4.7.1.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D is expected to have short-term minor adverse impacts on piping plovers at ASIS, because the feral horse population would slowly be reduced to a level where there would be a reduction in existing impacts to threatened and endangered species. As the feral horse population is reduced over the long-term (5-8 years), however, Alternative D could result in a minor long-term beneficial impact to piping plovers as long as the short-term impacts by feral horses do not cause a reduction in breeding pairs. Feral horses would remain free-roaming, but the number of feral horses potentially impacting piping plovers would be reduced as compared to the No-Action Alternative.

Cumulative Impacts of Alternative D

The cumulative impacts of Alternative D would be the same as those described under the No-Action Alternative (moderate and adverse) since the feral horses are not one of the dominant threats to this species at ASIS.

Conclusion

Impacts to piping plovers that might result from implementation of Alternative D are adverse and minor over the short-term, and beneficial and minor over the long-term. The total cumulative impact of other projects plus Alternative D is moderate and adverse, with Alternative D contributing a negligible to minor amount.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to piping plovers of Assateague Island National Seashore.

4.7.2 Seabeach Amaranth

Methodology

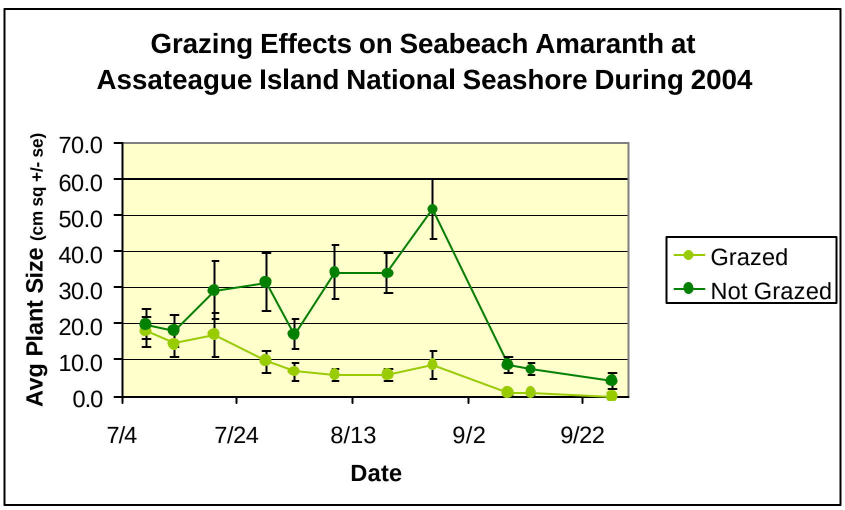
Assateague Island's seabeach amaranth population is being adversely affected by feral horse herbivory. The feral horses typically move to the ocean beach to cool off and avoid the abundant biting insects that are found in other island habitats during the summer months. This behavior causes feral horses to be more likely to encounter seabeach amaranth. Monitoring during a recent seabeach amaranth restoration project at ASIS (2000 to 2002) revealed evidence that feral horses eat seabeach amaranth (Lea et al. 2003). Additional monitoring of the seabeach amaranth population during 2006 demonstrated that feral horse herbivory is a primary factor limiting amaranth recovery on Assateague Island by reducing amaranth size, abundance, distribution, and reproductive success (Sturm, ASIS, pers. comm.).

Lea et al. (2003) hypothesized that herbivory by feral horses might provide a means of seed dispersal for seabeach amaranth, as a plant was observed growing from a pile of horse manure during the seabeach amaranth restoration project. Additional monitoring since 2002 has not shown this to be likely, however, since additional wild plants have seldom been observed growing out of horse manure.

An assessment of 140 amaranth plants revealed that feral horses were responsible for nearly half of all observed ungulate herbivory impacts on seabeach amaranth. Over the entire growing season, herbivory was found to lower seabeach amaranth survival by 27% and plant size by 58% (Sturm 2006). The reduction in survival and average size threatens the viability of Assateague Island's seabeach amaranth population since the species' survival strategy is to seed bank, meaning it seeks to produce large quantities of seeds that lie dormant until conditions again become suitable for germination. Larger plants produce exponentially more seeds (Lea et al. 2003), and therefore management strategies for seabeach amaranth should encourage many large plants throughout its range. Monitoring data indicate that seabeach amaranth seed production was reduced by more than 500% due to herbivory during 2006 (Sturm, ASIS pers com).

Based on the results of an experiment conducted during 2004 (see Figure 4.4) and continued in 2005, wire cages have been used at ASIS to reduce grazing impacts on a portion of the island's seabeach amaranth population. However, only a small percentage of the island's seabeach amaranth population is protected annually. For example, during 2006 roughly 14% of ASIS' total seabeach amaranth population was protected with cages.

Figure 4.4 Grazing Effects on Seabeach Amaranth at ASIS in 2004.



4.7.2.1 Alternative A: No-Action

The No-Action Alternative would result in moderate adverse impacts to seabeach amaranth over both the short-term and the long-term since feral horse grazing would continue to occur at roughly the current level of intensity. The protection of individual plants through the use of protective cages is expected to continue in order to prevent grazing impacts from becoming a major adverse impact.

Cumulative Impacts of Alternative A

Cumulative impacts to seabeach amaranth include global climate change, recreational activities, and historic land use activities. In consideration of the Park's overall management strategies, which encourage the maintenance of natural processes conducive to the perpetuation of favorable habitat conditions for seabeach amaranth and mitigate the effects of recreational activities, cumulative impacts would be minor and adverse.

Conclusion

Impacts to seabeach amaranth that might result from implementation of Alternative A are adverse and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative A is minor and adverse, with Alternative A contributing a moderate amount of the overall intensity level.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to seabeach amaranth of Assateague Island National Seashore.

4.7.2.2 Alternative B: One-time Capture and Removal

Alternative B is anticipated to result in moderate beneficial impacts to seabeach amaranth at ASIS over both the short-term and the long-term, as grazing pressure would be considerably reduced by the presence of a smaller feral horse population, and reduced over a relatively short period of time as compared to the other alternatives. The reduced feral horse population would continue to affect seabeach amaranth, however, grazing impacts would be proportionally reduced.

Cumulative Impacts of Alternative B

Cumulative impacts to seabeach amaranth include global climate change, recreational activities, and historic land use activities. Mitigated by the reduced impacts of a smaller feral horse population, the cumulative impacts of Alternative B would be minor and beneficial.

Conclusion

Impacts to seabeach amaranth that might result from implementation of Alternative B are beneficial and of moderate intensity, both short- and long-term. The total cumulative impact of other projects plus Alternative B is minor and beneficial, with Alternative B contributing a moderate amount towards mitigation the intensity of cumulative impacts.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to seabeach amaranth of Assateague Island National Seashore.

4.7.2.3 Alternative C: Intensive Contraception

Alternative C is anticipated to result in minor adverse impacts to seabeach amaranth over the short-term since the feral horse population would remain above the target range for most of the short-term period, and feral horses would continue to graze on seabeach amaranth at relatively high levels. Protective cages would continue to be used to protect plants from grazing. Under Alternative C, the reduction of the herd size would occur gradually over 5-8 years, resulting in a moderate, beneficial impact to seabeach amaranth over the long-term, because eventually, grazing pressure by feral horses would be reduced.

Cumulative Impacts of Alternative C

Cumulative impacts to seabeach amaranth include global climate change, recreational activities, and historic land use activities. Mitigated by the reduced impacts of a smaller feral horse population, the cumulative impacts of Alternative C would be minor and beneficial.

Conclusion

Impacts to seabeach amaranth that might result from implementation of Alternative C are adverse and minor over the short-term, and beneficial and moderate over the long-term. The total cumulative impact of other projects plus Alternative C is minor and beneficial, with Alternative C contributing a moderate amount towards mitigating the intensity of cumulative impacts.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to seabeach amaranth of Assateague Island National Seashore.

4.7.2.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D is anticipated to result in minor adverse impacts to seabeach amaranth at ASIS in the short-term, similar to those described under Alternative C. Under Alternative D, the reduction of the feral horse population would occur gradually, over 5-8 years, resulting in a moderate, beneficial impact to seabeach amaranth over the long-term, as grazing pressure by feral horses would be reduced.

Cumulative Impacts of Alternative D

Cumulative impacts to seabeach amaranth include global climate change, recreational activities, and historic land use activities. Mitigated by the reduced impacts of a smaller feral horse population, the cumulative impacts of Alternative D would be minor and beneficial.

Conclusion

Impacts to seabeach amaranth that might result from implementation of Alternative D are adverse and minor over the short-term, and moderate and beneficial over the long-term. The total cumulative impact of other projects plus Alternative D is minor and beneficial, with Alternative D contributing a moderate amount towards mitigating the intensity of cumulative impacts.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to seabeach amaranth of Assateague Island National Seashore.

4.7.3 State-Listed Species

Methodology

Most state-listed species of conservation concern at ASIS occur in similar habitats as those required by piping plovers and seabeach amaranth. Feral horses occasionally trample nests and disrupt nesting activity by ground-nesting species such as the least tern or black skimmer, because these birds often nest in fairly tight colonies in areas used by feral horses. However, neither the State nor the NPS have ever had opportunity to systematically document the intensity and consequence of feral horse impacts because of staff and resource limitations (Kumer, ASIS, pers. comm.).

Although there is no quantifiable data available describing the direct effects of feral horses on state-listed plants at ASIS, NPS staff have observed evidence of feral horse herbivory and trampling on many of these species. Recent research performed at ASIS found evidence of potential indirect impacts of feral horse grazing with the discovery that herbivory acts to stimulate the accelerated expansion of *Phragmites australis*, an aggressive invasive species (Sturm, ASIS, pers. comm.). Once established *Phragmites* frequently out-competes and displaces native vegetation including populations of state-listed plant species known to occur in habitats affected by *Phragmites*.

4.7.3.1 Alternative A: No-Action

The impacts from the No-Action Alternative to state-listed species such as the least tern, black skimmer, and listed plants are expected to be similar to those for piping plover and seabeach amaranth.

In consideration of the known impacts to seabeach amaranth from feral horse grazing and the similarity of habitats occupied by many of the state-listed plants, the No-Action Alternative is expected to result in moderate adverse short- and long-term impacts.

Cumulative Impacts of Alternative A

Cumulative impacts to state-listed species include global climate change, loss of habitat, recreational activities, and historic land use activities. In particular, cumulative impacts to ground-nesting bird species of conservation concern are believed to be moderate and adverse, with predation by other native species being a dominant factor affecting nesting success. However, because the Park’s overall management strategies encourage the maintenance of natural processes conducive to the maintenance of favorable habitat conditions for state-listed species of management concern, cumulative impacts would be minor and adverse.

Conclusion

Impacts to state-listed species that might result from implementation of Alternative A are adverse and of moderate intensity, both short- and long-term. The total cumulative impact of other events plus Alternative A is minor and adverse, with Alternative A contributing a minor amount.

Implementation of Alternative A is not likely to result in impairment of park resources or values related to state-listed species of Assateague Island National Seashore.

4.7.3.2 Alternative B: One-time Capture and Removal

The impact from Alternative B to state-listed species such as the least tern, black skimmer, and listed plants is expected to be the same as those for piping plover and seabeach amaranth. Thus the impacts would be minor/moderate and beneficial in both the short- and long-term because the feral horse population would be reduced, relatively quickly, to a much smaller size.

Cumulative Impacts of Alternative B

Cumulative impacts to state-listed species are anticipated to be less than the No-Action alternative (minor and adverse). A smaller herd size would be less capable of threatening state-listed species, but the affects of depredation on ground-nesting birds and habitat losses from *Phragmites* encroachment would continue to result in impacts.

