National Park Service
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Southeast Regional Office
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Coastal Species of Concern Predation Management Plan and Programmatic Environmental Assessment

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1. PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The National Park Service (NPS) Southeast Region has developed this programmatic environmental assessment (PEA) for a proposed coastal species of concern predation management plan. The predation management tools and methods evaluated in this PEA were developed based on depredation issues specific to coastal park units in North Carolina, South Carolina, Georgia, Florida, and Mississippi (see Figure 1 for a map of the plan area and park units in need of active predation management). However, any decision resulting from the PEA process would cover all Southeast Region park units where there is a need to protect coastal species of concern.

Many coastal park units in the NPS Southeast Region have coastal and dune habitats that support coastal species of concern. These "coastal species of concern" are in need of conservation actions based on their rarity, declining population trends, or susceptibility to threats. Coastal species of concern may include species listed as threatened and endangered under the Endangered Species Act (ESA) of 1973, as amended. They also include those species on state lists in the plan area and those protected by other laws or regulations, such as the Migratory Bird Treaty Act (MBTA).

Examples of coastal species of concern found in southeastern coastal national park units are snowy plover (*Charadrius nivosus*), piping plover (*C. melodus*), loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), southeastern beach mouse (*Peromyscus polionotus niveiventris*), and Perdido Key beach mouse (*P. p. trissyllepsis*).

Species of concern are those in need of conservation actions, based on their rarity, declining population trends, or susceptibility to threats. These species may be included on state or federal lists of threatened or endangered species, or they may be protected by other laws or regulations, such as the Migratory Bird Treaty Act.

Predators affecting these coastal species of concern include coyotes (*Canis latrans*), raccoons (*Procyon lotor*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), and feral swine (*Sus scrofa*). A more complete list of species analyzed in the PEA can be found in Table 1 and Table 2.

Predators are an important and necessary function of healthy ecosystems. However, predation can have devastating effects on coastal species of concern, such as protected sea turtles, shorebirds, and beach mice already stressed by other environmental factors, such as habitat loss and habitat fragmentation. For example, in 2014, coyotes depredated over 100 sea turtle nests at Canaveral National Seashore, and in 2018, feral swine are believed to have depredated roughly 25% of the sea turtle nests. Data have also demonstrated predators eliminating 500 sea turtle nests in one season at the United States Fish and Wildlife Service (USFWS) Archie Carr National Wildlife Refuge (Kneifl, pers. comm. 2013), which is near Canaveral National Seashore. While Cumberland Island National Seashore has experienced minimal sea turtle nest losses from mammalian predators, shorebird nesting success has suffered considerably (Hoffman, pers. comm. 2014). At Fort Matanzas, predation caused the collapse of a once robust least

Figure 1
Plan Area

National Park Service
US Department of the Interior

Source: NPS GIS 2016

Southeast Region Coastal Species of Concern Predation Management Plan
NAD 1983 UTM Zone 17N, September 13, 2018
NPSpredator_intro_V02.pdf
This map is for illustrative purposes only and does not represent a legal description.

Table 1.
Coastal Species of Concern Analyzed in this PEA[1]

Species Common Name	Species Scientific Name	Status[2]
American oystercatcher	*Haematopus palliatus*	ST
Anastasia Island beach mouse	*Peromyscus polionotus phasma*	FE
Black skimmer	*Rynchops niger*	ST
Common tern	*Sterna hirundo*	NL
Green sea turtle	*Chelonia mydas*	FT
Gull-billed tern	*Gelochelidon nilotica*	ST
Kemp's ridley sea turtle	*Lepidochelys kempii*	FE
Least tern	*Sternula antillarum*	FE
Leatherback sea turtle	*Dermochelys coriacea*	FE
Loggerhead sea turtle	*Caretta caretta*	FT
Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	FE
Piping plover	*Charadrius melodus*	FT/FE
Red knot	*Calidris canutus*	FT
Roseate tern	*Sterna dougallii*	FT/FE
Snowy plover	*Charadrius nivosus*	FT
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	FT
Wilson's plover	*Charadrius wilsonia*	NL

[1] This is not the complete list of coastal species of concern in the NPS Southeast Region. This list represents the species that are at threat from predation. Some park units may choose to expand this list, depending on site-specific issues; if so, additional NEPA analysis would be completed as appropriate.
[2] FE – federally listed as endangered; FT – federally listed as threatened; SE – state listed as endangered; ST – state listed as threatened; NL – not listed.

Table 2.
Predators Analyzed in this PEA[1]

Species Common Name	Species Scientific Name
Atlantic ghost crab	*Ocypode quadrata*
Armadillo	*Dasypus novemcinctus*
Coyote	*Canis latrans*
Crow	Family Corvidae
Feral cat	*Felis catus*
Feral swine	*Sus scrofa*
Gray fox	*Urocyon cinereoargenteus*
Great black-backed gull	*Larus marinus*
Mink	*Neovison vison*
Virginia opossum	*Didelphis virginiana*
Raccoon	*Procyon lotor*
Red fox	*Vulpes vulpes*

[1] This is not the complete list of predators in the NPS Southeast Region. This list represents the species that parks have been observed depredating or have the potential to depredate coastal species of concern. Some park units may choose to expand this list, depending on site-specific issues; if so, additional NEPA analysis would be completed as appropriate. All predators analyzed in this PEA would be managed by the same tools and methods regardless of nativity to further the protection of coastal species of concern.

tern population (Foote, pers. comm. 2014). Some predator species have large home ranges and exhibit considerable variability in food habits and habitat use. An increasing trend in coyote populations in the NPS Southeast Region has led to a growing concern regarding the ecological impacts of this predator on coastal species of concern.

PURPOSE OF AND NEED FOR ACTION

The NPS is proposing to establish tools and methods for park units in the NPS Southeast Region to use when conducting predation management in order to protect coastal species of concern and contribute to the recovery of those species listed under the ESA. The NPS recognizes that predation is a natural process. Nevertheless, coastal species of concern are often at very low population numbers, and predation management can be used to help achieve species or ecosystem management objectives, including recovery of federally listed species. There is a need to develop a predation management toolbox that can be used across the NPS Southeast Region to facilitate and streamline planning, interagency coordination, and program management for the protection and recovery of coastal species of concern.

PROJECT SCOPE

While many National Environmental Policy Act (NEPA) documents focus on site-specific projects, federal agencies can also prepare programmatic NEPA documents to assess potential impacts from policies, programs, and plans. Such documents are inherently broad in scope, as they typically could affect a larger geographic area, compared with site-specific projects.

After the PEA is completed and a decision document is signed, park managers would have the discretion to determine if and when predation management tools and methods analyzed in the PEA would be used to help protect and recover coastal species of concern. As needed, parks would complete tiered, site-specific NEPA compliance for implementing the specific actions.

ISSUES AND IMPACT TOPICS

Impact topics regarding depredation of coastal species of concern described in the affected environment (Chapter 3) and environmental consequences (Chapter 4) were based on the issues identified through internal and public scoping. Impact topics were carried forward based on NPS NEPA Handbook guidance (NPS 2015a).

Issues and impact topics analyzed further are as follows:

- Predators—Predation management could affect individual predator species, either through direct removal or through preventing their ability to prey on coastal species of concern.
- Coastal species of concern—Managing depredation through lethal or nonlethal actions would help protect coastal species of concern from depredation and would support species recovery goals.

For additional information on issues considered but dismissed from further analysis, see Appendix D.

2. ALTERNATIVES

The alternatives under consideration in this document are the "no-action" alternative and the proposed action. The no-action alternative, Alternative A, would continue current management practices across the NPS Southeast Region. The NPS planning team developed the proposed action, Alternative B (the NPS preferred alternative), and included feedback received during the public scoping process.

Under both the no-action alternative and the proposed action, predation management, particularly the use of lethal controls, is not intended to eradicate regional populations of any predator species; rather, management would target individuals or small groups of predators that are selectively preying on, or pose a threat to, adults, young, chicks, hatchlings, and eggs of coastal species of concern (NPS 2015b). Alternatives considered but dismissed from detailed analysis are described in Appendix D.

ALTERNATIVE A: NO-ACTION ALTERNATIVE

Under the no-action alternative, parks currently using predation management to protect coastal species of concern in the NPS Southeast Region would continue to control predators threatening these species on a case-by-case basis following park unit-specific guidance and need. The predation management tools and methods that would be used are described below, and are generally used to deter or remove individual predators, taking into account the effectiveness and humaneness of the tool or method in controlling the target predator species. Currently, park units are responsible for completing all NEPA compliance and consultation requirements for predation management. This can lead to inconsistent compliance approaches across the region.

Nonlethal Control Tools and Methods

The following nonlethal predation control tools and methods would continue to be used on a case-by-case basis under the no-action alternative:

Relocating feral cats

Feral cats may be trapped live via a walk-in cage trap and sent to a shelter.

Fencing single nests and colonies of shorebirds

Exclosures are typically 4-foot high, have a 4-foot radius, and can be made of 2-inch by 4-inch non-electrified wire mesh. Plastic bird netting is placed on top of the exclosure. This design allows small birds to pass through but keeps out larger birds, such as crows and gulls, and mammals, such as raccoons, feral cats, and canines (Figure 2 and Figure 3 in Appendix A). Predator exclosures do not protect eggs or chicks from ghost crabs, nor are they effective for protecting chicks from avian and mammalian predators once they are outside the predator exclosures. Additional predator exclosure use guidelines can be found in Appendix F of the "*Piping Plover (*Charadrius melodus*) Atlantic Coast Population Revised Recovery Plan*" (USFWS 1996). A link to this document is provided in the references section in Appendix C. These guidelines recommend that persons constructing predator exclosures have the appropriate authorization(s) and experience. Circular or square exclosures are recommended and should be constructed after a full clutch of eggs is confirmed during good weather. Behavior of the coastal species of concern should be monitored during and after exclosure construction for abandonment. Exclosures

should be removed after chicks have fledged or the birds have left the nest territory and will not be disturbed by exclosure removal.

Installing screens or cages on sea turtle nests

Such exclusion devices consist of a 4-foot-square panel of 2-inch by 4-inch wire mesh or comparable material securely anchored over the nest when it is first laid and located. Screens are used to deter mammalian predator species from excavating individual sea turtle nests, which results in the loss of eggs. These exclusion devices also protect hatchling turtles from avian predators when they are emerging from the nest during the time that they are still within the exclusion area. Screen or cage exclusion devices do not protect eggs or hatchlings from ghost crabs, nor are they effective for protecting hatchlings from avian and mammalian predators once they are outside the exclusion device.

Managing perches

Perch deterrents are devices designed to prevent predatory birds and corvids from using tall structures, generally artificial perches like power poles, as hunting platforms in prey habitats. Perch deterrents thereby hinder the ability of predatory birds and corvids to forage in certain areas, minimizing depredation. Commercially available perch deterrents are usually triangle shaped, cone-shaped, or are spike-type structures that dissuade perching on a horizontal beam or pole top (Dwyer and Doloughan 2014). Other perch management, such as removing perches (dead snags) and shortening tall signs, also deter predatory birds from perching and reduce depredation in certain areas (USDA APHIS 2016).

Providing chick shelters

Chick shelters are a type of cage or exclosure placed around individual bird nests to prevent depredation (Figure 4 in Appendix A). They are usually used in areas devoid of vegetation to provide cover. Materials and design of the shelters vary but may include small wooden A-frames, pallets, or pallets on top of bricks. Shelters can be approximately 8-inches high and 12-inches across the base.

Using effigies

Effigies, such as scarecrows, include mechanical pop-up versions and predator-mimicking devices, such as hawk or owl replicas. Most scarecrows are human-shaped effigies constructed from inexpensive materials, including grain sacks or old clothes stuffed with straw. Effigies are intended to mimic a human as closely as possible, and the more realistic the facial features and the human shape, the more effective effigies are likely to be (Belant and Martin 2011).

Using conditioned taste aversion

Conditioned taste aversion uses a nonlethal chemical that a predator inadvertently consumes when eating a certain food; the chemical causes illness and the illness causes an intense aversion to the flavor of the food. For predation management, bait that is similar to the coastal species of concern (e.g., quail eggs, which are similar in size and shape to plover eggs) is placed in areas where predators would hunt coastal species of concern, and the bait is tainted with the nonlethal chemical. The predator then associates the taste of the coastal species of concern with the illness symptoms and avoids the species.

Using biological odor repellants

Biological odors are used to repel some smaller mammalian predators, such as raccoons or opossums, that are sensitive to the odors of species that prey on them. Odors are typically created synthetically from the skin and fur, urine, feces, and anal gland secretions of predators such as foxes and coyotes. If these odors are placed around coastal species of concern nests, it may deter certain predators.

Using disruptive harassment

In some situations, if a predator enters an area where coastal species of concern are present, rubber bullets or other nonlethal projectiles are used. This deters predators posing an immediate threat to coastal species of concern.

Using frightening devices

Frightening devices, such as lights, pyrotechnics, and noise makers, are used to scare predators away from a site. This can provide immediate results if a predator is exposed to these devices when caught in the act of predation. This method is effective on some predatory birds at roost sites.