Conclusion

Impacts to state-listed species that might result from implementation of Alternative B are beneficial and of minor to moderate intensity, both short- and long-term. The total cumulative impact of other events plus Alternative B is minor and beneficial, with Alternative B contributing a minor amount towards mitigating the intensity of cumulative impacts.

Implementation of Alternative B is not likely to result in impairment of park resources or values related to state-listed species of Assateague Island National Seashore.

4.7.3.3 Alternative C: Intensive Contraception

The impact from Alternative C to state-listed plant and animal species is expected to be the same as those for piping plover and seabeach amaranth. Thus the impacts would be minor and adverse during the short-term and moderate/minor beneficial over the long-term because the feral horse population would eventually be reduced to a smaller size.

Cumulative Impacts of Alternative C

Cumulative impacts are anticipated to be the same as would occur under Alternative B (minor and adverse).

Conclusion

Impacts to state-listed species that might result from implementation of Alternative C are adverse and minor over the short-term, and beneficial and minor/moderate over the long-term. The total cumulative impact of other events plus Alternative C is minor and beneficial, with Alternative C contributing a minor amount towards mitigating the intensity of cumulative impacts.

Implementation of Alternative C is not likely to result in impairment of park resources or values related to state-listed species of Assateague Island National Seashore.

4.7.3.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

The impact from Alternative D to state-listed plant and animal species is expected to be the same as those for piping plover and seabeach amaranth. Impacts would be minor and adverse during the short-term and moderate/minor beneficial over the long-term because the feral horse population would be slowly reduced to the smaller target range.

Cumulative Impacts of Alternative D

Cumulative impacts would be the same as described under Alternative B (minor and adverse).

Conclusion

Impacts to state-listed species that might result from implementation of Alternative D are adverse and minor over the short-term, and beneficial and minor/moderate over the long-term. The total cumulative impact of other events plus Alternative D is minor and beneficial, with Alternative D contributing a minor amount towards mitigating the intensity of cumulative impacts.

Implementation of Alternative D is not likely to result in impairment of park resources or values related to state-listed species of Assateague Island National Seashore.

4.8 Impacts to Park Operations and Administration by Alternative

Methodology

Table 4.5 summarizes the annual cost in 2006 for the existing population management component of the feral horse management program on ASIS. The summary includes the costs associated with contraception as well as the population monitoring activities conducted to support the contraception effort.

The exact cost of removing a group of feral horses from ASIS is unknown, however data from a horse removal effort conducted at Cape Lookout National Seashore provides a general sense of the costs involved. Table 4.6 summarizes the estimated costs associated with rounding up 130 horses on 3,000 acres of land and then removing 20 horses from various harem bands on Cape Lookout National Seashore. Compared to Cape Lookout, the herd size at ASIS is slightly larger, the number of feral horses proposed for removal in Alternative B is higher, and the land area occupied by the feral horses is larger; therefore the actual ASIS costs is likely to be higher than the Cape Lookout example. There would also be additional costs associated with the care and maintenance of feral horses removed from the island while in quarantine (up to several weeks), inoculations and veterinary care/treatment, and transportation to the final destination.

Table 4.5 Feral Horse Management Costs at ASIS (2006 dollars)

Feral Horse Management Components	Average Cost / Year
Pregnancy testing	$520
Contraceptive vaccine	$1,715
Transportation	$5,115
Equipment and Supplies	$1,000
Personnel	$39,400
Overhead	$7,100
TOTAL	**$54,850**

Table 4.6 Cost Estimate of Feral Horse Capture and Dispersal at Cape Lookout National Seashore

Item		Cost $
Holding pens	Fencing (posts, wire and top boards, supplies, including a chute for loading) and NPS staff time to construct	$4,500
	Panels (used as gates and for temporary divisions/fencing) [20 x $200 each]	$4,000
Helicopter and pilot for 2 days	Cost dependant upon whether pilot is private vs. NPS	$7,500 to $10,000
ATVs	12 x $4,000 per ATV (new)	$48,000
Vets: State Vets* (4) and State Livestock Handlers (6)	Supplies and medications/drugs. $500 per Vet and $250 per handler per day [$500 x 2 days x 4 vets + $250 x 2 days x 6 handlers]	$7,000
Staff	Salary for 15 staff for 3 days (round up for two days, separate horses and transport on 3rd day). $160 per day per staff member [$160 x 3 days x 15 staff]	$7,200
Radios	Radios acquired from Forest Service fire cache. Shipping and extra batteries - $400 for 2 boxes of 15 radios each	$400
Boat and operator	For spotting purposes [$500 per day x 2 days]	$1,000
	TOTAL	**$82,100**

***State Vets are used instead of private vets because of the early Equine Infectious Anemia (EIA) chances/presence and because State Vets are best equipped to deal with wild animals**

An alternative method of estimating the potential costs of a one-time capture and removal at ASIS considers the cost of wild horse gathers conducted on western lands managed by the Bureau of Land Management. In 2006, the average per animal cost for gathering was $490, the average per day short-term holding cost was $3.69 per horse, and the average per horse adoption cost was $931 (Glenn, BLM, pers. comm.). Assuming the removal/dispersal of 30 horses from

ASIS, the estimated short-term cost for implementing Alternative B using this method would be approximately $45,000.

The periodic removal of select feral horses for population health management purposes is difficult to estimate, because the average cost of removing an individual feral horse depends on both the time spent capturing the animal and the disposition of the animal. Capturing a feral horse could be easy or difficult depending on the individual horse and its location on the island, and the cost of preparing a feral horse for adoption or another off-island situation depends on the animal's age and disposition, which can vary greatly. In 2005, ASIS removed a severely habituated stallion at the conservative cost estimate of $5,400, which included approximately 62 hours of personnel time, hay, feed, fly spray, castration, shots and vet fees, transportation to a rescue facility, 3 months training, board for 5 months, placement fee, and transportation to a final destination in Florida, where he now resides as a companion animal. Because the horse was severely habituated, he was very easy to capture (1/2 day for 3 staff); however, once removed, gelded and vaccinated, he still spent 5 months in a facility where he received training while waiting to find an appropriate adoptive home.

Thus, an estimate of time and materials needed to capture an individual feral horse under the varying circumstances ranges in cost from $800 to $8,700 per horse (Zimmerman, ASIS, pers. comm.). This estimate includes the cost of time spent arranging a recipient/destination for the feral horse, capture (locate animal, set up corral, bait, and capture), care and feeding on the mainland while in quarantine, as well as associated non-personnel costs including veterinary fees (lab testing, visit by vet) and transportation. These costs would also apply to any feral horse additions to the ASIS herd, as selected animals would need to be captured and removed from another herd, receive similar care, and then transported to ASIS.

Any feral horses removed from ASIS would require long-term monitoring, as ASIS would retain ownership of these horses.

Intensity Definitions

The intensity of potential impacts to park operations and administration is defined as follows:

<u>Negligible</u>: Impacts to park operations and/or administration would be largely unnoticed by staff and the visiting public. Existing programs and activities would remain essentially unchanged.

<u>Minor</u>: Park operations and/or administration would be impacted, but the effects would be limited in scope and not generally noticed by visitors. Increases or decreases in the Park's operating costs and staffing workload would require some re-alignment of funds, but would not require substantial changes in the Park's overall operating budget.

<u>Moderate</u>: Park operations and/or administration would be measurably affected and the impacts would be noticeable to some visitors. Increases or decreases in the park's operating costs and/or workload would require re-alignment of funds and would alter the scope or quality of some programs.

Major: Impacts to park operations and/or administration would be widespread and readily apparent to most visitors. Increases or decreases in operating costs and/or workload would require substantial changes in funding allocation and would alter the scope and quality of multiple programs or basic operational activities.

4.8.1 Alternative A: No-Action

The No-Action Alternative would not substantively alter any of the current horse management practices or programs at ASIS. However, because ASIS has met the feral horse population size goal recommended by the 1995 Environmental Assessment, the Park would reduce the intensity of contraception administration and maintain herd size at or about 150 horses. Under the No-Action Alternative, the costs associated with the contraception program would be slightly reduced in the short-term due to the decreased use of immunocontraceptives needed to maintain the population below the 150 horse threshold. Other costs would remain relatively constant. It is estimated that annual contraceptive program costs would decrease by approximately 5% (Zimmerman, ASIS, personal communication). The No-Action Alternative would have a negligible beneficial impact to overall Park operations and administration over both the short-term and the long-term, as the contraception program represents a small component of the Park's entire budget.

Cumulative Impacts of Alternative A

Because there would be no changes in other feral horse management activities and programs, the cumulative impacts of the No-Action Alternative to Park operations and administration would be negligible.

Conclusion

Impacts to Park operations and administration that might result from implementation of Alternative A are beneficial and of negligible intensity over both the short- and long-term. The total cumulative impact of other projects plus Alternative A would be negligible, with Alternative A contributing a negligible amount.

4.8.2 Alternative B: One-time Capture and Removal

Alternative B would have a moderate adverse impact to Park operations over the short-term, due to the costs associated with a one-time capture and removal of selected feral horses. The exact cost of removing a group of feral horses from ASIS is unknown, however data from a similar horse removal at Cape Lookout National Seashore (see Table 4.6) and BLM wild horse gatherings provide a general sense of the costs involved.

Regardless of which estimating method is used, the short-term impact of a one-time capture and removal to Park operations and administration is expected to be moderate adverse, as the funding needs would exceed the capacity of the Park's flexible budget component and would require some re-allocation of funding. However, once this is accomplished, the remaining herd would require less intensive immunocontraceptives for several years as the population is allowed to breed more freely until the upper population range is reached. In the long-term, a reduced herd size would require less personnel time and material expenditures to conduct the contraceptive program and other horse management activities (approximately 10-15% reduction. Zimmerman, ASIS, personal communication). However, some of the savings would be countered by the costs associated with long-term monitoring of the horses removed from the park, as ASIS would retain ownership of the feral horses for the duration of their lives. Overall, Alternative B would result in minor beneficial impacts to Park operations and administration over the long-term.

Cumulative Impacts of Alternative B

The cumulative impacts to Park operations and administration would be minor beneficial since the cost of implementing Alternative B would result in a slight reduction in the overall operational costs associated with horse management as compared to Alternative A.

Conclusion

Impacts to Park operations and administration that might result from implementation of Alternative B are adverse and moderate over the short-term, and beneficial and minor over the long-term. The total cumulative impact of other projects plus Alternative B is minor and beneficial, with Alternative B contributing a minor amount.

4.8.3 Alternative C: Intensive Contraception

Alternative C would have a negligible adverse impact to Park operation and administration over the short-term. The feral horse immunocontraceptive program would continue on an intensive basis as detailed in the No-Action Alternative until the new target population size is reached in approximately 5-8 years, after which time there would be a reduction in the personnel time and other costs associated with the contraceptive program and other horse management activities (approximately 10-15% reduction as described in Alternative B). The reduced costs of managing the contraceptive program would result in minor beneficial impacts to Park operations and administration over the long-term.

Cumulative Impacts of Alternative C

The cumulative impacts to Park operations and administration would be minor and beneficial as the overall costs of the contraception program representing a relatively small proportion of the Park's overall budget and operation.

Conclusion

Impacts to Park operations and administration that might result from implementation of Alternative C are adverse and negligible over the short-term, and beneficial and minor over the long-term. The total cumulative impact of other projects plus Alternative C is minor and beneficial, with Alternative C contributing a minor amount.

4.8.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would have a negligible adverse impact to Park operations and administration in the short term. As described in Alternative C, the personnel time and other costs associated with an intensive immunocontraceptive program would continue until such time as the target population size would be reached; approximately 5-8 years after implementation. At that point, there would be a reduction in contraceptive costs (approximately 10-15% as described in Alternative B) as the smaller herd would require less management.

Under Alternative D, periodic removals would be a recurring strategy and the cost of round-ups and management and care for removed feral horses is likely to counter any reduction in cost associated with a reduced herd size; thus the long-term impacts to Park operation and administration would be negligible beneficial.

Cumulative Impacts of Alternative D

Under Alternative D, long-term management of the herd would require additional periodic, hands-on intervention. However, the cumulative impacts to Park operations and administration would be similar to Alternative C (minor and beneficial), as the overall costs of the horse management program represent a relatively small proportion of the Park's overall budget and operation.

Conclusion

Impacts to Park operations and administration that might result from implementation of Alternative D are adverse and negligible over the short-term, and beneficial and negligible over the long-term. The total cumulative impact of other projects plus Alternative D is minor and beneficial, with Alternative D contributing a minor amount.

4.9 Impacts to Visitor Use and Experience by Alternative

Methodology

Providing a safe opportunity for the public to view and appreciate the Assateague horses is an important part of the Park's mission and purpose. Because the majority of Park visitation occurs in the Park's development zone, most viewing opportunities also occur in the developed areas.

There are occurrences of visitors attempting to feed and/or pet the feral horses, especially in the developed zone of ASIS, and this has the potential to jeopardize the safety of visitors, as the feral horses are not tame. Park staff and the Volunteer Pony Patrol would continue to educate the public on the dangers of feeding or getting too close to wildlife and law enforcement officers would continue to enforce regulations prohibiting close interactions with the feral horses.

Park records and anecdotal accounts from the 1970s and the 1980s indicate that even at much lower population sizes numerous feral horses inhabited the Park's developed zone. As such, there is little reason to believe that feral horses would not continue to be visible to the visiting public if the population is reduced to the range of 80-100. Mitigation measures would include public education and outreach in order to ensure that the feral horses remain part of the Assateague experience. These would include providing information on viewing locations where feral horses would most likely be visible.

Additionally, any feral horse selected for removal under Alternatives B and D would be removed from the Assateague Island National Seashore Foster Program, and ASIS would contact the "foster parents" and provide them an opportunity to "adopt" another feral horse. Although some foster parents might be disappointed in the removal of "their" horse, outreach and educational materials provided through the foster horse program have regularly discussed the need to manage the herd in balance with the Park ecosystem, and it is anticipated that most foster parents would support the removals for herd and ecosystem health purposes.

Intensity Definitions

The intensity of potential impacts to visitor use and experience is defined as follows:

<u>Negligible:</u> Changes in visitor use and/or experience would be at or below levels of detection. Visitors would not likely be aware of any impacts associated with the alternative.

<u>Minor:</u> Changes in visitor use and/or experience would be detectable, although the changes would be slight, localized, and likely short-term. Some visitors might be aware of the impacts associated with the alternative.

<u>Moderate:</u> Changes in visitor use and/or experience would be readily apparent. Most visitors would be aware of the impacts associated with the alternatives and would likely be able to express an opinion about the changes. Mitigation including education measures would probably be necessary to offset adverse effects and would likely be successful. Visitor satisfaction might be measurably affected (visitors could be either satisfied or dissatisfied).

<u>Major:</u> The change would have substantial and possibly permanent effects on visitor use and experience. Nearly all visitors would be aware of the impacts associated with the alternative and would likely express a strong opinion about the changes. Mitigation to offset adverse effects would be needed with success not assured. The change in visitor use and experience would preclude future generations of some visitors from enjoying park resources and values.

4.9.1 Alternative A: No-Action

The No-Action Alternative would not alter any of the current management practices or projects at ASIS, nor alter existing feral horse distribution within the developed areas. The population would continue to be managed to maintain a relatively stable population of about 150 horses. As a result, there would be little change in opportunities for Park visitors to see free-roaming feral horses at ASIS, and a negligible beneficial impact to visitor use and experience in both the short- and long-term.

Park staff and the Volunteer Pony Patrol would continue to educate the public on the dangers of feeding or getting too close to wildlife and law enforcement officers would continue to enforce regulations prohibiting close interactions with the feral horses. The No-Action Alternative would have negligible short- and long-term beneficial impacts to visitor health and safety at ASIS.

Cumulative Impacts of Alternative A

Cumulative impacts to visitor use and experience include other park projects that enhance recreational opportunities, detracting factors such as crowding, and the Volunteer Pony Patrol. The cumulative impacts of the No-Action Alternative on visitor use and experience would be negligible and beneficial.

Conclusion

Impacts to visitor use and experience that might result from implementation of Alternative A are negligible both over the short- and long-term. The total cumulative impact of other projects plus Alternative A is negligible and beneficial, with Alternative A contributing a negligible amount.

4.9.2 Alternative B: One-time Capture and Removal

Under Alternative B, the one-time capture and removal of feral horses has the potential for short-term (~5 years) minor impacts to visitor use and experience. The distribution of feral horses within the Park's development zone might be temporarily affected depending upon which feral horses were selected for removal. This might alter viewing opportunities until feral horse bands redistribute themselves within the affected areas. This minor impact could be either beneficial or adverse, as some visitors might notice a slight reduction of the number of feral horses available for viewing while others might appreciate the reduced presence of feral horses in public use areas. Alternative B would include public education and outreach to explain the short-term consequences of the action and ensure concerned visitors that the health and welfare of removed feral horses is being protected.

Under Alternative B, long-term impacts to visitor use and experience would be negligible. Park records and anecdotal accounts from the 1970s and the 1980s indicate that even at much lower population sizes numerous feral horses inhabited the Park's developed zone. As such, there is little reason to believe that feral horses would not continue to be visible to the visiting public if the population is reduced to the range of 80-100. Alternative B would also include public education and outreach as management strategies in order to ensure that the feral horses remain part of the Assateague experience. These would include providing information on viewing locations where feral horses would most likely be visible.

A reduced feral horse population size has the potential to reduce negative human-horse interactions, which would have both short- and long-term minor beneficial impacts to visitor health and safety.

Cumulative Impacts of Alternative B

Cumulative impacts on visitor use and experience are the same as the No-Action Alternative. Alternative B is likely to result in negligible beneficial cumulative impacts to visitor use, experience, health and safety at ASIS.

Conclusion

Impacts to visitor use and experience that might result from implementation of Alternative B could either be adverse or beneficial and of minor intensity over the short-term, depending on how the one-time capture and removal is received by individual visitors. Over the long-term, impacts to visitor use and experience would be beneficial and of negligible to minor intensity. The total cumulative impact of other projects plus Alternative B is negligible and beneficial, with Alternative B contributing a negligible amount.

4.9.3 Alternative C: Intensive Contraception

Alternative C is expected to result in negligible short-term impacts to visitor use and experience at ASIS. Under Alternative C, the current opportunity / chance for visitors to view wild and free-roaming feral horses would remain relatively unchanged for the short-term (~5 years) as outlined in the No-Action Alternative. Intensive contraception would reduce the population to the target size in 5-8 years, however, the reduction would occur slowly enough that feral horse redistribution within the developed areas is unlikely to be detectable by most visitors. In the long-term, Alternative C would result in negligible impacts to visitor use and experience because there is no indication that a lower population range would inhibit visitors from viewing the animals. Even at lower population levels the feral horses are still expected to congregate in the developed zone. Alternative C would also include public education and outreach as management strategies in order to ensure that the feral horses remain part of the Assateague experience. These would include providing information on viewing locations where feral horses would most likely be visible.

A reduced feral horse population size has the potential to reduce negative human-horse interactions, which would have both short- and long-term minor beneficial impacts to visitor health and safety.

Cumulative Impacts of Alternative C

Alternative C is expected to result in negligible beneficial cumulative impacts to visitor use, experience, health and safety at ASIS.

Conclusion

Impacts to visitor use and experience that might result from implementation of Alternative C would be beneficial and of negligible to minor intensity over both the short- and long-term. The total cumulative impact of other projects plus Alternative C is negligible and beneficial, with Alternative C contributing a negligible amount.

4.9.4 Alternative D: Intensive Contraception with Periodic Removals/Additions

Alternative D would have the same effects as detailed under Alternative C. Alternative D is likely to result in negligible impacts to visitor use and experience at ASIS. Under Alternative D, it is expected that the current opportunity / chance for visitors to view wild and free-roaming feral horses would remain largely unchanged for the short-term (~5 years) as outlined in the No-Action Alternative. With the intensive contraception program, the feral horse population would achieve the target population size in 5-8 years, however, any changes in feral horse distribution within the developed zone would occur slowly enough that most visitors would be unlikely to notice. Under Alternative D, there would be negligible long-term impacts to visitor use and experience, because there is no indication that a lower population range would inhibit visitors from viewing the animals. Even at lower population levels the feral horses are still expected to congregate and be visible in the developed zone. Periodic removals/additions of select feral horses for herd health purposes would be small enough that it would not be expected to alter the Assateague experience of viewing wild and free-roaming horses.

Alternative D would also include public education and outreach as management strategies in order to ensure that the feral horses remain part of the Assateague experience. These would include providing information to interested visitors about viewing locations where feral horses could most likely be seen.

A reduced feral horse population size has the potential of reducing negative human-horse interactions, which would have both short- and long-term minor beneficial impacts to visitor health and safety.

Cumulative Impacts of Alternative D

Alternative D is expected to result in negligible beneficial cumulative impacts to visitor use, experience, health and safety at ASIS

Conclusion

Impacts to visitor use and experience that might result from implementation of Alternative D would be beneficial and of negligible to minor intensity over both the short- and long-term. The total cumulative impact of other projects plus Alternative D is negligible and beneficial, with Alternative D contributing a negligible amount.

Chapter 5: Consultation and Coordination

NPS DO #12 requires the NPS to make “diligent” efforts to involve the interested and affected public in the NEPA process. This process, known as scoping, helps to determine the important issues and eliminate those that are not; allocate assignments among the interdisciplinary team members and/or other participating agencies; identify related projects and associated documents; identify other permits, surveys, consultations, etc. required by other agencies; and create a schedule that allows adequate time to prepare and distribute the environmental document for public review and comment before a final decision is made. This chapter documents the scoping process for this project and includes the official list of recipients for the document.

5.1 History of Planning and Public Involvement

To initiate this project, a kick-off meeting between Assateague Island National Seashore staff and Terwilliger Consulting, Inc. (contractor) was held on October 5, 2006, at the Barrier Island Visitor Center of Assateague Island National Seashore followed by a site visit of the island on October 26, 2006. A press release was issued in local and national newspapers on November 1, 2006, to introduce the proposed action to the public and to invite interested parties to attend the public Open House scoping meeting, which was held at the ASIS Barrier Island Visitor Center on December 6, 2006. The NPS Planning Environment and Public Comment (PEPC) website posted the Open House meeting announcement as well as background materials. Scoping packets were sent to known stakeholders, interested parties and agencies to identify concerns and solicit input on issues that should be addressed by the Environmental Assessment. Details of comments received and a list of stakeholders who received the scoping packet is outlined in Chapter 1 – Purpose of and Need for the Proposed Action.

5.2 Compliance with Specific Laws and Regulations

The following laws, regulations, executive orders and policies provided guidance and direction in the design of alternatives, the analysis of impacts, and the formulation of mitigation measures:

National Environmental Policy Act of 1969 (NEPA)(Title 42 U.S. Code Sections 4321 to 4370 [42 USC 4321-4370]). The purposes of NEPA include encouraging "harmony between [humans] and their environment and promote efforts which would prevent or eliminate damage to the environment...and stimulate the health and welfare of [humanity]". The purposes of NEPA are accomplished by evaluating the effects of federal actions on the environment and people. The results of these evaluations are presented to the public, federal agencies, and public officials in document format (e.g., environmental assessments and environmental impact statements) for consideration prior to taking official action or making official decisions. Implementing regulations for the NEPA are contained in Part 1500 to 1515 of Title 40 of the U.S. Code of Federal Regulations (40 CFR 1500-1515).