Lethal Control Tools and Methods

Currently, some park units use lethal control tools and methods to protect coastal species of concern from predators. Lethal control tools and methods that would continue to be used on a case-by-case basis under the no-action alternative include:

Foothold traps

Foothold traps are a versatile control method widely used by wildlife managers across the country. Foothold traps (Figure 5 in Appendix A) of the appropriate size and type can be effectively used to capture specific target animals that may not respond to other control tools or methods. Two primary advantages of the foothold trap are that they can be set under a variety of conditions and pan-tension devices can be used to reduce the potential for capturing smaller nontarget animals. Advances in technology (padded jaws, laminated jaws, and offset jaws) have made trap designs more efficient and humane for captured animals (see Best Management Practices [BMPs], described below). Effective trap placement and use of appropriate lures by trained personnel also contribute greatly to the foothold trap's selectivity. Modern trap designs minimize injury and stress to captured animals. Foothold traps also allow for on-site release or relocation of nontarget animals.

Trap placement location is contingent on the habits of the respective target species, habitat conditions, presence of nontarget animals, and occasionally the level of human (visitor) activity. Traps can be baited or scented using fetid food, urine, or musk to attract the target animal. Predation management personnel use foothold traps to capture a variety of predators, including coyotes, foxes, raccoons, opossums, and mink. Captured target species would continue to be dispatched by approved tools and methods described below.

Snares

Snares (Figure 6 in Appendix A) are capture devices composed of a cable loop and a slide locking device. Most snares are equipped with a swivel to minimize cable twisting and breakage while allowing a captured animal to move freely, decreasing the likelihood of injury. Snare cable sizes range from 1/16-inch to 3/16-inch and are commonly used in the United States to capture animals as small as mink to larger animals like feral swine. Available modifications include "stops" that prevent the slide lock from closing past a certain point to prevent capture of some nontarget species or to reduce tension-related stress on captured target animals. Break-away locks or links are designed to separate at specific tensions to avoid capturing larger nontarget animals like deer and livestock. Snare sets can be designed to capture an animal around the neck in both lethal and non-lethal situations. Foot snares utilize the same snare device with a throw mechanism to capture an animal above the foot for nonlethal capture. The Collarum® live capture device uses a throw mechanism with a large cable and stop installed to reduce

injury to both target animals (fox and coyote) and nontarget animals. Captured target species would continue to be dispatched by approved tools and methods described below.

Walk-in cage traps

Walk-in cage traps, commonly referred to as live traps or Havahart™ traps, are used to capture a variety of animals, including raccoons, opossums, feral cats, and in some instances, foxes (Figure 7 in Appendix A). Placement of walk-in cage traps is contingent on the habits of the respective target species, habitat conditions, and the presence of nontarget animals. Cage traps pose minimal risk to humans, pets, and other nontarget species, and they allow for on-site release or relocation of nontarget animals. Typical baits/attractants used for cage traps are food-based lures. Most feral cats are trapped using these devices and are sent to shelters. With the exception of feral cats, captured target species would continue to be dispatched by approved tools and methods described below.

Dog-proof traps

Dog-proof traps are a more recently developed foot capture trap used for raccoons and opossums and are designed to avoid the potential to capture dogs and other nontarget animals (Figure 8 in Appendix A). The trap design is based on a trigger mechanism that must either be pulled or pushed to trip the capture bar. The trigger mechanism is enclosed inside a small metal cylinder or box that prevents animals like dogs from accessing and operating the trigger. The trap's design is based on the ability of animals like raccoons and opossums to reach into a small space (in this case, a hole in the trap casing) and grab, push, or pull the trigger. When tripped, a spring-loaded bar slides across the opening and pins the animal's foot against the inside of the trap casing. Dog-proof traps are staked in the ground, secured with an anchor or cable, and baited with a variety of raccoon or opossum lures. Normal capture is well above the animal's foot, and injury is nonexistent to minimal in most cases. Captured target species would continue to be dispatched by approved tools and methods described below.

Box/cage/corral traps

Traps commonly used to capture feral swine include box traps, cage traps, and corral traps (Mississippi State University 2013) (Figures 9 and 10 in Appendix A). Box traps are usually wooden panels with an entry door. Cage traps for feral swine are square in design, made of metal panels, usually have a top and bottom panel, and an entry door. Cage traps are manufactured in a variety of sizes and door designs. Corral traps can be constructed of livestock panels or specifically manufactured trap panels secured together with pins, wire, and metal ground posts, and may have one or more entry doors. Ground area within corral traps can be large or small, depending on the number of hogs targeted, number of panels used, and the landscape of the trap area. Normal height for both cage and corral traps is 5-feet. Shorter heights risk escape of captured hogs by climbing or jumping out of the trap. Entry doors are designed to be tripped via a trip line placed in the rear of the trap, which allows multiple animals to enter before tripping the door(s). Recent advances in technology enable trap systems to be used whereby the trigger device communicates with a nearby surveillance camera, which talks to the user's cell phone. The user can operate the trap door mechanism via text commands from the cell phone if the camera shows hogs present inside the trap. This system ensures efficient capture of entire sounder groups of hogs and eliminates potential capture of nontarget animals like deer. Captured target species would continue to be dispatched by approved tools and methods described below.

Dispatching of captured animals

Use of the term "dispatching" in this document refers to quickly and humanely killing a trapped target animal. The term is interchangeable with "euthanasia"; acceptable tools and methods are discussed in detail in American Veterinary Medical Association (AVMA) Guidelines (AVMA 2013). The primary dispatch method in the context of predator management for protecting NPS coastal species of concern is use of firearms. Another method of dispatching animals caught in traps is use of a carbon monoxide/carbon dioxide gas chamber. These tools and methods, described below, would continue to be used by personnel trained in administering the chosen method.

Use of firearms or shooting

Use of firearms, or shooting, can provide immediate, efficient, and selective removal of predators causing losses or threats to coastal species of concern. The typical scenario for using firearms would be dispatching target animals caught in traps by administering a gunshot to an animal's head or cervical vertebrae with a non-lead bullet (AVMA 2007). Predator species also can be pursued with targeted hunting techniques or removed opportunistically when observed in and around areas where coastal species of concern exist. Shooting may sometimes be one of the only control options available if other factors prevent trapping or non-lethal methods from being employed or if predators exhibit trap-shy behavior while still causing losses. Shooting techniques may involve being mobile and searching for animals by walking or driving a vehicle or all-terrain vehicle, and can also consist of stationary stand hunting where target animals are known to frequent. Stand hunting can be conducted from elevated platforms or from ground level. Personnel may use pellet rifles, rimfire rifles/pistols, centerfire rifles, or shotguns. Specific firearm type and caliber or gauge of ammunition varies. In addition to daytime activity, advances in weapon sight system technology, including night vision and thermal optics, enable personnel to remove animals that are primarily nocturnal. Since no light is emitted by night vision and thermal optics, these devices are optimal for work around sea turtle species that are normally disturbed by unnatural light. In some cases, rifle suppressors are used to muffle noise from the shot's muzzle blast.

Euthanasia chamber

Euthanasia by carbon dioxide-induced narcosis may be used after a species has been captured using the above-mentioned tools and methods. Carbon dioxide is relatively safe to the wildlife technician and will suppress an animal's ability to experience pain prior to death. Depending on the species, the animal will expire within 30 minutes. This method involves the release of carbon dioxide into a chamber (wooden box, plastic trash can or barrel).

Best Management Practices

General

- Conduct predation management activities professionally and in the safest manner possible;
- Ensure only personnel with proper training and experience conduct predation management;
- Based on NPS staff's knowledge of visitor use patterns, conduct predation management activities away from areas of high human activity, including placing traps away from facilities or areas of high visitation. Coordinate with visitor use personnel to identify factors that affect wildlife control operations taking place, such as high public use areas, times of day, or seasons of high visitor use. In some instances, the amount or type of visitor use may negate control operations;

- Based on NPS staff's knowledge of park infrastructure, including structures, roads, trails, campgrounds, bodies of water, parking lots, and any feature that presents a safety hazard when firearms are used, make all possible efforts to discharge firearms in a safe, discreet manner, with safety as the primary concern;
- When necessary, notify visitors of certain operations and educate them on the details in a manner that will reduce potential safety hazards;
- When appropriate, notify park unit law enforcement of specific activities and coordinate any necessary or anticipated actions to ensure visitor safety.

Traps and snares

The International Association of Fish and Wildlife Agencies (AFWA) has developed BMPs for trapping, in order to maximize humaneness and minimize suffering. The AFWA worked with Congress and the National Trappers Association to test the most effective and humane traps for a number of species. This work resulted in species-specific BMP guides for trapping furbearers (AFWA 2006). All trap devices used by park units meet or exceed all specifications recommended in the AFWA BMPs. The AFWA BMPs describe various capture devices and their components; modifications to certain trap models; trap tuning, preparation, and maintenance; and trapping techniques. Only personnel with proper training and experience trap and dispatch predators.

While nontarget species may be accidentally caught and/or injured, research from the AFWA BMPs indicates that specific modifications to foothold traps may enhance animal welfare and still provide a sufficient efficiency in capturing target animals. Examples of such modifications are as follows:

- Offset jaws—Traps are now designed with a space between the gripping surfaces, typically from 1/8- to 1/4-inch. This reduces injury to the animal's foot when sprung.
- Lamination or padded jaws—Traps are now designed with jaws thickened by lamination, which may be attached above or below the trap jaws, or by adding rubber pads to the jaw themselves. These features increase the surface area of the jaw on a trapped animal's foot, which could influence both animal injury and capture efficiency.
- Four-coiling—This is a design feature where traps include two additional springs. These traps perform better in terms of reducing animal injury and improving capture efficiency because the trap is more stable when it is triggered.
- Double jaws—This is a design feature where a trap includes two jaws. A primary jaw restrains the foot, and the second jaw limits the animal's access to the foot when the trap is sprung.

In addition, traps are placed in sheltered areas with enough natural cover to protect the animal from adverse weather conditions and to reduce stress levels. Weather and environmental conditions permitting, all field equipment is checked at least once each day. If daily checking is not possible, all equipment is removed from the site. Ideally, trap checks should be performed early in the morning to remove any captured animals before public use. Timely removal of captured animals will reduce the chance that the public and park staff may see or interact with captured animals.

At times, it may be necessary to check traps several times daily, depending on wildlife patterns and visitor use patterns. Traps are set and placed to minimize catching nontarget species; any nontarget

species accidentally trapped would be released. Areas or roads would be closed temporarily during trapping and shooting. It may also be necessary to shut down or remove traps during busy times, to completely avoid public interaction.

Traps are placed away from facilities or areas of high visitation. As appropriate, the NPS leaves carcasses on-site or disposes of carcasses by burial, incineration, or by removing the carcasses to a remote site for decomposition.

The NPS installs warning signs, alerting people to the presence of foothold traps or snares, posted at points of access to areas where foothold traps or snares are used. When necessary, the NPS uses signs to temporarily close off areas during trapping or firearms operations. Also, park staff may briefly close an area when a situation dictates, such as when euthanizing an injured animal.

Use of Firearms or Shooting

The NPS may continue to use lead-free bullets and would continue to adhere to the 1998 Agreement on International Humane Trapping Standards and subsequent 2006 agreement, which included BMPs (AFWA 2006; described above). The NPS also adheres to the AVMA's guidelines for euthanizing animals (AVMA 2013). These guidelines are available on the AVMA's website (www.avma.org). They are updated as needed to reflect the best research and empirical information available. Those managing depredation are professionals experienced in the humane use of euthanasia techniques. The NPS conducts shooting when human activity is low or during park closed hours, when possible. Areas may be closed to visitors temporarily.

Considerations for Use of Predation Management Tools and Methods

Depending on the circumstances, use of a particular tool or method may have advantages and disadvantages; therefore, these tools and methods would continue to be used on a case-by-case basis in various combinations and to varying levels of intensity. Due to variations in management across the NPS Southeast Region, park units engage in predator management to varying degrees. Some park units use nonlethal tools and methods only, while others use both lethal and nonlethal tools and methods. Some park units implement proactive management techniques, while others engage in reactive approaches, responding to known predation events in an attempt to protect coastal species of concern. Currently, there is no consistency across the region regarding timing and triggers for predation management.

Monitoring and Data Collection

Some park units monitor coastal species of concern and predators and collect data at the park level, with required monitoring under state and federal oversight; however, there is no regionally consistent guidance on what should be monitored, so all park units have a different approach to monitoring and data collection.

ALTERNATIVE B: PROPOSED ACTION (NPS PREFERRED ALTERNATIVE)

Under the proposed action, all park units in the NPS Southeast Region would have a suite of tools and methods available to control predators threatening coastal species of concern, including tools and methods that were not previously used by some park units in the region. The proposed action would streamline the approach for predation management by providing programmatic NEPA compliance across

the region, resulting in the timely and efficient implementation of the tools and methods presented. The predation management tools and methods that would be available to parks are described below.

The proposed action would establish the framework for the use of predation management tools and methods, while park unit-specific depredation efforts would be proposed and evaluated in subsequent NEPA reviews that "tier" to this PEA, as mentioned in Chapter 1. The intent of tiering to a PEA is to encourage elimination of repetitive discussions and to focus on the site-specific issues. Tiering expedites the resolution of broader-scale issues in the PEA so that subsequent analysis can focus on park-specific impacts and issues. Those broader-scale issues and analyses do not have to be repeated in subsequent tiered environmental reviews, but can simply be referenced from the PEA. Tiering also allows the site-specific NEPA compliance to be conducted closer in time to the actual implementation of predation management tools and methods, so that details specific to each action or project can be considered, as appropriate.

Predation management under the proposed action would be selective to reduce the likelihood of adverse impacts associated with various predation management tools and methods. After identifying target predators, park staff would use the most effective and humane tools and methods available to deter or remove predators. The NPS would also apply regionally consistent BMPs and mitigation measures to reduce the likelihood of adverse impacts associated with predation management.

Nonlethal Control Tools and Methods

Nonlethal control tools and methods would be mostly the same as those described for Alternative A; however, certain tools and methods would not be implemented under the proposed action: effigy, conditioned taste aversion, biological odor repellant, disruptive harassment, and frightening devices. Most of these tools and methods were excluded because they are thought to be ineffective due to predator's high rates of habituation after multiple applications, such that they are no longer effective deterrents (Gilsdorf et al. 2003; Gorenzel and Salmon 2008; Shivik 2004). Other tools and methods, such as taste aversion and biological odor repellants, do not ensure large-scale deterring of the predator species because they cannot be administered over extensive areas, require intensive maintenance to be effective, or are not effective at modifying predatory behaviors (Dorrance and Roy 1978; Conover and Kessler 1994).

Lethal Control Tools and Methods

Lethal control tools and methods would be the same as those described for Alternative A with the addition of two tools. A toxicant that is intended to kill target species, 3-chloro-4-methylbenenamine hydrochloride (DRC-1339), may be used in unique situations to deter avian predators. The toxicant, DRC-1339, is registered with the Environmental Protection Agency (EPA; registration number 56228-29) and may be used to lethally control corvids (crows) and other predatory avian species. Corvids that are selectively preying on shorebird nests (eggs and chicks) could be removed safely and effectively with DRC-1339, a rapidly metabolized avian toxicant. Birds ingesting a lethal dose of DRC-1339 usually die away from the bait site within 12 to 72 hours. There is minimal chance of secondary toxicity to species ingesting birds treated with this chemical because it has been metabolized prior to death; if any treated bait remained in the digestive tract, the amount would be too minimal to harm another animal.

DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation. It is highly soluble in water; however, it does not hydrolyze there and degrades

rapidly (USDA 2001). This compound is also unique because of its relatively high toxicity to some species, such as corvids, but low to moderate toxicity to most predatory birds and almost no toxicity to mammals (DeCino et al. 1966; Schafer 1981). Only personnel trained and certified in the use of toxicants would be allowed to apply DRC-1339. Typical bait delivery would include injection of the chemical into chicken eggs or topical application to food items, including French fries, hot dog pieces, and other suitable baits consumed exclusively by the target bird species. Baiting would usually be conducted during times of feeding activity, and any remaining treated baits would be retrieved by NPS personnel prior to departing the site.

Additionally, under the proposed action, park units could remove ghost crabs using Fripp traps and manual removal from burrows. Fripp traps can include a gallon jug with a smaller bottle and sandpaper or mesh screening that it is buried in an active ghost crab burrow, ideally near an active and depredated nest site, and left overnight. Crabs that enter these traps are unable to leave and are collected by managers and dispatched. Removing ghost crabs from burrows involves selecting those that have created burrows between 5 and 15 meters from nest sites and those crabs depredating nest sites. Methods used to remove ghost crabs could include the use of "grabbers," or a mechanical device used to reach into burrows and extract crabs, or excavating burrows and extracting crabs by hand.

Considerations for Use of Predation Management Tools and Methods

Under the proposed action, park units would have the flexibility to use a suite of nonlethal and lethal tools and methods to manage depredation, which could take place year-round, as needed. Tools and methods that could be used, factors for consideration, and species affected are presented in Table 3. For all forms of control in the table, the decision on what tool or method to use would be based on experience, skill level, safety considerations, certifications of park personnel, best professional judgement of park staff on what tool to use, and knowledge of predator behavior and capacity to cause harm to species of concern.

Table 3.
Factors for Consideration Regarding Predation Management Tools and Methods

Predation Management Tool and Method	Target Predator Species	Target Coastal Species of Concern	Factors for Consideration, Such as Time and Location
Fencing single nests and colonies	Mammalian and avian predators	All avian coastal species of concern	Used during nesting season after nests have been established and eggs are laid. Ineffective after eggs have hatched. Fencing can be used when predation is anticipated in an area; where the area is an appropriate size for fencing; and where interactions with sea turtles, adult birds, and other species are not expected. May require permits from the state and must be monitored.
Installing screens or cages	Mammalian predators	Sea turtles	Used during nesting season in areas where parks anticipate predation. Given the staff effort and equipment needed, nest screens/cages are not used in areas where predation is not anticipated.

Table 3.
Factors for Consideration Regarding Predation Management Tools and Methods

Predation Management Tool and Method	Target Predator Species	Target Coastal Species of Concern	Factors for Consideration, Such as Time and Location
Managing perches	Avian predators	All avian coastal species of concern	Ability to use year-round where a known perch is near an active nest or colony. Easy to install and may be able to use existing infrastructure. May require replacement. Effective for some avian predators, though not all avian predators perch.
Chick shelters	Avian predators	All avian coastal species of concern	Used after chicks have hatched in areas devoid of vegetation. Weather is a consideration, as chick shelters can blow over. Chick shelters may attract predators, so they must be monitored. May disturb colony during placement and should be placed before chicks emerge.
Foothold trap	Coyote, red and gray fox, raccoon	All coastal species of concern	Ability to use year-round. Factors for consideration include weather, location, timing, and park expertise at knowing predator habits and ability to avoid park visitors from coming upon a trap or trapped animal.
Snare	Coyote, red and gray fox	All coastal species of concern	Ability to use year-round along travel routes. Requires substantial expertise to use successfully.
Walk-in (live, cage) trap	Raccoon, opossum, feral cat, fox, armadillo, mink	All coastal species of concern	Ability to use year-round near nests or along travel routes. Can be used when staff are not qualified to use firearms, if staff do not want to carry a firearm, and because it is safer for park staff because animals don't have to be moved or handled. Daily monitoring required.
Dog-proof trap	Raccoon, opossum	All coastal species of concern	Ability to use year-round and is more species-specific than other traps. Similar factors for consideration as for foothold traps.
Box/cage/ corral trap	Feral swine	All coastal species of concern	Ability to use year-round. Requires more time, as feral swine must be acclimated to pens. Factors for consideration include finding hog travel routes, baiting feeding locations, setting remote cameras, and access considerations for hauling large and heavy traps.

Table 3.
Factors for Consideration Regarding Predation Management Tools and Methods

Predation Management Tool and Method	Target Predator Species	Target Coastal Species of Concern	Factors for Consideration, Such as Time and Location
Shooting	All predators, except feral cats	All coastal species of concern	Ability to use year-round in any circumstance. More time-efficient than setting traps. Need trained personnel aware of safety considerations and appropriate timing (e.g., during hours when the park is closed) and location. May be more appropriate for predators that are difficult to trap.
Euthanasia chamber	Raccoon, opossum, fox, armadillo	All coastal species of concern	Used in concert with walk-in traps; factors for consideration are the same.

Source: NPS interdisciplinary team input

Several factors would affect the approach to predation management under Alternative B, including:

- The degree of threat that the predator poses to coastal species of concern, based on past experience in the park unit, known food habits, or documentation (scientific or otherwise) of that predator's ability to affect local protected species
- The vulnerability of a particular coastal species of concern's nesting colony, egg clutch, or habitat[1]
- Documented predator presence near coastal species of concern colonies, nests, and hatchlings

In park units where a coastal species of concern nests in relatively large numbers, park managers may establish a threshold of losses that would trigger the need for predation management. Thresholds would be based on such factors as professional experience and guidance from state, regional, or national recovery plans. Such a threshold could be expressed as a percentage of the total reproductive effort of a coastal species of concern or percentage of loss from depredation events, for example 10% of the total nests affected by depredation, 5% of hatched chicks lost, or 1% of the estimated total number of sea turtle eggs on a nesting beach lost. These numbers would be determined at the park unit level as necessary.

If the NPS uses a private contractor or skilled volunteers for predator control, it would require that those parties operate under park standard operating procedures (SOPs) and the contractor's own SOPs, if any. If the NPS uses the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) for predator control, the park and the USDA would develop a blanket SOP as part of the interagency agreement document. The use of skilled volunteers would be determined at the park level, during tiered park-specific NEPA compliance.

[1] This could be expressed as the overall level of protection needed for a particular species throughout its range, based on known global or local populations and threats or known minimal numbers of a species in a park unit's available habitat.

Mitigation Measures

Mitigation measures such as conducting cultural and archaeological surveys and implementing avoidance measures would be applied before predation management is implemented. If any cultural or archaeological resources were inadvertently discovered during a predation management activity, all work would be halted until the resources could be evaluated and an appropriate mitigation strategy developed to preserve the information and artifacts to the fullest extent. Cultural and archaeological resources were considered but dismissed as an issue in this plan due to these mitigation measures and other factors. For information on this resource topic and dismissal, please see Appendix D.

Emerging Technologies

The NPS would continue to research and use, where appropriate, emerging technologies for protecting coastal species of concern. The early investigation of and investment in emerging technologies may help advance predation management to protect coastal species of concern. Implementation of additional technologies or tools not covered in this PEA may require additional NEPA analysis.

Monitoring and Data Collection

A Coastal Species of Concern Depredation Monitoring Program would be developed at the park unit level for any park that tiers to this PEA and implements wide-scale predation management tools and methods. The monitoring program could include, but would not be limited to: the types of tools and methods implemented, number and type of depredation events, number and type of predators removed and/or relocated, and percentage of successful coastal species of concern reproductive events reported annually to determine effectiveness of predation management tools and methods. Based on monitoring results, management techniques may be altered at the park level to determine the best types and/or combination of management tools and methods to be utilized for subsequent years. Results from monitoring programs would be shared among NPS Southeast Region park units tiering to this PEA to contribute to regionwide effective management strategies, track numbers of predators removed, and record coastal species of concern reproductive success.

3. AFFECTED ENVIRONMENT

PREDATORS

Mammalian Predators

Coyote

Coyote range expansion is shown in Figure 11 in Appendix A; the species has a wide distribution throughout North America, Mexico, and into Central America. They have been documented in most of the NPS Southeast Region park units (NPS 2010a, 2011a, 2012b, 2013a, 2014a, 2014b, 2014c, 2016a, 2018a**;** Hoffman, pers. comm. 2014; NPS 2018), with populations ranging from 1 to roughly 30 (NPS 2018b). This species can easily access barrier islands connected to the mainland via bridges, such as Cape Hatteras National Seashore, and are thought to reach unconnected barrier islands, such as Cumberland Island National Seashore, by swimming (NCWRC 2018a).

Coyotes are opportunistic, generalist omnivores that eat a variety of food items, typically consuming items in relation to changes in availability. They eat foods ranging from fruit and insects to large ungulates and livestock, though coyotes in suburban areas are adept at exploiting human-made food resources and will readily consume dog food or other human-related items. Coyote home ranges typically average 6,400 acres but vary geographically, seasonally, and within populations (McCown and Scheick 2007).

Coyotes are abundant throughout their range and are increasing in distribution as humans continue to modify the landscape. The species is very versatile, especially in their ability to exploit human-modified environments. The coyote is considered a species of "least concern" on the International Union for Conservation of Nature (IUCN) Red List, which is defined as a species at lowest risk of extinction and considered widespread and abundant. Hunter or trapper take data for coyotes in recent years indicate public harvest numbers ranging from 5,115 in Mississippi (MDWFP 2018) to 25,000 in Georgia (Killmaster, pers. comm. 2017) and over 36,000 in North Carolina (NCWRC 2012) (see Appendix B for more information on state harvest of predators).

Feral Swine

Feral swine population expansion is shown in Figure 12 in Appendix A (USDA APHIS 2015). They have been documented at Cumberland Island, Canaveral, and Gulf Islands National Seashores (Hoffman 2009, 2010; NPS 2012a, 2014a). They can reproduce year-round, and have a short gestation period, high birth rates, and high habitat adaptability (USDA APHIS 2015). The presence of these animals in the United States is solely attributable to man-made introductions.

Feral swine are highly versatile opportunistic omnivores and feed primarily by rooting and grazing. Food items include roots, nuts, berries, leaves, bark, garbage, eggs, small rodents, amphibians, reptiles, and insects. In North America, the average home range size for feral swine varies from a few hundred to several thousand acres. Although feral swine are active at night and can move 20 miles or more in a single night to find food, they usually stay within 5 miles of their home range (NCWRC 2009).

There are no legal protections to maintain feral swine populations, and abundant eradication programs occur throughout the United States to minimize their damaging effects on human and natural

environments and to control their populations. Feral swine populations are estimated at over 6 million in the United States. Hunter or trapper take data for feral swine in Georgia, North Carolina, South Carolina, Alabama, and Florida indicate harvest numbers ranging from 1,422 (in Florida Fish and Wildlife Conservation Commission [FWC] wildlife management areas) to 208,200 (Alabama statewide harvest) (Bryant 2016; FWC 2018; NCWRC 2018b; Killmaster, pers. comm. 2017; SCDNR 2010).

Armadillo

Armadillos have expanded their range eastward and northward (Taulman and Robbins 1996) and now occupy all NPS Southeast Region states. In addition to this expansion, armadillos quickly fill vacant habitats by immigrating adults after they have been locally culled from an area (Loughry et al. 2013; McDonough et al. 2007). The species is known to occur at Cumberland Island and Gulf Islands National Seashores (Hoffman, pers. comm. 2017; NPS 2017a). Armadillos typically feed on insects, other invertebrates, and plants, but they also are known to feed on eggs, including those of sea turtles and plovers (FWC 2017a). The armadillo's home range is between 4.9 and 49 acres (Loughry and McDonough 1998); one study found that the mean home range of 12 individuals in Florida was 14.1 acres (Layne and Glover 1977).