Clean Water Act of 1972, as amended (CWA)(33 USC 1251-1387). The purposes of the CWA are to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters". To enact this goal, the U.S. Army Corps of Engineers has been charged with evaluating federal actions that result in potential degradation of waters of the U.S. and issuing permits for actions consistent with the CWA. The U.S. Environmental Protection Agency also has responsibility for oversight and review of permits and actions which affect waters of the U.S. Implementing regulations describing the USACE's CWA program are contained in 33 CFR 320-330. Neither the No-Action Alternative nor the proposed action would affect wetlands or other waters of the U.S. and no USACE permit is required.

Coastal Zone Management Act of 1972 (CZMA)(16 USC 1451-1464). The CZMA presents a congressional declaration to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations". The CZMA also encourages "states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone". In accordance with the CZMA, the State of Maryland has adopted state laws and regulations, including a Coastal Zone Management Plan administered by the Maryland Department of Natural Resources (MD DNR), Coastal Zone Management Program. All actions proposed by federal agencies must be consistent or compatible with the Coastal Zone Management Plan, as determined by the MD DNR. The NPS has requested concurrence from the MD DNR that the proposed action is consistent with the Maryland Coastal Zone Management Plan.

Endangered Species Act of 1973, as amended (ESA)(16 USC 1531-1544). The purposes of the ESA include providing “a means whereby the ecosystems upon which endangered species and threatened species depend might be conserved.” The ESA requires that "all Federal departments and agencies shall seek to conserve endangered species and threatened species" and “[e]ach Federal agency shall...insure that any action authorized, funded, or carried out by such agency...is not likely to jeopardize the continued existence of any endangered species or threatened species.” The U.S. Fish and Wildlife Service (non-marine species) and the National Marine Fisheries Service (marine species, including anadromous fish and marine mammals) administer the ESA. Agency actions that might affect endangered, threatened, or proposed species must be evaluated in consultation with either the USFWS or NMFS, as appropriate. Implementing regulations which describe procedures for interagency cooperation to determine the effects of actions on endangered, threatened, or proposed species are contained in 50 CFR 402. The NPS has requested review of this Environmental Assessment by the USFWS, and their concurrence with the NPS determination that the proposed action alternatives will not affect any listed species.

Cultural Resources Regulations and Policies. The National Park Service is mandated to preserve and protect its cultural resources through the **Organic Act of 1916 (USC title 16)** and such specific legislation as the **Antiquities Act of 1906 (16 USC 431)**, the **National Historic Preservation Act of 1966, as amended (16 USC 470)**, the National Environmental Policy Act of 1969, as amended (42 USC 4321,4331,4332), the **Archeological Resources Protection Act of 1979 (16 USC 470)**, and the **Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001)**. In addition, the management of cultural resources is guided by the Advisory Council on Historic Preservation’s implementing regulations regarding “Protection of Historic Properties ” ((36 CFR 800), the Secretary of the Interior’s *Standards for the Treatment of Historic Properties* (1995) and *Guidelines for the Treatment of Cultural Landscapes* (1996), Chapter 5 of the National Park Service's *Management Policies* (2006b), and the National Park Service's *Cultural Resources Management Guideline* (DO-28, 1998)). Section 106 of the National Historic Preservation Act requires that federal agencies having direct or indirect jurisdiction over undertakings consider the effect of those undertakings on resources either listed in or eligible for listing in the National Register of Historic Places. It also requires that the Advisory Council on Historic Preservation, state/territorial/tribal historic preservation officer(s), and other concerned parties be provided an opportunity to comment. The NPS has requested review of this Environmental Assessment by the Maryland State Historic Preservation Office, and concurrence with the NPS determination that the proposed action alternatives do not constitute an undertaking as defined by section 106 of the National Historic Preservation Act.

NPS Organic Act and Management Policies. The Organic Act that created the National Park Service (NPS) states that NPS will "...conserve the scenery and the natural and historic objects and the wildlife therein and...provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1, the National Park Service Organic Act; NPS 2001). The Organic Act prohibits the impairment of Park resources and values unless a particular law explicitly directs otherwise (NPS 2006b).

In 2001, the NPS issued Director's Order #12 to guide *Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2001a) and an accompanying Handbook (NPS 2001b) on implementing the requirements of the National Environmental Policy Act of 1969. Director's Order #12 recommends an interdisciplinary approach to decision-making, basing decisions on technical and scientific information, and fully involving the public and other stakeholders in evaluating proposed NPS actions (NPS 2001a). The *2001 NPS Management Policies* (NPS 2000) and their revision in 2006 (NPS 2006b) provide detailed guidance on land protection, natural resource management, cultural resource management, wilderness stewardship, interpretation and education, and visitor use and facilities management within the National Park System.

Coastal Barriers Resources Act of 1982 (CBRA) (96 Stat. 1653; 16 USC 3501 et seq.). Congress passed the Coastal Barriers Resources Act in 1982 to address problems caused by coastal barrier development. The law encourages the conservation of hurricane prone, biologically rich coastal barriers by restricting federal expenditures that encourage development, such as federal flood insurance through the National Flood Insurance Program. This system is made up of a defined list of undeveloped coastal lands and associated aquatic environments that serve as barriers protecting the Atlantic, Gulf, and Great Lakes coasts. The John H. Chafee Coastal Barrier Resources System currently includes 585 units comprising nearly 1.3 million acres and about 1,200 shoreline miles. There are also 271 Otherwise Protected Areas (OPA), a category added by the **Coastal Barrier Improvement Act of 1990 (P.L. 101-591; 104 Stat. 2931)** to add a layer of federal protection to coastal barriers already held for conservation or recreation, such as national wildlife refuges, national parks and seashores, state and county parks, and land owned by private groups for conservation or recreational purposes, and discourage development of privately owned inholdings. The only federal funding prohibition within OPAs is federal flood insurance. Three important goals of this act are to minimize loss of human life by discouraging development in high risk areas, reduce wasteful expenditure of federal resources, and protect the natural resources associated with coastal barriers. Assateague

Island has been designated as an OPA, Units MD-01P (in Maryland) and VA-01P (in Virginia) of the Coastal Barrier Resources System.

Migratory Bird Treaty Act, as amended (MBTA) (16 USC 703-712). The Migratory Bird Treaty Act implements various treaties and conventions between the U.S. and Canada, Japan, Mexico and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing or possessing migratory birds is unlawful.

Executive Order 12989 Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations. Directs federal agencies to avoid federal actions that cause disproportionately high and adverse impacts on minority and low-income populations with respect to human health and environment.

Executive Order 11988 Floodplain Management. Directs federal agencies to avoid the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to restore and preserve the natural and beneficial values served by floodplains.

Executive Order 11990 Protection of Wetlands. Requires federal agencies to consider all practicable alternatives to impacts to wetlands.

Maryland Non-game and Endangered Species Conservation Act (Code of Maryland Regulations: Natural Resources: Title 10: Subtitle 2A). The Non-game and Endangered Species Conservation Act of Maryland recognizes state and federally listed threatened and endangered species and other non-game species and affords them the rights guaranteed under the federal Endangered Species Act by prohibiting the taking, possession, transportation, exportation, procession, sale, offer for sale, or shipment of these species.

5.3 Agency Consultation

Consultations and coordination occurred with the following agencies and organizations through written correspondence, telephone conversations or in-person meetings:

- Maryland Department of Natural Resources - Assateague State Park
- Maryland Department of Natural Resources – Wildlife and Heritage Service
- Maryland Department of Natural Resources – Public Lands Policy and Planning
- Maryland Coastal Bays Program
- Assateague Coastal Trust
- Assateague Mobile Sportfishermen Association
- Chincoteague National Wildlife Refuge
- Cape Lookout National Seashore
- U.S. Fish and Wildlife Service
- Bureau of Land Management, National Wild Horse and Burro Program
- Humane Society of the United States
- American Horse Protection Association
- ICUN/SCC Conservation Breeding Specialist Group
- Science and Conservation Center - Zoo Montana

- o Wildlife Conservation Society

5.4 List of Recipients

The EA will be on formal review for 45 days and has been distributed to a variety of interested individuals, agencies, and organizations (listed below). It is also available on the NPS Planning Environment and Public Comment (PEPC) website at http://parkplanning.nps.gov.

Copies of the EA are available for public review at the Assateague Island National Seashore Barrier Island Visitor Center, 7206 National Seashore Lane, Berlin, MD

Federal Agencies and Officials

U.S. Fish and Wildlife Service, Chesapeake Bay Field Office
Chincoteague National Wildlife Refuge
Cape Lookout National Seashore
Bureau of Land Management, National Wild Horse and Burro Program
Congressman Wayne Gilchrest
Senator Barbara Mikulski
Senator Benjamin Cardin

State and Local Agencies and Officials

Maryland State Delegate Jim Mathias
Maryland State Delegate Norm Conway
Maryland State Senator Lowell Stoltzfus
Maryland Department of Natural Resources, Assateague State Park
Maryland Department of Natural Resources, Wildlife and Heritage Service
Maryland Department of Natural Resources – Public Lands Policy and Planning
Maryland Department of Planning – Maryland Historical Trust
President, Worcester County Commissioners
Worcester County Department of Comprehensive Planning

Other Organizations and Interested Parties

Maryland Coastal Bays Program
Assateague Coastal Trust
Friends of Assateague State Park
Assateague Mobile Sportfishermen Association
Humane Society of the United States
American Horse Protection Association
Science and Conservation Center - Zoo Montana

5.5 List of Preparers and Contributors

This document was prepared by Terwilliger Consulting, Inc. with input from staff at Assateague Island National Seashore and the NPS Northeast Regional Office, Philadelphia.

Terwilliger Consulting, Inc.

Karen Terwilliger, President
Harmony Hall, Research Associate
Tracy Rice, Research Associate

Assateague Island National Seashore

Carl Zimmerman, Chief, Division of Resource Management
Jack Kumer, Natural Resource Specialist
Mark Sturm, Ecologist
Allison Turner, Wildlife Technician

NPS Northeast Regional Office, Resource Planning and Compliance, Philadelphia

Jacki Katzmire, Regional Environmental Coordinator
Richard Armenia, Program Analyst

References

Brinker, D. F., Williams, B., Watts, B. D., and R. M. Erwin. 2007. Colonial-nesting seabirds in the Chesapeake Bay Region: where have we been and where are we going? *in* 2005 Estuarine Research Federation Conference, Session: Waterbirds of the Chesapeake Bay and Vicinity: Harbingers of Change (Chair: M. Erwin), Norfolk, Virginia. Available online at < http://www.erf.org/cgi-bin/conference05_abstract.pl?conference=erf2005&id=116>

Brotherton, D. K. 2005. Herpetological inventory of Assateague Island National Seashore 2005: a cooperative agreement between the National Park Service and Wildlife Conservation Society. Assateague Island National Seashore, Berlin, Maryland.

Brown, S., C. Hickey, B. Harrington and R. Gill (editors). 2001. United States shorebird conservation plan. Second edition. Manomet Center for Conservation Sciences, Manomet, Massachusetts. 60 pp. Available online at <http://www.manomet.org/USSCP/files.htm>

Chincoteague National Wildlife Refuge (online resource). 2007. Data compiled by the U.S. Fish and Wildlife Service. Available online at <http://www.fws.gov/northeast/chinco/birdlist.htm> Data accessed on September 16, 2007.