The IUCN Red List conservation status for armadillo is "least concern". Their widespread and stable populations combined with their continuing expansion makes this species resilient to declines (Loughry et al. 2014).

Feral Cat

To be defined as feral, a cat must have been previously domesticated and is now living free of human involvement (Munton 1982). Feral cats have established populations throughout most of the world, including all states in the NPS Southeast Region. Habitat use varies seasonally, likely in response to prey availability, depredation risk, and environmental stress (Horn et al. 2011). Feral cats are known to occur in Cape Hatteras, Cape Lookout, and Gulf Islands National Seashores (NPS 2018b, 2014a, 2014b). Cats are opportunistic carnivores, but some have a diet subsidized by human feeding. Feral cat home ranges vary, from approximately 4 acres for urban cats to up to 100 acres for rural cats (Ogan and Jurek 1997). While the species is not listed on the IUCN Red List, populations appear to be abundant; in Florida, the estimated feral cat population is 2.8 million (FWC 2003).

Gray Fox

The gray fox is a small canine with a habitat range that includes all of the NPS Southeast Region. Range expansion to formerly unoccupied or previously extirpated areas in the northern United States during the last 80 years demonstrates the adaptability of gray foxes to various habitat types (Sullivan 1996). Gray foxes are known to occur or could occur in Cape Hatteras, Cape Lookout, and Gulf Islands National Seashores (NPS 2014a, 2018b). Gray foxes are opportunistic, generalist omnivores with an average home range of 740 acres (Sullivan 1996).

The gray fox is considered a species of "least concern" on the IUCN Red List, being widespread and abundant. Available evidence suggests that their numbers are probably stable across their range and not subject to any rangewide threats causing marked declines in the overall population size, despite being trapped for their pelts in many parts of their range (Roemer et al. 2016). Harvest numbers from trappers ranged from about 600 to 12,032 foxes (which includes both gray and red foxes) over the past decade in Mississippi, North Carolina, Alabama, and Georgia (Table 3 in Appendix B).

Mink

Mink is a small mammal that occurs in North America from Alaska and Canada throughout most of the United States (except very arid areas). The species is known to occur or could occur at Cape Hatteras, Cape Lookout, and Cumberland Island National Seashores. Strictly carnivorous, the mink's diet reflects the local prey base and mink typically prey on fish, amphibians, crustaceans, muskrats, and small mammals (South Carolina Species Information 2017). The mink's home range averages 1.5 miles of stream length but can extend up to 4 miles; seasonal habitat selection varies based on food and den availability (GADNR 2005).

The mink is listed on the IUCN Red List as a species of "least concern" because it has a wide distribution and is relatively common across its range. Local declines have occurred, which have been attributed to pesticide use in the 1950s and 1960s as well as removal of the wetland, coastal marsh, and swamp habitats they rely on (South Carolina Species Information 2017; NCWRC 2018c; GADNR 2005). However, the species is stable in many areas (Reid et al. 2016). Statewide harvest data in Mississippi, North Carolina, and Georgia ranged from about 19 to 529 mink over the past decade (Table 4 in Appendix B).

Opossum

Common in the United States east of the Rocky Mountains, opossums are known to occur at Cape Hatteras and Cumberland Island National Seashores. The species' range appears to be expanding north and west (Pérez-Hernandez et al. 2016; NatureServe 2018a). Opossums are generally found at highest densities in areas with concentrated food sources. They have an opportunistic diet and eat birds, small mammals, reptiles, carrion, insects, earthworms, leaves, seeds, fruits, and nuts (North Carolina Wild 2017). The species uses all habitats within their range of ecological tolerances, maintaining a seasonal home range of approximately 350 acres for males and 160 acres for females (GADNR 2006).

An IUCN Red List species of "least concern", opossums are widespread and common throughout their range, and this species is adaptable to human-dominated landscapes. Although hunted or trapped locally for food, sport, and as predators of poultry, opossums do not appear to have been adversely affected by human settlement (Pérez-Hernandez et al. 2016). Hunter and trapper take data for opossums in recent years indicate harvest numbers from over 7,000 in Mississippi to over 15,000 in Georgia (MDWFP 2018; GADNR 2006). The Georgia Department of Natural Resources (GADNR) noted that opossums hunted or trapped are likely a very small percentage of the overall population in Georgia (GADNR 2006).

Raccoon

Racoons inhabit most of the continental United States and are expected to occur in all park units within the NPS Southeast Region. Highly adaptable to a variety of habitats, raccoons are most abundant near water (Tesky 1995), though they thrive in urban and suburban areas due to abundant food resources and den sites. Raccoons forage either independently or in groups. They are an opportunistic omnivore, eating fruits, nuts, insects, small mammals, bird eggs and nestlings, reptile eggs, frogs, fishes, aquatic invertebrates, worms, and garbage. Raccoons obtain most food on or near the ground and near water (Timm et al. 2016). In the United States, raccoon home ranges are highly variable, from 12.6 acres in suburban residential areas up to 6,300 acres in the prairies of North Dakota (Lotze and Anderson 1979).

The raccoon is an IUCN Red List species of "least concern" because it is broadly distributed across North America in a variety of habitats, is fairly common, and is present in many protected areas. It is not

undergoing any significant decline and is adaptable to human conversion of habitat. Recent statewide harvest numbers from Mississippi, North Carolina, Alabama, and Georgia ranged from about 7,294 to 92,104 raccoons (Table 5 in Appendix B).

Red Fox

The red fox has a wide distribution and occurs or could occur in Cape Hatteras National Seashore, Cape Lookout National Seashore, Fort Matanzas National Monument, and the Gulf Islands National Seashore (NPS 2018b). Range expansion has been attributed in part to agricultural development, which has displaced red foxes from densely forested areas. Red foxes are adaptable and opportunistic omnivores and are capable of successfully occupying urban areas (Hoffmann and Sillero-Zubiri 2016). Prey availability is an important determining factor in red fox habitat use; in the United States, the red fox annual home range varies between 3,600 and 4,900 acres (Lariviere 1996).

The red fox is an IUCN Red List species of "least concern" and has the widest geographical range of any member of the order Carnivora, being distributed widely across the entire northern hemisphere. Harvest numbers from trappers ranged from about 600 to 12,032 foxes (which includes both gray and red foxes) over the past decade in Mississippi, North Carolina, Alabama, and Georgia (Table 6 in Appendix B).

Avian and Other Non-mammalian Predators

Corvids

Corvids, such as American crow and fish crow, are widespread throughout much of North America and are known to occur or could occur at Cape Hatteras, Cape Lookout, Cumberland Island, and Gulf Islands National Seashores (Strickland 2015; NPS 2015c). Control of American and fish crows is allowed to protect species of concern per 50 CFR 21.43: "a federal permit shall not be required to control … cowbirds, all grackles, crows, and magpies, when found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance" (USFWS 2013a).

American crows thrive in suburban neighborhoods and urban parks and in coastal habitats (Parr 2005), and its diet consists predominantly of insects, amphibians, reptiles, eggs, young birds, and small mammals (Cornell Lab of Ornithology 2017a). Home range estimates for crows vary with different geographic settings; the home range is from about 2.5 acres in highly urban environments to over 8,649 acres in nonurban landscapes (Marzluff et al. 2001).

American crow and fish crow are IUCN Red List species of "least concern" with extremely large ranges and increasing population trends (Birdlife International 2016a). The North American Breeding Bird Survey provides data on bird species observed along randomly established routes and is used to monitor the status and trends of North American bird populations. Breeding Bird Surveys in 2016 and 2017 observed 9,030 and 9,461 American crows, respectively, over approximately 260 routes in Florida, Georgia, Mississippi, and North Carolina. Over the same time period and area, 1,143 and 1,150 fish crows were observed (Pardieck et al. 2018). In addition, Partners in Flight estimate 460,000 fish crows in the United States with a 30% increase in population since 1970 and 27 million American crows with a 12% increase in population since 1970 (Partners in Flight 2017).

Great Black-Backed Gull

Great black-backed gulls are found throughout the Atlantic Coast and are present throughout the NPS Southeast Region. The species is thought to be common during all seasons in northern North Carolina but is uncommon during winter in areas to the south (National Audubon Society 2018). Great black-backed gulls are omnivorous; common food items are mussels, crabs, sea urchins, and fish. While the species' home range is not known, great black-backed gulls are known to travel widely along coastal areas to forage (Cornell Lab of Ornithology 2017b).

Great black-backed gulls are federally protected under the MBTA (USFWS 2013a). The great black-backed gull population in the Northwest Atlantic is estimated at between 690,000 and 940,000 (BirdLife International 2016b).

Atlantic Ghost Crab

The Atlantic ghost crab lives on coastal beaches throughout the NPS Southeast Region. Ghost crabs are rarely seen in the winter but are otherwise common or abundant on beaches in the NPS Southeast Region (Knott 2006). This species is omnivorous, feeding on insects, filter feeders (such as clams and mole crabs), the eggs and hatchlings of turtles and birds (Kwon et al. 2018; USFWS 1996; Sabine et al. 2006), and beach mice (NMFS and USFWS 2007a, 2013). Burrows are found from near the high tide line up to 0.25 miles landward from the water (Knott 2006), and they can travel up to 328 yards while foraging at night (Izzo and Kothari 2011).

The South Carolina Department of Natural Resources (SCDNR) notes that despite the species' abundance, population estimates have not been developed across a wide geographic area within the state (SCDNR 2005). They have been noted as abundant at Cape Hatteras National Seashore (Henry, pers. comm. 2018). A study of ghost crab density in North Carolina found 1.5 ghost crab burrows per square meter across all sampling areas, indicating that thousands of ghost crab burrows could be present in under one acre of beach habitat (Seyfried 2017).

COASTAL SPECIES OF CONCERN

Sea Turtles

Green Sea Turtle

Green sea turtles in the NPS Southeast Region belong to the North Atlantic distinct population segment (DPS), which is listed as threatened under the ESA, along with seven other DPSs (NOAA Fisheries 2017). The IUCN lists green turtles as "endangered" due to extensive subpopulation declines in all major ocean basins over the last three generations (Seminoff 2004). The green sea turtle is a species of special concern in Georgia.

Both adult and juvenile green turtles occur in waters off the Atlantic and Gulf of Mexico coasts (NMFS and USFWS 2007a). Nesting activity on sandy beaches has been documented in Alabama, Florida, Georgia, South Carolina, and North Carolina. Nesting in the southeast United States takes place mainly from June through September. Females nest at night, and eggs incubate for about 45 to 75 days before hatching. Females will nest an average of five times per season, and remigration intervals range from two to four years (NMFS and USFWS 1991; NOAA Fisheries 2017).

Despite rangewide declines in the overall population size and the number of nesting females, the nesting population in Florida appears to be increasing, based on monitoring data from 1989 to 2006 (NMFS and

USFWS 2007a). While populations have fluctuated greatly from year to year, green sea turtle nest totals at Canaveral National Seashore have shown a general increasing trend, from 662 in 2000 to 7,736 in 2017 (Table 9 in Appendix B). A similar trend has been observed at Cumberland Island National Seashore, where two green sea turtle nesting events were recorded prior to 2008. Recent data from 2009 to 2017 confirm 34 nests from this species, with annual nesting events ranging from 0 to 14 nests (GADNR unpublished data and Hoffman, pers. comm. 2018; Table 12 in Appendix B). Cape Hatteras and Cape Lookout National Seashores have documented 2 to 24 green sea turtle nests in recent years (Table 10 in Appendix B).

In the United States, threats to this species are loss or degradation of nesting habitat, depredation of eggs and hatchlings, entrapment or entrainment in net fisheries, and the disease fibropapillomatosis (NMFS and USFWS 2007a). Recovery criteria are outlined in the green sea turtle recovery plan (see NMFS and USFWS 1991, 2007a), and the species was downlisted from endangered to threatened in 2016. Information on depredation events by predator and park unit in the NPS Southeast Region is detailed in Table 1 of Appendix B.

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle is listed as endangered under the ESA and as "critically endangered" by the IUCN due to steep populations declines after 1945 (Marine Turtle Specialist Group 1996; NMFS and USFWS 2015). It is also listed as endangered in Mississippi and a species of special concern in Georgia.

The Kemp's ridley sea turtle has one of the most restricted distributions of any sea turtle species (Morreale et al. 2007). It is commonly found throughout the entire NPS Southeast Region, but adult turtles are thought to primarily inhabit the Gulf of Mexico, while juveniles and subadults also regularly occur along the eastern seaboard of the United States and Canada.

Nesting occurs almost exclusively on the beaches of the western Gulf of Mexico (NMFS et al. 2010). In the United States, most nesting takes place in Texas (Shaver and Caillouet 2015), but infrequent nesting has been documented in Alabama, Florida, Georgia, South Carolina, and North Carolina (NMFS and USFWS 2015). Kemp's ridley nests have been recorded at Canaveral, Cape Lookout, Cumberland Island, and Cape Hatteras National Seashores in low numbers, with no more than 2 nests observed in a given year at either Canaveral or Cape Hatteras National Seashores (Table 9 and Table 10 in Appendix B; NPS 2011b, 2012c, 2013b, 2016b). The species has also been recorded at Gulf Islands National Seashores, with 26 nests documented since 1998 (Nicholas, pers. comm. 2018). Nesting occurs mainly from April to July, and adult females may nest up to three times per season (NMFS and USFWS 2015). Eggs incubate for approximately 42 to 62 days before hatching. The time between nesting varies but is estimated to be about two years.