De Stoppelaire, G. H. 2002. Impact of horse grazing on American beachgrass and dune geomorphology: Assateague Island National Seashore. Master of the Arts Thesis, University of Florida, Gainesville, Florida.

Eggert, L. S., Maldonaldo, J. E., Fleischer, R. C. and D. M. Powell. 2005. An assessment of the genetic status of the feral horse population of Assateague Island National Seashore. Report to National Park Service. Smithsonian Institution, Washington, D.C.

Furbish, C. E. 1990. Factors affecting the distribution of *Distichlis spicata* in the *Spartina alterniflora* saltmarshes of Assateague Island, Maryland. Master of Science Thesis, University of Maryland, College Park, Maryland.

Furbish, C. E. and M. Albano. 1994. Selective herbivory and plant community structure in a mid-Atlantic Salt Marsh. Ecology 75: 1015-1022.

Higgins, E.A.T., R.D. Rappleye, and R.G. Brown. 1971. The flora and ecology of Assateague Island. University of Maryland, Agriculture Experimental Station Bulletin A-172.

Hill, S. R. 1986. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). Castanea 51: 265-305.

Howard, J. M. Unpublished data reported to NPS in 1986. Initial study results for project title: a yearlong, bimonthly study of the egg counts of gastrointestinal parasites in a band of feral ponies on Assateague Island.

International Panel on Climate Change. 2007. Climate change 2007: the physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)].

Keiper, R. R. 1976. The behavior, ecology and social organization of the feral ponies of Assateague Island. National Park Service, Berlin, Maryland.

Keiper, R. R. and J. Berger. 1982. Refuge-seeking and pest avoidance by feral horses in desert and island environments. Applied Animal Ethology 9:111-120.

Keiper, R. R. and K. Houpt. 1984. Reproduction in feral horses: an eight-year study. American Veterinary Medical Association/American Journal of Veterinary Research Volume 45: 991-995.

Keiper, R. R. and H. H. Sambraus. 1986. The stability of equine dominance hierarchies and the effects of kinship, proximity and foaling status on hierarchy rank. Applied Animal Behavior Science 16: 121-130.

Keiper, R. R. and S. M. Zervanos. 1979. Ecological impact and carrying capacity of feral ponies on Assateague Island National Seashore. Report to the National Park Service, Assateague Island National Seashore. Pennsylvania State University, State College, Pennsylvania.

Kirkpatrick, J. F., and J. W. Turner, Jr. 1991. Compensatory reproduction in feral horses. Journal of Wildlife Management, 55: 649-652.

Kirkpatrick, J. F., Liu, I. K. M., Turner, J.W. Jr., Naugle, R, and R. Keiper. 1992. Long-term effects of porcine zonae pellucidae immunocontraception on ovarian function of feral horses (*Equus caballus*). Journal of Reproductive Fertility 94: 437-444.

Kirkpatrick, J. F. 1995. Management of wild horses by fertility control: the Assateague experience. National Park Service Scientific Monograph, National Park Service, Denver, Colorado. 60 pp.

Kirkpatrick, J. F., Naugle, R., Liu, I. K. M., Bernoco, M. and J. W. Turner, Jr. 1995. Effects of seven consecutive years of porcine zona pellucida contraception on ovarian function in feral mares. Biological Reproductive Monograph Series 1: Equine Reproduction 6:411-418.

Kirkpatrick, J. F. and A. Turner. 2002. Reversibility of action and safety during pregnancy of immunizing against porcine zona pellucida in wild mares *(Equus caballus).* Reproduction Supplement 60:197-202.

Kirkpatrick, J. F. and A. Turner. 2003. Absence of effects from immunocontraception on seasonal birth patterns and foal survival among barrier island wild horses. Journal of Applied Animal Welfare Science 6:301-308.

Knisley, C. Barry. 2007. Distribution and abundance of two rare tiger beetles, *Cicindela dorsalis media* and *C. lepida*, at Assateague Island National Seashore in 2006 – final report. National Park Service, Assateague Island National Seashore, Berlin, Maryland.

Kumer, J and A. Turner. 2003. Dealing with problem horses – response protocol for field personnel. Resource Management Division, Assateague Island National Seashore, Berlin, Maryland.

Lea, C., H. Hamilton, F. K. Hudson, and N. Roeder. 2000. Additions to flora and rare plant surveys and status, 1996-1999. Assateague Island National Seashore, Division of Resource Management, Berlin, Maryland.

Lea, C., M. Sturm, H. Hamilton, S. Weller, S. King, and B. McIntyre. 2003. Assateague Island National Seashore seabeach amaranth restoration final report – 2002. National Park Service, Assateague Island National Seashore, Berlin, Maryland. 46 pp.

Loegering, J. P. 1992. Piping plover breeding biology, foraging ecology and behavior on Assateague Island National Seashore, Maryland. Master of Science thesis. Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 247 pp.

Mackintosh, B. 1982. Assateague Island National Seashore: an administrative history. History Division, National Park Service, Department of the Interior, Washington, D.C.

McCann, J. 1992. A comparison of the fall density of neotropical migrant landbirds on Assateague Island and mainland Worcester County, Maryland. (1992 is a progress report). Maryland Department of Natural Resources, Annapolis, Maryland.

McCulloh, J. Unpublished report submitted to NPS in 2002. Intestinal parasite levels of Assateague Island feral horses: variation within the herd and comparison to domestic horses.

Mitchell, J.C., and J.M. Anderson. 1994. Amphibians and reptiles of Assateague and Chincoteague Islands. Virginia Museum of Natural History Special Publication No. 2. Virginia Museum of Natural History, Martinsville, VA. 120pp.

Morton, John. 1996. Effects of human disturbance on the behavior and energetics of nonbreeding sanderlings. Ph.D. Dissertation. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

National Park Service. 1982. General management plan. Assateague Island National Seashore, Berlin, Maryland.

_____. 1985. Feral pony management plan. Assateague Island National Seashore, Berlin, Maryland.

_____. 1995. Environmental assessment of alternatives for managing the size of the feral horse population of Assateague Island National Seashore. Assateague Island National Seashore, Berlin, Maryland.

_____. 1999. Resource management plan. Assateague Island National Seashore, Berlin, Maryland.

_____. 2000. 2001 National Park Service management policies. U.S. Department of the Interior, National Park Service, Washington, D.C. Available online at <http://www.nps.gov/policy/mp/policies.html>.

_____. 2001a. Director's order #12: conservation planning, environmental impact analysis, and decision-making. U.S. Department of the Interior, National Park Service, Washington, D.C. Available online at http://www.nps.gov/policy/DOrders/DOrder12.html.

_____. 2001b. Director's order #12: handbook for environmental impact analysis. U.S. Department of the Interior, National Park Service, Washington, D.C. 127 pp.

_____. 2002a. Long range interpretive plan. Assateague Island National Seashore, Berlin, Maryland.

_____. 2002b. Personal watercraft use environmental assessment. Assateague Island National Seashore, Berlin, Maryland.

_____. 2006a. Management and monitoring of the piping plover (*Charadrius melodus*) at Assateague Island National Seashore, Maryland, 2006 Annual Report. Assateague Island National Seashore, Berlin, Maryland. 34 pp.

_____. 2006b. Management Policies: the guide to managing the National Park System. U.S. Department of the Interior, National Park Service, Washington, D.C. 274 pp.

Oliver, J. H., Jr. 1988. Investigators annual report progress report, "*Ixodes* ticks and *Borrelia burgdorferi* in the southeastern U.S." Dr. James H. Oliver, Jr.

Olson, Brad. 2003. Sacred places North America. CCC Publishing, San Francisco, California. 304 pp.

Orr, R. 2006. Annual progress report for the 2006 field season on the baseline survey of selected insect groups of Assateague Island National Seashore. Unpublished report. Assateague Island National Seashore, Berlin, Maryland.

Patterson, M. E. 1988. Piping plover breeding biology and reproductive success on Assateague Island. Masters of Science thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 131 pp.

Powell, D. M. 1999. Preliminary evaluation of porcine zona pellucida (PZP) immunocontraception for behavioral effects in feral horses *(Equus caballus)*. Journal of Applied Animal Welfare Science. 2:321-335.

Powell, D. M., D. E. Danze, and M.W. Gwinn. 2006. Predictors of biting fly harassment and its impact on habitat use by feral horses *(Equus caballus)* on a barrier island. Journal of Ethology 24: 147-154.

Prezant, R. S. and C. L. Counts. 2002. Mollusca of Assateague Island, Maryland and Virginia: additions to the fauna, range extensions, and gigantism. The Veliger 45: 337-355.

Rudman R. and R. R. Keiper. 1991. The body condition of feral ponies on Assateague Island. Equine Veterinary Journal 23: 453-456.

Rutberg, A. T. 1987. Horse fly harassment and the social behavior of feral ponies. Ethology 75:145-154.

Rutberg, A. T. and S. A. Greenberg. 1990. Dominance, aggression frequencies and modes of aggressive competition in feral pony mares. Animal Behavior 40: 322-331

Seligsohn, E. M. 1987. Dominance relationships and reproductive success within bands of feral ponies. Unpublished doctoral dissertation, University of Connecticut.

Seliskar, D. 1997. The effect of grazing by feral horses on American beachgrass at Assateague Island National Seashore. Final Report. University of Delaware, Dover, Delaware.

Stribling, J. M. 1989. Nutrient dynamics in *Spartina alterniflora* effects of grazing. Master of Science thesis, University of Maryland, College Park, Maryland.

Sturm, M. 2004. Assateague Island National Seashore vegetation monitoring, North End Restoration Update 1996-2003. National Park Service, Assateague National Island Seashore, Berlin, Maryland.

Sturm, M. 2006. Increase seabeach amaranth survival and reproductive success, project report. National Park Service, Assateague National Island Seashore, Berlin, Maryland.

Sturm, M. 2007a. A comparison of some ecological implications of proposed horse population reduction actions at Assateague Island National Seashore. National Park Service, Assateague National Island Seashore, Berlin, Maryland.

Sturm, M. 2007b. Assessment of the effects of feral horses, sika deer and white-tailed deer on Assateague Island's forest and shrub habitat. National Park Service, Assateague Island National Seashore, Berlin, Maryland.

The Nature Conservancy. 1995. Vegetation classification of Assateague Island National Seashore. The Nature Conservancy, Eastern Regional Office, Boston, Massachusetts.

Turner, A. and J.F. Kirkpatrick. 2002. Effects of immunocontraception on population, longevity and body condition in wild mares (*Equus caballus*). Reproduction Supplement 60:187-195.

Turner, A., J. Kumer and C. Zimmerman. 2003b. Dealing with sick, injured or dead horses - response protocol for field personnel. Resource Management Division, Assateague Island National Seashore, Berlin, Maryland.

Turner, A. 2005. Assateague Island National Seashore Pony Patrol - 2005. Resource Management Division, Assateague Island National Seashore, Berlin, Maryland.

U.S. Army Corps of Engineers. 1998. Ocean City, Maryland, and vicinity water resources study, final integrated feasibility report and environmental impact statement. Baltimore, Maryland. Various paginations.

U.S. Fish and Wildlife Service. 1993a. Endangered and threatened wildlife and plants: *Amaranthus pumilus* (seabeach amaranth) determined to be threatened: final rule. Federal Register 58 (65): 18035-18042.

_____. 1993b. Master plan, Chincoteague National Wildlife Refuge. Chincoteague National Wildlife Refuge, Chincoteague Island, Virginia.

_____. 1996a. Piping plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. U.S. Department of the Interior, Fish and Wildlife Service, Hadley, Massachusetts. 245 pp.

_____. 1996b. Recovery Plan for seabeach amaranth (*Amaranthus pumilius*) Rafinesque. U.S. Department of the Interior, Fish and Wildlife Service, Atlanta, Georgia. 55 pp + appendices.

_____. 2002. 2000-2001 status update: U.S. Atlantic Coast piping plover population. Sudbury, Massachusetts. 9 pp.

Watts, B.D. 1999. Partners in Flight: the Mid-Atlantic coastal plain bird conservation plan (physiographic area 44). Version 1.0. American Bird Conservancy, Williamsburg, Virginia. 78 pp.

Wazniak, C. E. and M. R. Hall (editors). 2005. Maryland's coastal bays: ecosystem health assessment 2004. DNR-12-1202-0009. Maryland Department of Natural Resources, Tidewater Ecosystem Assessment, Annapolis, Maryland.

Wazniak, C. E., Hall, M. R., Carruthers, T. J. B., Sturgis, B., Dennison, W. C., and R. J. Orth. 2007. Linking water quality to living resources in a mid-Atlantic lagoon system, USA. Ecological Applications. In Press.

Weakley, A., and M. Bucher. 1992. Status survey of seabeach amaranth (*Amaranthus pumilus rafinesque*) in North and South Carolina, second edition (after Hurricane Hugo). Report to North Carolina Plant Conservation Program, North Carolina Department of Agriculture, Raleigh, North Carolina, and Asheville Field Office, U.S. Fish and Wildlife Service, Asheville, North Carolina. 149 pp. + appendices.

Zervanos, S. M. 1978. Summer determination of activity patterns of Assateague ponies by means of long range telemetry. National Park Service, Assateague Island National Seashore, Berlin, Maryland.

Zervanos, S. M. and R. R. Keiper. 1979. Winter activity patterns and carrying capacities of Assateague Island feral ponies. Final Report, Contract No. PX2000-8-D045. Assateague Island National Seashore, Berlin, MD. 12pp.

Zimmerman, C., M. Sturm, J. Ballou, and K. Traylor-Holzer (editors). 2006. Horses of Assateague Island population and habitat viability assessment: final report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, Minnesota.

Personal Communications

Glenn, Don. 2007. Acting Group Manager. Wild Horse and Burro Program, Bureau of Land Management, Washington, D.C.

Hoffman, Mark. 2007. Associate Director of Administration. Wildlife and Heritage Service, Maryland Department of Natural Resources, Annapolis, Maryland.

Kumer, Jack. 2007. Natural Resource Specialist. Assateague Island National Seashore, National Park Service, Berlin, Maryland.

Sturm, Mark. 2007. Ecologist. Assateague Island National Seashore, National Park Service, Berlin, Maryland.

Zimmerman, Carl. 2007. Chief, Division of Resource Management. Assateague Island National Seashore, National Park Service, Berlin, Maryland.

Acronyms and Abbreviations

ACT	Assateague Coastal Trust
AMSA	Assateague Mobile Sportfishermen's Association
ASIS	Assateague Island National Seashore
ASP	Assateague State Park
ATM	Airborne Topographic Mapper
BLM	Bureau of Land Management
CBSG	Conservation Breeding Specialist Group
CEQ	Council on Environmental Quality
CIR	color-infrared aerial
CNWR	Chincoteague National Wildlife Refuge
cy	cubic yards
CZMA	Coastal Zone Management Act
DO	Director's Order
EA	Environmental Assessment
EEE	Eastern Equine Encephalitis
EIA	Equine Infectious Anemia
EO	Executive Order
ESA	Endangered Species Act
ft	feet
FTE	full time equivalencies
GMP	General Management Plan
HSUS	Humane Society of the U.S.
IUCN	World Conservation Union
km	kilometer
LIDAR	Light Detection and Ranging
m	meter
MCBP	Maryland Coastal Bays Program
mcy	million cubic yards
MD DNR	Maryland Department of Natural Resources
MBTA	Migratory Bird Treaty Act
NASA	National Aeronautics and Space Administration
NBS	National Biological Survey

NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NPS	National Park Service
NRCS	Natural Resources Conservation Service
ORV	off-road vehicle
OPA	Otherwise Protected Areas
PEPC	Planning Environment and Public Comment
PHVA	Population and Habitat Viability Assessment
PZP	porcine zolla pellucida
SAV	submerged aquatic vegetation
TCI	Terwilliger Consulting, Inc.
TN	total Nitrogen
TNC	The Nature Conservancy
TP	total Phosphorus
USFWS	United States Fish and Wildlife Service
USHS	United States Humane Society
USACE	United States Army Corps of Engineers
VIMS	Virginia Institute of Marine Sciences
WNV	West Nile Virus

Appendix A – Environmental Screening Form

DO-12 APPENDIX 1

ENVIRONMENTAL SCREENING FORM

This form should be attached to all documents sent to the regional director's office for signature. Sections A and B should be filled out by the project initiator (may be coupled with other park project initiation forms). Sections C, D, E, and G are to be completed by the interdisciplinary team members. While you may modify this form to fit your needs, you must ensure that the form includes information detailed below and must have your modifications reviewed and approved by the regional environmental coordinator.

A. PROJECT INFORMATION

Park Name Assateague Island NS

Project Number 17228

Project Type Implementation Plan (IMPL)

Project Location Worcester County, Maryland

Project Originator/Coordinator Carl Zimmerman

Project Title Development of Alternatives for Managing the Feral Horses of Assateague Island National Seashore

Contract #/Contractor Name P4190060044/Terwilliger Consulting

Administrative Record Contact Carl Zimmerman

Administrative Record Location ASIS NRM Files

B. PROJECT DESCRIPTION/LOCATION *[To begin the statutory compliance file, attach to this form, maps, site visit notes, agency consultation, data, reports, categorical exclusion form (if relevant), or other relevant materials.]*

The Assateague horses are an important visitor experience, but are known to be resulting in a broad range of adverse effects on the park's other natural resources. There is a need to manage the population in ways that will both provide for the long-term health of the herd as well as minimize adverse impacts to other park resources and values. The project will conduct a planning and compliance process to develop and assess the environmental consequences of alternatives for long-term management of the Assateague feral horses, including potential actions to reduce the size of the population, manage reproductive rates, manage human-horse interactions, and enhance the health and viability of the herd. The planning process relates exclusively to the feral horse population owned by the National Park Service and inhabiting the Maryland portion of Assateague Island National Seashore.

Preliminary drawings attached? No

Background info attached? Yes

Date form initiated 10/01/2006

Anticipated compliance completion date 10/01/2008

Projected advertisement/Day labor start N/A

Construction start N/A

C. RESOURCE EFFECTS TO CONSIDER

Please see section F (Instructions for Determining Appropriate NEPA Pathway) prior to completing this section. Also, use the process described in DO-12, 2.9 and 2.10; 3.5; 4.5(G) to (G)(5) and5.4(F) to help determine the context, duration and intensity of effects on resources.

Are any impacts possible on the following physical, natural or cultural resources?	**Yes**	**No**	**N/A**	**Data Needed to Determine/Notes**
1. Geological resources – soils, bedrock, streambeds, etc.	X			Marsh soils; dune processes
2. From geohazards		X		
3. Air quality		X		
4. Soundscapes		X		
5. Water quality or quantity	X			
6. Streamflow characteristics		X		
7. Marine or estuarine resources	X			Tidal marsh
8. Floodplains or wetlands	X			Tidal marsh
9. Land use, including occupancy, income, values, ownership, type of use		X		
10. Rare or unusual vegetation – old growth timber, riparian, alpine	X			Sparsely vegetated beach habitat
11. Species of special concern (plant or animal; state or federal listed or proposed for listing) or their habitat	X			Seabeach Amaranth
12. Unique ecosystems, biosphere reserves, World Heritage Sites		X		
13. Unique or important wildlife or wildlife habitat	X			T&E species habitats
14. Unique or important fish or fish habitat		X		
15. Introduce or promote non-native species (plant or animal)	X			*Phragmites* expansion
16. Recreation resources, including supply, demand, visitation, activities, etc.		X		
17. Visitor experience, aesthetic resources	X			Horse viewing
18. Cultural resources including cultural landscapes, ethnographic resources		X		
19. Socioeconomics, including employment, occupation, income changes, tax base, infrastructure		X		
20. Minority and low income populations, ethnography, size, migration patterns, etc.		X		
21. Energy resources		X		
22. Other agency or tribal land use plans or policies		X		
23. Resource, including energy, conservation potential		X		
24. Urban quality, gateway communities, etc.		X		
25. Long-term management of resources or land/resource productivity		X		

26. Other important environment resources (e.g. geothermal, paleontological resources)?		X		

D. MANDATORY CRITERIA

Mandatory Criteria: If implemented, would the proposal:	**Yes**	**No**	**N/A**	**Data Needed to Determine/Notes**
A. Have material adverse effects on public health or safety?		X		
B. Have adverse effects on such unique characteristics as historic or cultural resources; park, recreation, or refuge lands; wilderness areas; wild or scenic rivers; national natural landmarks; sole or principal drinking water aquifers; prime farmlands; wetlands; floodplains; or ecologically significant or critical areas, including those listed on the National Register of Natural Landmarks?		X		Park lands
C. Have highly controversial environmental effects?		X		
D. Have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks?		X		
E. Establish a precedent for future action or represent a decision in principle about future actions with potentially significant environmental effects?		X		
F. Be directly related to other actions with individually insignificant, but cumulatively significant, environmental effects?		X		
G. Have adverse effects on properties listed or eligible for listing on the National Register of Historic Places?		X		
H. Have adverse effects on species listed or proposed to be listed on the List of Endangered or Threatened Species or have adverse effects on designated Critical Habitat for these species?				FWS informal consultation needed
I. Require compliance with EO 11988 (Floodplain Management), EO 11990 (Protection of Wetlands), or the Fish and Wildlife Coordination Act?		X		
J. Threaten to violate a federal, state, local, or tribal law or requirement imposed for the protection of the environment?		X		
K. Involve unresolved conflicts concerning alternative uses of available resources (NEPA sec. 102(2)(E)?		X		
L. Have a disproportionate, significant adverse effect on low-income or minority populations (EO 12898)?		X		
M. Restrict access to and ceremonial use of Indian sacred sites by Indian religious practitioners or adversely affect the physical integrity of such sacred sites (EO 130007)?		X		

N. Contribute to the introduction, continued existence, or spread of federally listed noxious weeds (Federal Noxious Weed Control Act)?		X		
O. Contribute to the introduction, continued existence, or spread of non-native invasive species or actions that may promote the introduction, growth or expansion of the range of non-native invasive species (EO 13112)?	X			
P. Require a permit from a federal, state, or local agency to proceed, unless the agency from which the permit is required agrees that a CE is appropriate?		X		
Q. Have the potential for significant impact as indicated by a federal, state, or local agency or Indian tribe?		X		
R. Have the potential to be controversial because of disagreement over possible environmental effects?	X			
S. Have the potential to violate the NPS Organic Act by impairing park resources or values?		X		

E. OTHER INFORMATION (Please answer the following questions/provide requested information.)
Are personnel preparing this form familiar with the site? Yes

Did personnel conduct a site visit? No. IDT members are intimately familiar with site

Is the project in an approved plan such as a General Management Plan or an Implementation Plan with an accompanying environmental document? No

Are there any interested or affected agencies or parties? Yes
Did you make a diligent effort to contact them? Yes

Has consultation with all affected agencies or tribes been completed? No
(If so, attach additional pages detailing the consultation, including the name, the dates, and a summary of comments from other agencies or tribal contacts.)