Kemp's ridley populations are threatened by the public harvesting eggs from the nest, accidental capture in fishery trawls, loss or degradation of nesting habitat, and sea level rise (NMFS and USFWS 2015). Nest depredation by mammals and ghost crabs poses a serious threat to marine turtle populations at Cape Hatteras National Seashore, where Kemp's ridleys sometimes nest (NPS 2013b, 2016b). In its most recent five-year review (NMFS and USFWS 2015), the USFWS notes that the population is not projected to grow at former rates. Downlisting criteria as detailed in the species recovery plan (USFWS 2011) are unlikely to be attained by 2024, unless survival rates improve (NMFS and USFWS 2015).

Leatherback Sea Turtle

Leatherback turtles are listed as endangered across their range under the ESA and as "vulnerable" by the IUCN due to an overall global population decline (Wallace et al. 2013). They are also listed as endangered in Mississippi and as a species of special concern in Georgia.

In the NPS Southeast Region, leatherback turtles are found in Atlantic and Gulf of Mexico waters, and nesting has been documented on beaches in Florida, Georgia, South Carolina, and North Carolina. This species is known to occur or could occur at all coastal park units in the NPS Southeast Region.

Leatherbacks spend most of their lives at sea in the open ocean but are also found in coastal areas when breeding, nesting, or while foraging on seasonally abundant jellyfish populations (Stewart and Johnson 2006). They nest in the southeast United States at night on sandy beaches, primarily from March through July. Adult females are known to nest 5 to 7 times on average per nesting season, and eggs incubate for 55 to 75 days. Remigration intervals are typically two to three years (NMFS and USFWS 1992).

In Florida, the number of nests has been increasing by an average of 10.2% annually from 1979 through 2008; however, in its most recent five-year review, the USFWS did not recommend delisting or reclassifying the species (NMFS and USFWS 2013). The number of leatherback nests at Canaveral National Seashore increased from 9 to 23 between 2000 and 2017 (Table 9 in Appendix B), but only two leatherback nests were documented at Cape Hatteras National Seashore from 2009 to 2016 (Table 10 in Appendix B). Leatherback sea turtle nesting data for Cumberland Island National Seashore from 1981 to 2008 recorded 5 nesting events. Recent data from 2009 to 2017 confirms 10 nests from this species, with annual nesting events ranging from 0 to 5 nests (GADNR unpublished data; Hoffman, pers. comm. 2018).

Threats to leatherbacks are loss or degradation of nesting habitat and nest depredation. At Canaveral National Seashore, raccoons and ghost crabs are primary nest predators in the area (NPS 2013b). Hatchlings are also subject to depredation, and misorientation can greatly increase their exposure to predators, such as ghost crabs (NMFS and USFWS 1992). "*The Recovery Plan for Leatherback Turtles in the US Caribbean, Atlantic, and Gulf of Mexico"* (NMFS and USFWS 1992) lists predator and predation control as management criteria.

Loggerhead Sea Turtle

The loggerhead sea turtle has received federal protection since 1978, when it was listed as threatened throughout its range under the ESA. Currently, nine DPSs have been identified, based on genetic, physical, or behavioral discreteness, population uniqueness, and conservation status (NMFS and USFWS 1996; USFWS 2017). The Northwest Atlantic DPS, which uses both nesting and oceanic habitat in the NPS Southeast Region, is listed as threatened. Loggerhead sea turtles are also listed as state threatened in South Carolina, as special concern species in Georgia and North Carolina, and as endangered in Mississippi.

The Northwest Atlantic DPS is the largest loggerhead nesting aggregation in the world (Casale and Tucker 2015). Critical habitat for this DPS has been designated in coastal North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi (USFWS 2014a), including several beaches in NPS Southeast Region park units. Nesting typically occurs on sandy beaches at the western rims of the Atlantic (Conant et al. 2009). Nesting season in the southeastern United States is from April to

September, peaking in June and July; eggs incubate for about 45 to 65 days. Loggerheads are known to lay between 1 and 7 nests per season, approximately 14 days apart with a two- to three-year remigration interval.

Despite earlier decreases in nesting populations at sites along the US Atlantic coast (NMFS and USFWS 2007b), there has been an overall 19% increase in nesting from 1989 to 2017 in Florida, which hosts 90% of loggerhead nests in the Northwest Atlantic DPS (Ceriani and Meylan 2015; FWC 2017c). Loggerheads have laid several thousand nests annually at Canaveral National Seashore since 2000, from a low of 2,281 in 2004 to 4,556 in 2017 (Table 9 in Appendix B). Relatively fewer nests (101 to 313) have been documented at Cape Hatteras and Cape Lookout National Seashores (Table 10 in Appendix B). This is likely because these park units lie at the northern limit of the species' breeding range (NPS 2011b, 2017b). Recent nesting data for Cumberland Island National Seashore shows an average of 226 nests per year from 2000 to 2009 and 552 nests per year from 2010 to 2017 (over a two-fold increase); hatch success has been stable for the previous 17 years, impacted only by occasional major storm events (Hoffman, pers. comm. 2018).

In the southeastern United States, threats to loggerhead populations are loss or degradation of nesting habitats, increased human presence, nest depredation, sea level rise, and incidental capture in nets or longline fisheries (NMFS and USFWS 2008). Lighting associated with development has had substantial impacts on hatchling dispersal and may elevate depredation rates due to increased exposure time. From 1996 to 2013, hatching success of loggerheads ranged from 55% to 71% at Canaveral National Seashore, where the main predators are raccoons and ghost crabs (NPS 2013b). In 2001, 635 of 3,110 sample nests on Florida beaches were depredated by raccoons, ghost crabs, armadillos, foxes, domestic dogs, feral swine, and spotted skunks (Witherington et al. 2006). The recovery plan for the Northwest Atlantic population identifies minimizing nest predation as an objective for the recovery of loggerheads (NMFS and USFWS 2008). In its most recent five-year review, the USFWS did not recommend delisting or reclassifying the species (NMFS and USFWS 2007b).

General Depredation Trends on Sea Turtles

Many park units record depredation of sea turtles but do not record the particular sea turtle species owing to the high abundance of nests; for this reason, general trends on sea turtle depredation are detailed here, as well as in Tables 1, 2, and 13 of Appendix B.

At Canaveral National Seashore, nest depredation by raccoons poses a serious threat to marine turtle populations, with depredation rates exceeding 90% in the early 1980s. Placing screens on nests has helped reduce depredation rates substantially, and the annual depredation rate now varies between 5% and 15% (NPS 2013b). However, a large number of sea turtle nests are still depredated each year (Table 13 in Appendix B). At Cape Lookout and Gulf Islands National Seashores, depredation of sea turtle nests by coyotes, raccoons, armadillos, and ghost crabs has been documented in recent years (NPS 2015d, 2016d, 2017b; Nicholas, pers. comm. 2018), while on nesting beaches in Georgia, depredation by raccoons, coyotes, feral swine, armadillos, and foxes was documented from 2009 to 2015 (NPS 2016a). In addition to eggs, sea turtle hatchlings are also depredated on their way from the nest to the water. At Cape Hatteras National Seashore, tracks from mammalian predators, such as feral cats, dogs, raccoons, and mink, were observed at nest sites on mornings following hatching, and depredation by mink, coyote, opossum, and an unknown canine species was documented (NPS 2013c, 2014d, 2016c). Depredation of hatchlings by ghost crabs has been documented in nest cavities and inside ghost crab holes (NPS 2013c,

2014f). Depredation has resulted in high mortality of hatchlings in the Florida District of Gulf Islands National Seashore, where light pollution from surrounding developed areas often causes them to crawl in the wrong direction when leaving nests at night, exposing them to predators (NPS 2014b).

Shorebirds

American Oystercatcher

The American oystercatcher is listed as state threatened in Florida, a special concern species in North Carolina, and a special concern animal species in Georgia.

The American oystercatcher (*Haematopus palliatus*) is a resident and coastal breeder throughout the NPS Southeast Region. American oystercatchers are ground nesters and lay their eggs in a scrape of sand, shell, or gravel (FWC 2016). The estimated global population is 74,000 (Partners in Flight 2017). Along the US East Coast, the population is estimated to be 11,000 birds, with numbers declining in the core mid-Atlantic breeding areas (USFWS 2007a).

The main threats to American oystercatchers are loss of habitat, poor water quality, human disturbance, and depredation of eggs and chicks by coyotes, raccoons, cats, red foxes, mink, gulls, and crows (USFWS 2007a). In North Carolina and Georgia, mammalian depredation was identified as the primary cause of nest failure (AOWG 2012). Additionally, human disturbance may increase predator-related mortality by flushing adults from nests and exposing eggs and nest locations (Sabine et al. 2006).

Nest monitoring in North Carolina indicated that mammalian nest predators were responsible for more than 50% of nest failures in cases where the cause of failure could be identified (USFWS 2007a). Further, monitoring at Cape Lookout National Seashore has found depredation to be the greatest known cause of nest failure, with depredation rates increasing from 21% to 78% in recent years (Table 16 in Appendix B) (NPS 2017c; Altman, pers. comm. 2017). On Cumberland Island National Seashore, at least seven American oystercatcher pairs produced only one hatched chick and no fledglings in 2015. The cause of failure was not documented, but coyote depredation was described as very high (GSA 2015; Table 1 in Appendix B). Use of surveillance cameras on American oystercatcher nests during the 2017 season confirmed 13 nests lost to coyote predation, with an additional nest lost to a raccoon. Cameras were used again in 2018 and confirmed opossums were responsible for the only three oystercatcher nest losses that season (GADNR unpublished data; Hoffman, pers. comm. 2018).

Black Skimmer

The black skimmer is listed as threatened in Florida due to population reduction, likely caused by habitat fragmentation (FWC 2013). It is also a special concern animal species in Georgia. The overall black skimmer population trend is declining, but the decline is not expected to exceed 30% over 10 years, or three generations (BirdLife International 2017a). In Florida, fewer than approximately 2,000 pairs nest at approximately 36 sites. Some regions in Florida have seen a steep decline. For example, there was a 91.6% decline in the northeastern region of the state from the 1970s to 2010 (FWC 2013). In South Carolina, recent breeding numbers are much lower than historical levels; however, from 1988 to 2009, nest counts have generally increased, ranging from 483 in 1988 to 1,450 in 2006 (Snipes and Sanders 2012). There were an estimated 169 nests, 318 eggs, and 26 chicks at Cape Hatteras National Seashore in 2016 (NPS 2016b).

Threats to black skimmers are coastal development, human recreation, beach driving, shoreline hardening, oil spills, and sea level rise. Another threat is predators, such as raccoons, crows, opossums, feral swine, and coyotes, all of which feed on eggs and chicks (FWC 2017d). Predator disturbance is thought to contribute to loss of nests and chicks at Cape Hatteras National Seashore (NPS 2016b). Depredation has been documented at Cape Lookout and Gulf Islands National Seashores (Table 1 in Appendix B).

Common Tern

The common tern is listed as a special concern species in North Carolina and is a USFWS nongame bird species of management concern (Cuthbert et al. 2003).

Common terns are known to nest in North Carolina, South Carolina, Mississippi, and Louisiana, and they are observed during spring and fall migration in Florida, Georgia, and Alabama. The global population is estimated to be 1.6 million to 3.6 million. While the overall population trend is unclear, in North America, the species has declined 26.2% per decade over the past 40 years, based on breeding bird survey and Christmas bird counts (BirdLife International 2016c). Surveys documented an estimated 91 nests, 184 eggs, and 42 chicks at Cape Hatteras National Seashore during the peak 2016 nesting season, whereas over 200 nests were documented in 2012 (NPS 2016b).

Depredation is cited as a potential cause of nest and chick loss at Cape Hatteras National Seashore, where coyotes and mink are perpetual predators (NPS 2016b). Other potential predators of common terns are ghost crabs, raccoons, feral cats, red foxes, gray foxes, and other birds, such as gulls (Table 1 in Appendix B).

Gull-Billed Tern

Gull-billed terns are federally protected by the MBTA. At the state level, gull-billed terns are listed as threatened in Georgia and North Carolina. It is designated as a species of special concern or equivalent in Alabama, Mississippi, and South Carolina. There are two subspecies of gull-billed tern; one that occurs along the western United States and Mexico and the other that occurs along the Atlantic Coast, from New York through Florida, and from Florida through Texas in the Gulf of Mexico. Breeding and nonbreeding birds along the Gulf Coast may be present year-round, while those along the Atlantic Coast are present during the breeding season only.

The current United States eastern population is unlikely to exceed 3,600 pairs. Over 60% of these birds occur in Texas, where numbers appear stable; however, populations in North Carolina, Florida, and possibly Georgia have declined. The number of breeding pairs and colony sites for states with comprehensive statewide censuses ranged from 17 to 2,004 and 3 to 150, respectively, between 2000 and 2004 (Table 17 in Appendix B). There were an estimated 23 nests, 40 eggs, and 3 chicks at Cape Hatteras National Seashore during the peak 2016 nesting season, whereas over 40 nests were documented in 2012 (NPS 2016b).