Are there any connected, cumulative, or similar actions as part of the proposed action? No
(If so, attach additional pages detailing the other actions.)

F. INSTRUCTIONS FOR DETERMINING APPROPRIATE NEPA PATHWAY

First, always check DO-12, section 3.2, "Process to Follow" in determining whether the action is categorically excluded from additional NEPA analyses. Other sections within DO-12, including sections 2.9 and 2.10; 3.5; 4.5(G)(4) and (G)(5), and 5.4(F), should also be consulted in determining the appropriate NEPA pathway. Complete the following tasks: conduct a site visit or ensure that staff is familiar with the site's specifics; consult with affected agencies, and/or tribes; and interested public and complete this environmental screening form.

If your action is described in DO-12 section 3.3, "CE's for Which No Formal Documentation is Necessary," follow the instructions indicated in that section.

If your action is not described in DO-12, section 3.3, and IS described is section 3.4, AND you checked yes or identified "data needed to determine" impacts in any block in section D (Mandatory Criteria), this is an indication that there is potential for significant impacts to the human environment, therefore, you must prepare an EA or EIS or supply missing information to determine context, duration and intensity of impacts.

If your action is described in section 3.4 and NO is checked for all boxes in section D (Mandatory Criteria), BUT you have initially checked "yes" in section C (Resource Effects to Consider) during internal scoping, this means that the team should do additional analyses to determine the context, duration and intensity of effects. If the magnitude of effects is then determined to be at the negligible or minor level, then usually there is no potential for significant impacts, then an EA or EIS is not required. If, however, during internal scoping and further investigation, resource effects still remain unknown, or are at the minor to moderate level of intensity, and the potential for significant impacts may be likely, an EA or EIS is required.

In all cases, data collected to determine the appropriate NEPA pathway must be included in the administrative record.

G. INTERDISCIPLINARY TEAM SIGNATORY (All interdisciplinary team members must sign.)

By signing this form, you affirm the following: you have either completed a site visit or are familiar with the specifics of the site; you have consulted with affected agencies and tribes; and you, to the best of your knowledge, have answered the questions posed in the checklist correctly.

Interdisciplinary Team Leader Name:	Field of Expertise	Date Signed
Carl Zimmerman	Park Management	
Technical Specialists Names:	Field of Expertise	Date Signed
Mark Sturm	Ecology	
Jack Kumer	Wildlife Biology	
Allison Turner	Horse Management	
Carl Zimmerman	NEPA/NHPA Compliance	

H. SUPERVISORY SIGNATORY

Based on the environmental impact information contained in the statutory compliance file and in this environmental screening form, environmental documentation for this stage of the subject project is complete.

Recommended:

Compliance Specialist	Telephone Number	Date

Approved:

Superintendent	Telephone Number	Date

Appendix B – Agency Correspondence and Coordination Letters

United States Department of the Interior
National Park Service
Assateague Island National Seashore
7206 National Seashore Lane   Berlin, Maryland 21811

Mr. John Wolflin
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

Re: Environmental Assessment of Alternatives for Managing the Feral Horses of Assateague Island National Seashore, Worcester County, MD

Dear Mr. Wolflin:

The purpose of this letter is to notify you of the availability of an Environmental Assessment (EA) of alternatives for managing the feral horses of Assateague Island National Seashore, and to request your review and comments.

It is the goal of the National Park Service (NPS) to manage the Assateague horses in a manner that protects both the long-term health and viability of the herd as well as the barrier island ecosystem that supports them. The enclosed EA evaluates four alternatives for managing the feral horse population, and compares the impacts of each on other resources occurring within the National Seashore, including threatened and endangered species. Each of the three action alternatives proposes that the horse population be reduced to and maintained at a size range between 80-100 horses; a reduction from the current population of approximately 140. The action alternatives differ from one another in the means by which that population goal is achieved, the time frame, and how the population is subsequently managed. The no-action alternative proposes no changes in current management strategies and would maintain the horse population at around 150.

The NPS has determined that two federally listed threatened species routinely occur in the project area – piping plover (*Charadrius melodus*) and sea beach amaranth (*Amaranthus pumilus*). Based upon NPS research and monitoring programs, both species are known to be influenced by the actions and activities of feral horses. In the case of piping plover, documented effects include occasional disturbance of nesting adults, damage to predator exclosures, displacement of chicks from preferred feeding grounds, and a single observation of direct chick mortality by crushing. All of the three action alternatives will reduce the number of horses and thereby reduce the frequency of adverse interactions between horses and piping plover.

Sea beach amaranth is also known to be adversely affected by the feral horses. Monitoring data indicates that grazing by feral horses and deer lowers amaranth survival and plant size which, in turn, lowers rates of seed production; a critical factor in the population's long-term success. The use of protective cages since 2005 has, however, effectively mitigated much of the grazing impact, stimulating a four-fold expansion of the sea beach amaranth population to more than 2,100 plants in 2007. Again, all three of the action alternatives will reduce the number of horses and thereby reduce the frequency of grazing on sea beach amaranth.

Our assessment of impacts indicates that all three of the action alternatives will result in a minor to moderate long-term beneficial impact on threatened and endangered species. The three action alternatives differ in their short-term impacts, with Alternative B resulting in a moderate beneficial impact while Alternatives C and D result in minor impacts. The short-term minor impacts result from the fact that the horse population is reduced to the target population size more slowly (5-8 years) under those alternatives. The No-action Alternative (A) will maintain the existing population size and management practices, and result in moderate short-term and minor to moderate long-term impacts.

Based upon our analysis, we believe that the action alternatives proposed by the subject EA may effect, but are not likely to adversely effect the populations of piping plover and sea beach amaranth occurring within Assateague Island National Seashore. We look forward to any guidance or comments you may wish to provide.

We ask that comments be provided no later than July 11, 2008. Please mail your response to Carl Zimmerman, 7206 National Seashore Lane, Berlin, MD 21811 or fax to (410) 641-1099. Thank you for your assistance in this matter. If you need additional information or have any questions regarding this matter, please contact Carl Zimmerman at (410) 641-1443, extension 213, or by mail at the above address.

Sincerely,

/S/

Scott J. Bentley
Superintendent

Enclosure

United States Department of the Interior
National Park Service
Assateague Island National Seashore
7206 National Seashore Lane Berlin, Maryland 21811

Mr. Shawn Clotsworthy
Project Review Coordinator
Maryland Department of Natural Resources
Land Acquisition and Planning
Tawes State Office Building, E-4
Annapolis, MD 21401

Re: Environmental Assessment of Alternatives for Managing the Feral Horses of Assateague Island National Seashore, Worcester County, MD

Dear Mr. Clotsworthy,

The purpose of this letter is to notify you of the availability of an Environmental Assessment (EA) of alternatives for managing the feral horses of Assateague Island National Seashore, and to request your review and comments.

It is the goal of the National Park Service (NPS) to manage the Assateague horses in a manner that protects both the long-term health and viability of the herd as well as the barrier island ecosystem that supports them. The enclosed EA evaluates four alternatives for managing the feral horse population, and compares the impacts of each on other resources occurring within the National Seashore and Assateague State Park. Each of the three action alternatives proposes that the horse population be reduced to and maintained at a size range between 80-100 horses; a reduction from the current population of approximately 140. The action alternatives differ from one another in the means by which the population goal is achieved, the time frame, and how the population is subsequently managed. The no-action alternative proposes no changes in current management strategies and would maintain the horse population at around 150.

We ask that comments be provided no later than July 11, 2008. Please mail your response to Carl Zimmerman, 7206 National Seashore Lane, Berlin, MD 21811 or fax to (410) 641-1099. Thank you for your assistance in this matter. If you need additional information or have any questions regarding this matter, please contact me at (410) 641-1443, extension 213, or by mail at the above address.

Sincerely,

/s/

Carl S. Zimmerman
Acting Superintendent

Enclosure

United States Department of the Interior
National Park Service
Assateague Island National Seashore
7206 National Seashore Lane Berlin, Maryland 21811

Ms. Lori A. Byrne
Wildlife Heritage Division
Maryland Department of Natural Resources
Tawes State Office Building, E-1
Annapolis, MD 21401

Re: Environmental Assessment of Alternatives for Managing the Feral Horses of Assateague Island National Seashore, Worcester County, MD

Dear Ms. Byrne,

The purpose of this letter is to notify you of the availability of an Environmental Assessment (EA) of alternatives for managing the feral horses of Assateague Island National Seashore, and to request your review and comments.

It is the goal of the National Park Service (NPS) to manage the Assateague horses in a manner that protects both the long-term health and viability of the herd as well as the barrier island ecosystem that supports them. The enclosed EA evaluates four alternatives for managing the feral horse population, and compares the impacts of each on other resources occurring within the National Seashore and Assateague State Park. Each of the three action alternatives proposes that the horse population be reduced to and maintained at a size range between 80-100 horses; a reduction from the current population of approximately 140. The action alternatives differ from one another in the means by which that population goal is achieved, the time frame, and how the population is subsequently managed. The no-action alternative proposes no changes in current management strategies and would maintain the horse population at around 150.

The NPS has determined that numerous Maryland state-listed species routinely occur in the project area, and that many are to be influenced by the activities of feral horses (see Section 4.7.3 in the EA). Our assessment of impacts indicates that all three of the action alternatives will result in a minor to moderate long-term beneficial impact on threatened and endangered species. The three action alternatives differ in their short-term impacts, with Alternative B resulting in a moderate beneficial impact while Alternatives C and D result in minor impacts. The short-term minor impacts result from the fact that the horse population is reduced to the target population size more slowly (5-8 years) under those alternatives. The No-action Alternative (A) will maintain the existing population size and management practices, and result in moderate short-term and minor to moderate long-term impacts.

We ask that comments be provided no later than July 11, 2008. Please mail your response to Carl Zimmerman, 7206 National Seashore Lane, Berlin, MD 21811 or fax to (410) 641-1099. Thank you for your assistance in this matter. If you need additional information or have any questions regarding this matter, please contact me at (410) 641-1443, extension 213, or by mail at the above address.

Sincerely,

/s/

Carl S. Zimmerman
Acting Superintendent

Enclosure

Appendix C – Annotated Bibliography

Vegetation Studies

Contained below is a list of studies pertinent to the feral horse situation at ASIS.

Ecological Impact and Carrying Capacity of Feral Ponies on Assateague Island National Seashore
Keiper, R.R. and S. Zervanos. 1979. Penn State University. Report to the NPS.

This study concluded that the percentage of protein and the amount of total digestible nutrients in the primary horse forage species: *Spartina alterniflora, Scirpus americana* and *Ammophila breviligulata* provided the necessary nutrients for the feral horses during summer. Sixty-two feral horses were found on the Maryland portion of the island during the study and the population increased at a rate of 10% per year. Based upon the availability of forage (only), the study estimated that the park could support as many as 150 horses. However, even at this horse density the authors concluded that the north end of Assateague Island was overgrazed. Other island areas were considered to be experiencing only limited impacts.

Nutrient Dynamics in *Spartina alterniflora* Effects of Grazing
Stribling, J.M. 1989. Master of Science thesis, University of Maryland.

This was a simulated grazing study, which took place on one marsh on the north end of Assateague Island. Exclosures were used to prevent feral horse grazing within areas exposed to rest from grazing. During the study vegetation was clipped at varying intervals over two years. The variables measured included standing crop, net aboveground productivity, plant nitrogen and phosphorus levels, and soil nutrient concentrations and redox potential. Primary productivity standing crop and nutrient pools were reduced in clipped and grazed plots suggesting that grazing pressure probably would have a negative long term effect on *S. alterniflora* at its then current intensity. Simulated ungulate grazing was found to: 1) reduce *S. alterniflora* primary productivity, 2) interfere with nutrient transfer and storage in *S. alterniflora* and 3) possibly be the cause of the short phenotypic expression of *S. alterniflora* found in this marsh.