Main threats to gull-billed tern populations in North America are loss of natural nesting islands through beach erosion or disturbance to estuarine functions, development or modification of upland habitats near breeding areas that may be important for foraging, and disturbances to colonies by humans and feral or human-subsidized predators (NatureServe 2018b). Known predators are raccoons, coyotes, and feral cats (Table 1 in Appendix B).

Least Tern

Mississippi, Florida, Georgia, North Carolina, and South Carolina have classified the least tern as a special status species (threatened, rare, or species of concern). Least terns (*Sternula antillarum*) are the smallest tern and are found mainly along Atlantic and Gulf shorelines, but they can also be found inland near bodies of freshwater. Least terns nest on sandy or gravel substrate and occasionally use gravel rooftops for nesting, where natural habitat is degraded or no longer available (FWC 2016).

The global population of least terns is estimated at 53,000 (Partners in Flight 2017). The Atlantic Coast population is approximately 10,000 pairs (Department of Inland Fisheries and Wildlife 2011), and breeding populations of least terns occur throughout the NPS Southeast Region. Gulf Islands National Seashore has some of the largest breeding populations of least terns. Here, colonies establish and reestablish along the length of the islands. Least terns will nest wherever suitable habitat exists and will relocate when habitat is disturbed. There were an estimated 295 nests, 446 eggs, and 30 chicks at Cape Hatteras National Seashore during the peak nesting season in 2016; the total estimated number of nests was slightly higher in 2016, relative to 2015, but lower than those documented from 2010 to 2014 (NPS 2016b). Fort Matanzas had a documented high of 256 nests in 2010, which plummeted to 0 by 2015 due to depredation and erosion of foredune habitat (Foote, pers. comm. 2018).

Primary threats to least terns are degradation or loss of nesting habitat, increased disturbance of nesting areas, and depredation. Habitat loss, increased human disturbance, and increased depredation also have contributed to an increase in nesting on tar and gravel roofs, rather than on natural beaches (Zambrano and Warraich 2010). One study found depredation accounted for 47% of nest loss over 2 years (Brooks et al. 2013). No least tern chicks were produced at Gulf Islands National Seashore in 2014 following ongoing depredation by coyotes, whereas at least 41 least tern chicks hatched the previous year (NPS 2014c). Depredation continues to be a problem at several NPS Southeast Region park units (Table 1 in Appendix B).

Piping Plover

Piping plovers are federally listed under the ESA; the Atlantic Coast (Newfoundland to North Carolina) population is listed as threatened (ECOS 2017). This species is also listed as endangered by the state of Mississippi and is a species of special concern in Georgia. The IUCN lists piping plovers as "near threatened" due to a small population that has declined significantly since the 1950s; however, there have been population increases since 1991 as a result of intensive conservation management (BirdLife International 2017b). Piping plovers are still dependent on intensive conservation efforts, which if ceased, would warrant immediate uplisting (BirdLife International 2017b).

North Carolina is considered the southernmost nesting area for the Atlantic Coast population, although a few piping plover nests were observed in South Carolina in 1986, 1990, 1991, and 1993 (Hecht and Melvin 2009, in Schweitzer 2017). Overall population size is estimated at approximately 8,000 (BirdLife International 2017b; Partners in Flight 2017), but numbers fluctuate, reflecting the quantity and quality of suitable foraging and roosting habitat (Table 7 in Appendix B).

Piping plovers arrive at breeding grounds between late March and early April, and they nest in May and June (FWC 2017b). Most (77% in 2017) nesting pairs in North Carolina are in the Cape Lookout and Cape Hatteras National Seashores; however, the number of breeding pairs in Cape Lookout National Seashore declined by almost 50% from 2012 to 2017 due to the inability to deploy predator exclosures

at remote nesting sites, increased nest predation, and the presence of coyotes (NPS 2017d; Schweitzer 2017; Altman, pers. comm. 2018).

Disturbance by humans or domestic animals, depredation by feral cats, gulls, crows, raccoons, and foxes, habitat loss, severe storms, and sea level rise are primary threats to piping plover populations (BirdLife International 2017b; NFWF 2015; USFWS 1996, USFWS 2009). Piping plover depredation from coyotes, foxes, raccoons, and from birds, such as crows and gulls, has been documented at Cape Hatteras and Cape Lookout National Seashores (Schweitzer 2017; Table 1 in Appendix B).

Red Knot

Two subspecies of red knot, the rufa red knot and Alaskan red knot, are found in the United States during migration and in the winter. The IUCN lists the red knot as "near threatened", and the rufa red knot is listed as threatened under the ESA due to large population declines over the last decade (BirdLife International 2017c).

The southeastern coast of the United States provides valuable foraging habitat for red knots along their migratory route, particularly during fall and spring (USFWS 2013b). The global population of red knot is estimated at one million (Partners in Flight 2017).

Surveys in South Carolina and Georgia from 1999 to 2002 showed the average southeast wintering population size to be 11,700 (USFWS 2015a). The barrier coast of Georgia, including Cumberland Island National Seashore, supports large numbers of red knots from about mid-July through May; in fall there can be as many as 10,000 birds at one time (Niles et al. 2008). Peak counts and abundance of red knots fluctuate at Cape Lookout National Seashore; in recent years the lowest peak count was 525 in 2009 and the highest peak count was 2,666 in 2014 (Table 8 in Appendix B; NPS 2017e).

Habitat loss and degradation, human interference, and reduced availability of prey are primary threats to this species (BirdLife International 2017c). Common predators of red knot eggs and chicks are great black-backed gulls, other large gulls, and birds of prey. In migration areas, red foxes and feral cats may be a threat to red knots, but direct mortality may be low (USFWS 2015a).

Roseate Tern

The roseate tern (*Sterna dougallii dougallii*) has two protected populations: the endangered northeastern roseate tern, and the threatened Caribbean roseate tern. The northeastern population (Atlantic Coast south to North Carolina) is listed as federally endangered, whereas the Caribbean population (Western Hemisphere and adjacent oceans, including Florida) is listed as federally threatened.

The northeastern roseate tern breeds along the Atlantic Coast and falls outside the NPS Southeastern Region. The Caribbean population recovery review includes mainland Florida, the Florida Keys, Georgia, South Carolina, and North Carolina (even though these areas are not considered Caribbean). The northeastern population has only briefly exceeded 4,000 nesting pairs from 1999 to 2000, and only 3 colonies have consistently supported 200 or more nesting pairs. Data suggest a regionwide reduction in productivity since 2000, with the rangewide northeastern population having declined 25% between 2000 and 2009 (USFWS 2010). Based on the most recent five-year review, the threatened Caribbean roseate tern population consists of approximately 261 pairs in Florida, but the state population has been declining since the 1970s (USFWS 1999a, 2010). Recovery criteria detailed in the *"Roseate Tern* (Sterna dougallii) *recovery plan - Northeastern population"* (USFWS 1998) had not been met for either population

as of 2010 (USFWS 1998, 2010). These criteria specify the number of breeding pairs and colonies needed for delisting. The global population of roseate tern is estimated at 160,000 for both populations (Partners in Flight 2017).

Snowy Plover

The Gulf of Mexico breeding population of snowy plovers is listed as a shorebird of conservation concern, requiring immediate management action (US Shorebird Conservation Plan Partnership 2015).

The snowy plover mainly occupies coastal habitats but can also be found near inland, brackish waters (BirdLife International 2017d). The North American population is estimated to contain between 24,000 and 26,000 mature plovers. Snowy plovers occur in the NPS Southeast Region in Louisiana, Mississippi, Alabama, and Florida.

Snowy plovers are usually solitary nesters, breeding along the Gulf of Mexico coastline between February and August (FWC 2017e). Well-camouflaged nests are laid in small scrapes on sandy or shelly substrate and typically consist of two to four eggs. Over the past few decades, breeding snowy plover populations have declined, largely owing to chronically low reproductive rates, which may be the result of egg and chick depredation, food availability, and natural disturbance. Raccoons, coyotes, ghost crabs, crows, and gulls are notable snowy plover nest predators (Himes et al. 2006). Known predators of plover eggs at Gulf Islands National Seashore are coyotes, ghost crabs, other bird species, and armadillos (Table 1 in Appendix B). Depredation rates at snowy plover nesting sites at Gulf Islands National Seashore are extremely high, with up to 100% depredated in recent years (Table 18 in Appendix B).

Wilson's Plover

Wilson's plovers are listed as state special status species in North Carolina, South Carolina, and Georgia. Wilson's plovers are residents of coastal areas in northern South America and southern North America, Central America, and the Caribbean (BirdLife International 2017e). There are three subspecies of this small plover recognized across its range. *Charadrius wilsonia*, the subspecies in the NPS Southeast Region, is found along sandy beaches, inlets, and sandflats (Florida Shorebird Alliance 2017).

The total US Atlantic population is estimated at 1,000 to 1,100 breeding pairs; the US Gulf Coast population is estimated at 3,000 to 3,200 breeding pairs. Population estimates for states in the NPS Southeast Region are as follows: 245–270 pairs in North Carolina; 375–400 pairs in South Carolina; 355–395 pairs in Georgia; 25–35 pairs in Mississippi; and 475–525 pairs in Florida (Zdravkovic 2013). Christmas bird count data indicate both short- and long-term population declines for the Wilson's plover, including a 78% decline in the wintering population of the continental United States over the past 40 years (Zdravkovic 2013).

Major threats to this species are destruction of breeding habitat by development, human disturbance, and depredation. Wilson's plover depredation has been documented at Gulf Islands National Seashore and Cumberland Island National Seashore, where coyotes, opossums, Atlantic ghost crabs, and yellow rat snakes were confirmed as predators (NPS 2014c; GSA 2015).

Beach Mice

Anastasia Island Beach Mouse

The Anastasia Island beach mouse (*Peromyscus polionotus phasma*) is a federally endangered species that inhabits sand dunes with sea oats and dune panic grass vegetation (USFWS 2005). The species occurs in scattered habitat patches on county land between Anastasia State Park and Fort Matanzas on Anastasia Island, where the population size fluctuates seasonally between 2 and 90 mice per acre. Based on photos taken at two camera traps set up in the dunes of Fort Matanzas, mice numbers ranged from 7 to 4,127 from 2017 to 2018 (Table 14 in Appendix B).

On islands, beach mice have evolved in the absence of predators such as feral cats and foxes; therefore, they lack appropriate predator recognition and avoidance mechanisms, making them highly vulnerable to depredation (Bird et al. 2002). Controlling feral cats has been identified as important to the mouse's survival (USFWS 2005). Populations at Anastasia State Park have benefited following reductions in feral cat populations (USFWS 2015b). Snakes, bobcats, foxes, raccoons, skunks, and owls are also known predators of this species (USFWS 1993). Mammalian predators are likely a threat at Fort Matanzas National Monument (Table 1 in Appendix B). As this park has lost 80 to 400 feet of dune habitat (depending on the location) due to recent hurricanes and other severe storms, mitigation of any further potentially negative impacts, such as depredation, on the Anastasia Island beach mouse population is likely to assist in species recovery (Foote, pers. comm. 2018).

The Anastasia Island beach mouse can be considered for reclassification from endangered to threatened status if five viable, self-sustaining populations can be established (USFWS 1993); however, according to the most recent five-year review, this criterion has not been met (USFWS 2007b). Because most of this subspecies' historical range has been permanently destroyed and habitat continues to decline, it is not likely that it can fully recover or be delisted (USFWS 2007b).

Perdido Key Beach Mouse

The Perdido Key beach mouse is listed as endangered under the ESA. The Perdido Key beach mouse is a small rodent native to the coasts of Alabama and Perdido Key in Florida and is restricted to isolated dune habitat. Designated critical habitat is on Gulf State Park, western Perdido Key, Perdido Key State Park, Gulf Beach, and Gulf Islands National Seashore (USFWS 2014b). Historically, all populations of Perdido Key beach mice on public lands had been extirpated, but at least one viable population has been relocated to restore the extirpated populations.

Populations have increased in recent years; however, the area in the Perdido Key beach mouse historical range continues to be developed, and suitable habitat on private lands is becoming increasingly fragmented. Long-term population trends are difficult to establish, in part due to sporadic and inconsistent tracking and trapping (USFWS 2015b). The most recent five-year review does not provide rangewide population estimates; however, monitoring using track tubes indicates an expanding population trend on public lands, with an increase from 48% to 94% of Perdido Key beach mice found at Gulf Islands National Seashore between 2009 and 2013 (Table 15 in Appendix B).

Downlisting criteria identified in the Perdido Key beach mouse's recovery plan include increasing populations and protecting critical habitat, but these goals have not been met (USFWS 2014a). Threats include habitat loss due to coastal development and storms, as well as depredation from such species as coyote, gray fox, red fox, raccoon, and feral cat (USFWS 2014c). Depredation of beach mice at Gulf

Islands National Seashore is a major concern (Nicholas, pers. comm. 2017). Depredation following Hurricane Opal in 1995 likely extirpated the Perdido Key beach mouse population at Florida Point in Gulf State Park (USFWS 2015b).

Southeastern Beach Mouse

The southeastern beach mouse, a subspecies of the oldfield mouse, is listed as threatened under the ESA (USFWS 2008). Historically, the southeastern beach mouse occupied coastal beaches and dunes in Florida, from Volusia County south to Broward County; however, recent data indicate that the subspecies is restricted to Volusia County, Brevard County, and possibly isolated locations in Indian River and St. Lucie Counties. There is no critical habitat designated for the southeastern beach mouse (USFWS 2008).