Factors Affecting the Distribution of *Distichlis spicata* in the *Spartina alterniflora* Saltmarshes of Assateague Island, Maryland
Furbish, C. E. 1990. Master of Science thesis, University of Maryland.

Distichlis spicata is usually found in association with high salt marsh species, such as *Spartina patens*. On Assateague Island, it is also commonly found in association with *Spartina alterniflora* in low salt marshes. This study examined selected physical/chemical parameters known to limit optimal grass productivity. A suspected biological parameter of preferential grazing pressure on *S. alterniflora* over *D. spicata* was also investigated. Evidence of preferential grazing was recorded, and the responses of both grasses to simulated preferential grazing and non-preferential grazing pressures were determined.

Results indicated that physical/chemical parameters are within the ranges described for both species, but are sub-optimal for *S. alterniflora*. Salt marsh water levels were not linked to tidal changes, and overall water levels in the salt marshes might be a function of weather parameters (wind). Interruption of inlet formation by man-made dune lines might also be preventing regular, increased-amplitude tidal flushing of salt marshes. High stem densities of *D. spicata* compared to *S. alterniflora* might contribute to slight increases in elevation and decreases in subsurface salinity within *D. spicata* patches.

Behavioral observations and fecal analysis indicate that feral horses are plausibly responsible for preferential grazing pressure. The grasses responded to simulated preferential grazing with a decrease in *S. alterniflora* counts and coverages, and an increase in *D. spicata* coverage.

The results also support other studies which point to interception of sediment supply to bayside marshes by artificial structures as a determining factor in salt marsh erosion and senescence (reduced productivity). In addition, preferential grazing pressure probably would affect intra- and interspecies competition among the grasses of bayside salt marshes.

Selective Herbivory and Plant Community Structure in a mid-Atlantic Salt Marsh
Furbish, C. E. and M. Albano. 1994. Ecology, Vol. 75, No. 4. pp. 1015-1022.
Published version of Furbish C. E. 1990.

Factors affecting the distribution of the grasses *Spartina alterniflora* and *Distichlis spicata* in a mid-Atlantic salt marsh were examined. A series of eight shallow wells, four in patches of each grass type, was used to describe physiochemical conditions known to limit the distribution of both grasses. Tidal amplitude, surface of subsurface salinity, and subsurface oxidation-reduction potential were found to be within range, but suboptimal, for both grasses. Evidence of selective grazing upon *S. alterniflora* was found through examination of grazing sign within the grass patches, observations of feral horse feeding behavior, and examination of feral horse feces for grass epidermal fragments. An exclosure experiment simulated preferential grazing and showed that *S. alternifora* responded negatively while *D. spicata* responded positively to simulated preferential grazing of *S. alterniflora*. These results point to a competitive relationship between the grasses under suboptimal conditions for dominance of either species. Selective herbivory (analogous to predation) upon *S. alterniflora* was shown to be a plausible factor impacting the competition relationship to favor *D. spicata*. Location along physical gradients, interspecies competition, and herbivory are discussed in relation to salt marsh plant communities.

The Effect of Grazing by Feral Horses on American Beachgrass at Assateague Island National Seashore
Denise Seliskar. 1997. Final Report. University of Delaware.

This study investigated the effects of feral horse grazing on American beachgrass (*Ammophila breviligulata)* on Assateague Island, Maryland. The study evaluated the response of dune vegetation to a reduction in grazing pressure at a series of exclosure/control study sites located in differing types of dune habitats. Two years of data were collected from the study sites. These data showed that horse grazing (by 160+ horses) had a substantial effect on the growth and abundance of American beachgrass. Feral horse grazing reduced plant cover, the vegetative spread of plants, biomass, flowering and seed production. Without the extensive root and rhizome system of American beachgrass, and other dune vegetation, to hold sand in place, the dunes become vulnerable to erosion.

Impact of Horse Grazing on American Beachgrass and Dune Geomorphology: Assateague Island National Seashore, USA
Georgia H. De Stoppelaire. 2002. Master of the Arts thesis, University of Florida.

The effects of non-native horse foraging on American beachgrass (*Ammophila breviligulata*) and the resulting interruption of dune-formation and stabilization at ASIS were investigated using field data, color-infrared aerial (CIR) photography and National Aeronautics and Space Administration (NASA) Airborne Topographic Mapper (ATM) surveys. American beachgrass, a plant species responsible for primary succession, grows near the Atlantic shoreline and promotes the formation and stabilization of dunes. By 2001, the ASIS feral horse herd had grown to 175 individuals. These horses persistently feed on American beachgrass, with intense grazing occurring between April and September. A vegetation study conducted in 1994 9see Seliskar study above] had constructed (6) pairs of 15 meter x 20 meter fenced and unfenced plots in areas with similar topography and vegetation cover. CIR photographs that were taken in 1998 were compared to 2001 field measured cover estimates to analyze the difference of American beachgrass cover within the fenced and unfenced plot-pairs. This analysis indicated a major difference in vegetation occurred within the experimental plot-pairs. NASA ATM surveys from 1997, 1999, and 2000 were used to analyze topographic change between the fenced and unfenced plot-pairs. Dune development at 1 meter elevation was evident within the fenced plots, while there was an absence of dune development within the unfenced plots. A substantial difference in the elevation mean between the plot-pairs was observed. Additionally, newly formed dunes within the fenced plots were observed to migrate landward, while unfenced plots with existing dunes were observed to erode further. This study clearly established the correlation between horse grazing on *A. breviligulata* and the interruption of dune formation.

Assessment of the Effects of Feral Horses, Sika Deer and White-Tailed Deer on Assateague Island's Forest and Shrub Habitats
Mark Sturm. 2007. Report to the NPS. Assateague Island National Seashore.

This research looked at the individual and combined effects of white-tailed (*Odocoileus virginianus*), sika deer (*Cervus nippon*) and feral horses (*Equus caballus*) on Assateague's terrestrial habitats. Between 2003 -2005, island shrub and maritime forest communities were subjected to an exclosure experiment where treatments included exposure to feral horse and deer herbivory, exposure to deer herbivory - rest from feral horse herbivory, and rest from all ungulate herbivory. Feral horse herbivory was found to be considerably reducing plant species diversity and altering plant community composition (a = 0.05). In response to horse herbivory *Ammophila breviligulata*, *Chasmanthium laxum* and *Fimbristylis castanea* exhibited notably lower abundances while the abundance of *Scirpus pungens* greatly increased. Additionally, in response to horse herbivory the average height of *Smilax rotundifolia* greatly increased while that of *Hudsonia tomentosa* noticably decreased.

Project Report: Increase Seabeach Amaranth Survival and Reproductive Success
Mark Sturm. 2006. Unpublished Report to the NPS. Assateague Island National Seashore.

The average plant size of seabeach amaranth has been shown to be exponentially correlated with seed production, with larger plants producing disproportionately more seeds (Lea, et al. 2003). Successful management strategies for this species should encourage increased plant size. To better understand the effects of horse and deer grazing on this species, the survival and average size of 70 protected (with metal cages) and unprotected plants were monitored. Throughout the entire growing season, average survival rates were 97% for protected and 70% for unprotected plants, and average plant sizes were 91 square cm for protected plants and 38 square cm for unprotected plants. During the monitoring effort the type of ungulate herbivory (horse or deer) was documented whenever possible. Results indicate that Assateague's horse and deer populations were roughly equally responsible for the observed reductions in amaranth survival and average plant size.

Horse-related Studies

Reproduction in Feral Horses: An Eight-Year Study
Keiper, R.R. and K. Houpt. 1984. American Journal of Veterinary Research, Vol. 45, No.5. pp. 991-995.

This study investigated reproductive rates and foal survival of the free-ranging ponies on Assateague Island National seashore during an eight year period, 1975 to 1982. Most (98%) of the 86 foals born during the study were born in the months of April through July. The mean foaling rate was 57 % and the mean foal survival rate was 88%. Forty-eight colts and 55 fillies were born; a sex ratio of 53% female. The foaling rate of 3-year-old mares was 23%, that of 4-year-old mares was 46%, that of 5-year-old mares was 53%, and 6-year-old mares was 69%. Despite the relatively low reproductive rates, the population increased from 43 to 80 during the course of the study, an increase of >10% per year.

The Stability of Equine Dominance Hierarchies and the Effects of Kinship, Proximity and Foaling Status on Hierarchy Rank
Keiper, R.R. and H.H. Sambraus. 1986. Applied Animal Behavior Science, Vol. 16, pp.121-130.

This study determined dominance hierarchies in four bands of feral horses living on Assateague Island. The bands varied in size from 10-16 horses, and consisted of one stallion, several mares and their offspring. Hierarchies in three bands were compared with hierarchies for the same bands determined three years before and showed that hierarchies change over time. Age was noticably correlated with rank. Mares with foals did not appear to rank any higher in the hierarchies than mares without foals. Kinship also did not appear to have an effect on dominance rank. The band stallions were not the highest-ranking animals of any band, and were located farther away from their nearest neighbors for a greater percentage of time than other band members.

Management of Wild Horses by Fertility Control: The Assateague Experience
Jay Kirkpatrick. 1995. Scientific Monograph NPS/NRASIS/NRSM-92/26. U.S. Department of the Interior, National Park Service.

This monograph summarizes research conducted at Assateague Island National Seashore between 1986 and 1994 to develop methods of managing feral horses using fertility control. Immunocontraception using a porcine zona pellucida (PZP) vaccine was found to prevent contraception in mares, did not interfere with pregnancies in progress, did not interfere with social organization. A single annual booster was adequate to continue contraception. After 120 mare-years of PZP contraception, only four foals were born. Reversal of contraception action was documented in mares after 1, 2, 3, and 4 years of consecutive treatment. In addition, methods were developed for the detection of pregnancy in uncaptured horses using urinary and fecal estrogen metabolites, progesterone metabolites, and fecal total estrogens. These methods were used to assess the effects of 7 consecutive years of PZP contraception upon ovarian function. Seven consecutive years of contraception resulted in failure to ovulate and depressed estrogen concentrations; no other side effects were noted.

Preliminary evaluation of porcine zona pellucida (PZP) immunocontraception for behavioral effects in feral horses (Equus caballus)
Powell DM. 1999. Journal of Applied Animal Welfare Science. 2:321-335.

This study evaluated the effects of PZP immunocontraception on the behavior and reproductive physiology of feral horses on Assateague Island, Maryland. No differences were found between treated and untreated mares in their activity budgets, sexual behavior, aggressive behavior, and spatial relationships. Female dominance rank was found to influence foraging time, copulation success, and the frequency of sexual behavior.

An Assessment of the Genetic Status of the Feral Horse Population of Assateague Island National Seashore
Eggert, L.S., J.E. Maldonaldo, R.C. Fleischer, and D.M. Powell. 2005. Smithsonian Institution, Washington, DC. Report to NPS.

This study characterizes the current level and distribution of genetic diversity within the Assateague horse population. Based upon an analysis of both mitochondrial and nuclear genetic markers the study found that there is less mitochondrial DNA diversity within the Assateague population than has been found in established breeds, but the level of nuclear diversity is comparable to that found in established breeds. Preliminary results from phylogenetic analyses using microsatellite data suggest that the Assateague horses might be somewhat differentiated genetically from other breeds worldwide. Using genotype data, existing maternal pedigrees were affirmed and amended, and inferred for horses that were born when records were incomplete ("X" horses). Genetically-verified pedigree data was used to conduct genetic and demographic condition analyses, including assessments of the effects of selective culling.