The rangewide population is estimated at approximately 5,000 to 6,000. Despite a severely limited and fragmented distribution in south Florida, healthy southeastern beach mouse populations are still found on Canaveral National Seashore (USFWS 1999b). Recent surveys reveal that this species occurs in very small numbers where it is found. A 2003-2004 survey on Canaveral National Seashore indicated a relatively stable population trend since the 1991-1992 survey. As of 2008 (the year of the most recent five-year USFWS species review), Smyrna Dunes Park, Merritt Island National Wildlife Refuge/Kennedy Space Center, and Cape Canaveral Air Force Station contained viable populations of southeastern beach mice, with an effective breeding size of at least 500 and stable population trends (USFWS 2008).

In addition to habitat, southeastern beach mice are vulnerable to depredation. Feral cats presumably extirpated a healthy population in Brevard County, Florida, by 1972 (USFWS 2015b). Predation from feral cats and competition from house mice may be restricting the distribution of southeastern beach mice at the north end of Canaveral National Seashore. Other known and probable predators are armadillo, gray fox, coyote, and raccoon. The southeastern beach mouse can be considered for delisting if viable, self-sustaining populations can be established throughout a substantial portion of its historical range; however, recovery criteria had not been met as of 2008 (USFWS 2008).

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4. ENVIRONMENTAL CONSEQUENCES

The analysis of environmental effects of the no-action alternative and proposed action described in this PEA focuses on the issues identified in Chapter 1. It is based on the expected changes that each alternative would have on the existing conditions of the resources described in Chapter 3. The analysis evaluates the types of predators and coastal species of concern that could be affected by proposed actions, including the impacts of a full array of potential predation management actions that could be implemented for each alternative; how or why these species may be affected; and the BMPs or other measures that would be implemented to mitigate impacts.

Consistent with guidance from the Council on Environmental Quality (CEQ) and due to the programmatic nature of the actions proposed in the PEA across a large analysis area—coastal environments in the NPS Southeast Region (see Figure 1)—the impact analysis on species' populations and habitats is correspondingly broad. For this reason, a qualitative analysis is used to describe the degree to which wildlife habitat and populations (including both predators and coastal species of concern) would be affected by a given management tool. Qualitative descriptions of impacts are based on professional judgment, information provided by NPS staff, relevant references, and technical literature. Where possible, a range of quantitative measures is given, such as numbers of predators removed and amount of take from available state hunting data. Consistent with CEQ guidance, prior to taking action, park units would complete additional site-specific NEPA reviews that tier from this programmatic analysis.

CUMULATIVE IMPACTS SCENARIO

Past, present, and reasonably foreseeable actions that contribute to cumulative impacts on predator species or coastal species of concern were identified during internal and external scoping. These include actions taken by other entities in the NPS Southeast Region or actions taken at or near the park units in coastal environments that are unrelated to NPS depredation management tools and methods. In all cases, these other actions have impacts on the same resources or values as the alternatives evaluated in this plan, potentially resulting in a cumulative impact.

State Hunting and Trapping

Each state has primary responsibility and authority over hunting and trapping wildlife within its boundaries. This includes defining the species and number that can be hunted or trapped by individuals, hunting seasons, areas open and closed on state lands, harvest limits, and permit issuance.

In the NPS Southeast Region, several of these hunted species are the predators discussed in this PEA: coyote (North Carolina, Florida, Georgia, Mississippi); feral swine (Florida, Georgia, Mississippi, South Carolina); gray fox (North Carolina, Florida, Mississippi, South Carolina); mink (North Carolina, Georgia, Mississippi); raccoon (North Carolina, Florida, Georgia, Mississippi, South Carolina); red fox (North Carolina, Florida, Mississippi, South Carolina); American crow (North Carolina, South Carolina, Mississippi, Florida, and Georgia); opossum (North Carolina, Mississippi, South Carolina); and armadillo (Florida, Georgia). Hunting and trapping by individuals is managed by the respective state or territory wildlife agency, as follows: the GADNR; the North Carolina Wildlife Resources Commission (NCWRC); the Florida FWC; the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP);

the SCDNR; Puerto Rico Department of Natural and Environmental Resources; and US Virgin Islands Department of Planning and Natural Resources.

States may change the allowable limits or begin programs for hunting or trapping on lands next to park units. In addition, hunting is allowed in some NPS units as specified in their enabling legislation. For example, several public hunts are held on Cumberland Island National Seashore during Georgia's hunting season. Park staff work closely with state governments regarding hunting to manage and conserve wildlife species.

Animal and Plant Health Inspection Service—Wildlife Services

The mission of the USDA APHIS Wildlife Services program is to provide professional assistance for resolving wildlife conflicts to allow people and wildlife to coexist. Wildlife Services manages conflicts involving agriculture, human health and safety, property, and natural resources. To accomplish this goal, Wildlife Services works with Federal agencies, state and local governments, tribes, universities, organizations, the public, and other stakeholders. Several park units in the NPS Southeast Region have utilized Wildlife Services via interagency agreements to manage predation affecting coastal species of concern as well as general nonnative (feral swine) species population reduction.

Wildlife Services consists of specialized wildlife control personnel with extensive experience, equipment, and technology to address a multitude of species and issues throughout the United States. From 2000 to 2002, and again from 2010 to 2012, Wildlife Services assisted Cumberland Island National Seashore with achieving and maintaining significant reduction in levels of predation to loggerhead sea turtle nests by feral swine and raccoons (Hoffman, pers. comm. 2018). In 2012, Wildlife Services implemented programs in Florida to protect 41 threatened and 13 endangered species, including 4 sea turtle species. Owing to dramatic increases in feral swine populations in Florida over recent decades, damage to sensitive wetlands, croplands, and threatened and endangered species has increased substantially (USDA APHIS 2015). Between 2002 and 2012, Wildlife Services addressed this invasion by establishing a cooperatively funded program to trap and remove feral swine from multiple counties, state parks, and military bases in Florida. A recent priority on the national level is controlling feral swine. In 2014, USDA created the APHIS National Feral Swine Damage Management Program. Its purpose is to protect agricultural, natural resources, property, animal health, and human health and safety by managing damage caused by feral swine in the United States and its territories. Implementation of this program has provided additional resources to cooperators (including NPS) across the country who are managing feral swine populations.

ISSUE 1: IMPACTS ON PREDATOR SPECIES

Alternative A: No-Action Alternative

Under the no-action alternative, any of the nonlethal and lethal management tools and methods described in Chapter 2 would continue to be used on a case-by-case basis, depending on park-specific needs.

Nonlethal Management Tools and Methods Analysis for All Predator Species

Proposed nonlethal management tools and methods such as fencing single nests or colonies, installing screens or cages on sea turtles nests, installing perch deterrents, using effigies, using taste aversion, disruptive harassment, or installing chick shelters would not impact the population size of predator species because these tools and methods are not intended to remove a predator species from park

units but rather deter these species from depredating individual coastal species of concern and their nests, eggs, and hatchlings. None of these tools or methods would be implemented with the intent of removing a predator species from the area (with the exception of feral cats); therefore, the implementation of these tools and methods is not expected to impact the population size of predator species either locally or regionally.

Fencing or screening may impact the ability of predator species to access localized habitats to find food. Fencing of single shorebird nests or screening single nests of sea turtle coastal species of concern would exclude approximately 16 square feet of habitat for sea turtle protection and up to 50 square feet for individual shorebird nest protection and would only be in place during nesting seasons (February to August for shorebirds, and May to October for sea turtles). Fencing a shorebird colony may exclude up to 2 acres of habitat and remain in place from February to August. However, all mammalian predator species considered in this PEA have home ranges extending between tens to thousands of acres (e.g., up to 49 acres for armadillos; over 6,000 acres for coyotes and raccoons). Fencing or screening exclosures represent an average reduction in potential local habitat of less than 4% for armadillos, which have the smallest home range (see Chapter 3) and less than 1% for species with large home ranges, like coyotes, raccoons, and feral swine. Due to large home ranges and the ability to adapt to a range of habitats and food sources (Schrecengost et al. 2009; Hickman et al. 2015; Ogan and Jurek 1997; Horn et al. 2011; Gaston 2008; NCWRC 2009; Sullivan 1996; Roundtree 2004; Lariviere 1996; Tesky 1995; Lotze and Anderson 1979; Marzluff et al. 2001; GDNR 2006; Siciliano 2013; GDNR 2005; South Carolina Species Information 2017; Loughry and McDonough 1998; Layne and Glover 1977; Gammons 2006), fencing, screening, and exclosures are not expected to impact predator species access to habitat in a meaningful way.

The nonlethal capture and relocation of feral cats would be intended to reduce the park unit population size of this species. Feral cats would be captured using a nonlethal walk-in cage trap. These cage traps may cause stress to the animal, but this would be temporary, lasting less than 24 hours before the animal could be transported to a local shelter. In Florida alone, there are an estimated 2.8 million feral cats, and the Florida FWC suggests there may be a constant stream of new cats that can arrive into an area (FWC 2003). One study found feral cat populations would not decline unless a population reduction of greater than 50% was reached and sustained (Kanine and Mengak 2014). While local individuals may be captured and relocated to shelters, this is not expected to impact regionwide populations. Of note, this species is feral and not considered native to park units in the Southeast Region. Per NPS Management Policies, all exotic or nonnative species that are not maintained to meet an identified park purpose will be managed, up to and including eradication from the park unit (NPS Management Policies 4.4.4.2).

Lethal Management Tools and Methods Analysis for All Predator Species

Lethal control tools and methods would have direct impacts on individual predators and local predator populations from stress and direct mortality. The number of predators that would be selectively removed each season would be based on monitoring and local expert knowledge by park staff for their respective park units. Precise numbers of predators that would be removed through lethal means would vary depending on the park unit, the severity of depredation, local predator populations, type of predators present, and ability of park units to carry out lethal control methods. For analysis purposes, the no-action alternative assumes that park units currently removing predators lethally on a consistent and annual basis (four park units) would continue. In addition to the numbers of predators expected to

be removed, discussed below under predator species-specific headings, additional park units could find it necessary to remove predators on a case-by-case basis and would complete appropriate NEPA reviews specific to those removals in the future, as necessary.

To be most humane, park units would continue to use the AFWA adopted standard international BMPs to evaluate traps, based on animal welfare, efficiency, selectivity, practicality, and safety (AFWA 2006; White 2015). BMPs were developed considering regional and species-specific conditions. For example, modifying foothold traps, with such techniques as lamination and padding (AFWA 2006), would help minimize injury to coyotes and foxes due to use of foothold traps. In addition, offset jaws may be used on traps to reduce clamping pressure to improve animal welfare while in the trap. Lastly, traps would be placed in sheltered areas with enough natural cover to protect animals from adverse weather conditions and to reduce stress levels.

Impacts on Coyote

Foothold traps or snares would continue to be used, and are intended to capture a coyote around the foot or neck and hold the coyote in place until NPS staff can access the animal. The coyote would be held in the device for less than 24 hours. BMPs listed in Chapter 2, and described above, are intended to reduce stress and injury to the animal once held in the trap. Once NPS staff reach the coyote, staff would dispatch the coyote by firearm or euthanasia. NPS staff may also lethally remove coyotes opportunistically through ground shooting.

Lethal management of coyotes would continue at four park units, and it is assumed that an estimated 12 coyotes at each park unit would continue to be removed annually. This would result in approximately 48 coyotes being removed annually across the NPS Southeast Region. Available state hunter or trapper harvest data (see Chapter 3) show annual harvests of coyotes in coastal NPS Southeast Region states can reach a total of over 68,000 individuals. Removal of 48 coyotes by NPS lethal methods would represent less than 1% of the annual harvested population. For park units on barrier islands not connected to the mainland via bridges, the annual removal of an estimated 12 coyotes could result in slightly greater impacts locally, as these populations are considered isolated from the mainland and new coyotes could not easily replace the removed individuals; coyotes are thought to reach unconnected barrier islands by swimming (NCWRC 2018a).

Impacts on Feral Swine

A box, cage, or corral trap would be used to capture feral swine. Once a door is triggered and one or multiple swine are inside the trap, feral swine may experience stress. Feral swine would be dispatched via firearm within 24 hours of being held within the pen or corral trap.

Lethal management of feral swine would continue at four park units, and it is assumed that 100 feral swine at each park unit would continue to be removed annually. This would result in approximately 400 feral swine being removed annually across the NPS Southeast Region. Harvest data (see Chapter 3) show annual harvests in coastal NPS Southeast Region states can reach a total of over 375,000 individuals. Removal of 400 feral swine by NPS lethal methods would represent less than 1% of the annual harvested population.

Impacts on Armadillo, Red and Gray Fox, Mink, Opossum, and Raccoon

Walk-in cage traps would continue to be used to lethally remove armadillos, foxes, mink, opossums, and raccoons. While the walk-in cage trap does not touch or restrain the animal, the animal may

become stressed in the trap. A walk-in cage trap may also be designed as a euthanasia chamber, using carbon-dioxide-induced narcosis to euthanize the species within 30 minutes (see Chapter 2). Other lethal management tools, such as foothold traps, dog-proof traps, or snares, would be used on species listed in Table 3 and would have similar impacts as described under *Impacts on Coyote*, causing short-term stress in traps and direct mortality through humane dispatch methods.

Removal estimates were developed based on data submitted by four park units. For armadillos, it is assumed that an estimated 6 armadillos at four park units would continue to be removed annually. This would result in approximately 24 armadillos being removed annually across the NPS Southeast Region. While population and harvest data are not available for this species, the IUCN Red List conservation status for armadillos is "least concern" due to their widespread and stable populations and continuing expansion (see Chapter 3). As such, it is anticipated that removal of 24 armadillos by NPS lethal methods would represent a small fraction of the regionwide population.

It is assumed that an estimated 4 foxes (gray and red) would continue to be removed each year at four park units. This would result in approximately 16 animals removed each year across the Southeast region. Harvest data (see Chapter 3) show annual harvests of foxes in coastal NPS Southeast Region states can reach a total of over 17,000 individuals. Removal of 16 foxes by NPS lethal methods would represent less than 1% of the annual harvested population. Impacts on foxes in island park units would be as described for coyotes.

It is assumed that an estimated 8 mink would continue to be removed annually at four park units. This would result in approximately 32 mink being removed annually across the NPS Southeast Region. Harvest data (see Chapter 3) show annual harvests of mink in coastal NPS Southeast Region states can reach a total of over 800 individuals. Removal of 32 mink by NPS lethal methods would represent less than 4% of the annual harvested population.

It is assumed that an estimated 67 opossums at each park unit would continue to be removed at four park units, resulting in approximately 268 opossums being removed annually across the NPS Southeast Region. Harvest data (see Chapter 3) show annual harvests of opossums in coastal NPS Southeast Region states can reach a total of 33,405 individuals. Removal of 268 opossums by NPS lethal methods would represent less than 1% of the annual harvested population.

It is assumed that an estimated 70 raccoons at four park units would continue to be removed, resulting in approximately 280 raccoons being removed annually across the NPS Southeast Region. Harvest data (see Chapter 3) show annual harvests of raccoons in coastal NPS Southeast Region states can reach a total of nearly 150,000 individuals. Removal of 280 raccoons by NPS lethal methods would represent less than 1% of the annual harvested population.

Impacts on Avian and Other Non-mammalian Predators

No lethal management tools or methods would be used for avian predators or Atlantic ghost crab under the no-action alternative.

Cumulative Impacts

Actions outside the park units covered in this PEA and in surrounding regions that would affect predators are state hunting and trapping and APHIS management. State hunting and trapping would contribute to the most take of predator species, indicating an adverse impact on populations at the

regional/state level subject to hunting; however, in the United States, wildlife is managed to ensure the long-term sustainability of populations. Permit numbers are typically driven by species population levels and are adjusted yearly, based on annual changes to ensure that harvest numbers are sustainable.

State harvest numbers for most of the predator species considered in this PEA are large, ranging from hundreds to hundreds of thousands of individuals (see Tables 3 through 6, in Appendix B), indicating that state wildlife agencies do not consider take by hunting to be suppressing population numbers of predators; therefore, hunting would not contribute to substantial population declines for most species. Harvest of some species, such as coyotes and feral swine, is even encouraged to reduce the spread of already abundant populations, though bounty and harvest incentive programs have proven ineffective in achieving declines in predator populations (NCWRC 2018a).

APHIS management would continue to allow for and increase lethal predation management of several predator species covered in this PEA. APHIS programs, such as feral swine control, are intended to conserve and manage wildlife resources, while alleviating damage or other problems caused by wildlife (USDA APHIS 2015). Such actions would have a slight adverse impact on predator species by causing direct mortality and potentially contributing to local population declines in areas where they are damaging public and environmental resources.

Use of nonlethal and lethal management tools and methods under the no-action alternative could contribute adverse incremental impacts to the overall cumulative impacts, within specific park units that employ those tools and methods consistently. However, many park units would not consistently use these tools and methods under the no-action alternative, and therefore, the no-action alternative overall would contribute only a small incremental adverse impact to the overall cumulative impacts on predator species across the NPS Southeast Region. This is evidenced by the small percentage of take at the park unit and regional level relative to statewide and regional harvest numbers, as discussed for individual predator species in the analysis above, as well as by the continual expansion and abundance of most of these species.

Discussion

The nonlethal tools and methods discussed in Chapter 2 would prevent predator species from accessing individual coastal species of concern and their nests, eggs, and hatchlings. This is not expected to impact the ability of predator species to locate food sources, as most of these coastal species of concern are found in extremely limited numbers (as described in Chapter 3) and do not contribute substantially to the diet of predator species. Additionally, all predator species analyzed in this plan are opportunistic omnivores or carnivores adapting to different prey based on availability and having large home ranges to find food elsewhere (Schrecengost et al. 2009; Hickman et al. 2015; Ogan and Jurek 1997; Horn et al. 2011; Gaston 2008; NCWRC 2009; Sullivan 1996; Roundtree 2004; Lariviere 1996; Tesky 1995; Lotze and Anderson 1979; Marzluff et al. 2001; GDNR 2006; Siciliano 2013; GDNR 2005; South Carolina Species Information 2017; Loughry and McDonough 1998; Layne and Glover 1977; Gammons 2006). The use of exclusion fencing or screening ranging from 16 square feet to 2 acres would have little to no impact on these species, as they would result in an average reduction in potential local habitat of less than 4% for armadillos, which have the smallest home range (see Chapter 3) and less than 1% for species with very large home ranges, like coyotes, raccoons, and feral swine.

The estimated annual lethal removal of each predator species by NPS park units in the NPS Southeast Region is presented in Table 4 and is based on data submitted by park units. The data presented in Table 4 show that if every park unit currently using lethal control consistently on an annual basis were to take the estimated number of each predator, it would represent a small fraction of the annual state harvested population.

Table 4.
Estimated Lethal Control of Predators under Alternative A

Species	Estimated Number Removed at Each Park Unit	Number of Park Units	Total Estimated NPS Lethal Removal Numbers	Total Annual Regionwide Hunter and Trapper Harvest Data	NPS Removal Compared with State Harvest (%)
Coyote	12	4	48	68,000 individuals over three states[1]	Less than 1%
Feral swine	100	4	400	375,000 individuals over four states[2]	Less than 1%
Armadillo	6	4	24	N/A	N/A
Red and gray fox	4	4	16	17,000 individuals over four states[3]	Less than 1%
Mink	8	4	32	800 individuals over three states[4]	Less than 4%
Opossum	67	4	268	33,405 individuals over three states[5]	Less than 1%
Raccoon	70	4	280	150,000 individuals over four states[6]	Less than 1%
Corvid	0	N/A	N/A	N/A	N/A
Great black-backed gull	0	N/A	N/A	N/A	N/A
Ghost crab	0	N/A	N/A	N/A	N/A

Sources: NPS team input
[1] MDWFP 2018; Killmaster, pers. comm. 2017; NCWRC 2012
[2] Bryant 2016; FWC 2018; NCWRC 2018b; Killmaster, pers. comm. 2017; SCDNR 2010
[3] MDWFP 2017; NCWRC 2012, 2018b; Bryant 2016; Waters 2015
[4] MDWFP 2017; Waters 2015; NCWRC 2018c
[5] MDWFP 2018; GADNR 2006
[6] MDWFP 2017; NCWRC 2018b; Bryant 2016; Waters 2015

Lethal management of predators under the no-action alternative would affect local populations by temporarily reducing the population; however, research has shown that these predators typically reinvade quickly after removal unless large proportions of the population are removed. For instance, a population model by Pitt et al. (2001) assessed the impact of removing a set proportion of a coyote population for one year and then allowing the population to recover. In the model, all populations recovered within one year when less than 60% of the population was removed. Recovery occurred within five years when 60% to 90% of the population was removed (Pitt et al. 2001 in NCWRC 2018a). These findings are consistent with an earlier model developed by Connolly and Longhurst (1975) and revisited by Connolly (1995), which indicated that coyote populations could withstand an annual removal of up to 70% of their numbers and still maintain a viable population (Connolly 1995). Similarly,

research suggests that removal of 70% of feral swine populations would result in the maintenance of stable population sizes (Centner and Shuman 2014). Of note, this species is feral and not considered native to park units in the Southeast Region. Per NPS Management Policies, all exotic or nonnative species that are not maintained to meet an identified park purpose will be managed, up to and including eradication from the park unit (NPS Management Policies 4.4.4.2).

This trend appears to apply to smaller mammalian predators as well. One lethal control study showed that even when a local armadillo population was eliminated, total numbers of armadillos remained stable over three years through transient armadillos occupying vacant habitats (McDonough et al. 2007). At Canaveral National Seashore, lethal removal of 215 raccoons (about 50% of the local population) did not impact the local population (Ratnaswamy et al. 1997) because raccoons from nearby areas reinvaded quickly. As a result, it is expected that the lethal management of predators under the no-action alternative would not affect predator populations beyond a local scale and short-term timeframe.

For park units on barrier islands not connected to the mainland via bridges, the annual removal of the estimated species discussed above could result in slightly longer-lasting impacts locally as these populations are considered isolated from the mainland and new predators could not easily replace the removed individuals; predators are thought to reach unconnected barrier islands by swimming (NCWRC 2018a).

Overall, each park unit would continue to use existing tools and methods to control predator species on a case-by-case basis. Some park units would use a sporadic or reactive approach to control predators with a limited suite of tools and methods, while others have a more comprehensive and proactive approach to predation management. Such strategies would periodically reduce localized predator populations but are not expected to reduce regional predator populations or habitat use and availability. Of note, all the predator species covered in this analysis with an IUCN status are species of "least concern" (see Chapter 3), indicating they are at lowest risk of extinction and are considered widespread and abundant. Predator management actions under the no-action alternative would not have meaningful effects on predator populations, as evidenced above. Furthermore, in the event the NPS were to observe any meaningful decreases in predator populations, cessation of lethal management activities would allow predator populations to recover within a few years, at most.

Alternative B: Proposed Action

Nonlethal Management Tools and Methods Analysis for All Predator Species

Under the proposed action, most of the nonlethal tools and methods described in Chapter 2 would be available to park units regionwide. Impacts would be similar to those described under *Alternative A, Nonlethal Management Tools and Methods Analysis for All Predator Species.* Effigies, conditioned taste aversion, biological odor repellents, disruptive harassment and frightening devices would not be used. The elimination of these tools and methods from the proposed action may slightly decrease impacts on predator species compared to the no-action alternative. While effigies, frightening devices, and biological odor repellants temporarily cause predator species to avoid small areas, rapid habituation is likely; therefore, elimination of this tool would not change the way predator species are impacted under the proposed action. The elimination of conditioned taste aversion and disruptive harassment may have small beneficial impacts on localized predator species through a decrease in stress and disruption of use of habitat. Compared to the no-action alternative, impacts would be imperceptible.

Lethal Management Tools and Methods Analysis for All Predators Species

Under the proposed action, impacts of lethal management tools and methods would be similar to those described under the no-action alternative. The number of predators removed using lethal methods would be greater than the no-action alternative but would still be a small proportion compared to the total estimated regional populations or state harvest levels. As park units tier to this PEA, the number of park units conducting lethal removal is expected to increase from current conditions and the no-action alternative, thereby increasing the total number of predators removed at a regional level. The analysis below assumes that when these tools and methods are available to all park units in the NPS Southeast Region, an estimated 10 parks may implement lethal removal.

Impacts on Coyote

Approximately 12 coyotes at 10 park units could be removed annually, resulting in approximately 120 coyotes being removed annually across the NPS Southeast Region. Removal of 120 coyotes would represent less than 1% of the annual harvested population in coastal NPS Southeast Region states.

Impacts on Feral Swine

Approximately 100 feral swine at 10 park units could be removed annually, resulting in approximately 1,000 feral swine being removed annually across the NPS Southeast Region. Removal of 1,000 feral swine would represent less than 1% of the annual harvested population in coastal NPS Southeast Region states.

Impacts on Armadillo, Red and Gray Fox, Mink, Opossum, and Raccoon

Approximately 6 armadillos at 10 park units could be removed annually, resulting in approximately 60 armadillos being removed annually across the NPS Southeast Region. While population and harvest data are not available for this species, the IUCN Red List conservation status for armadillos is "least concern" due to their widespread and stable populations and continuing expansion (see Chapter 3). As such, it is anticipated that removal of 60 armadillos would represent a small fraction of the regionwide population in the states in which the park units that would be conducting removal are located.

Approximately 4 foxes could be removed annually at 10 park units, resulting in approximately 40 foxes being removed each year across the NPS Southeast Region. Removal of 40 foxes would represent less than 1% of the annual harvested population in coastal NPS Southeast Region states.

Approximately 8 mink could be removed annually at 10 park units, resulting in the removal of 80 mink annually across the NPS Southeast Region. Removal of 80 mink would represent 10% of the annual harvested population in coastal NPS Southeast Region states. Of note, the IUCN Red List conservation status for mink is "least concern" because it has a wide distribution and is relatively common across its range (see Chapter 3). As such, it is anticipated that removal of 80 mink by NPS lethal methods would represent a small fraction of the regionwide population. In the event the NPS were to observe any meaningful decreases in local mink populations, cessation of lethal management activities would allow predator populations to recover within a few years, at most.

Approximately 67 opossums could be removed annually at 10 park units, resulting in approximately 670 opossums being removed annually across the NPS Southeast Region. Removal of 670 opossums would represent 2% of the annual harvested population in coastal NPS Southeast Region states.

Approximately 70 raccoons at 10 park units could be removed annually, resulting in approximately 700 raccoons being removed annually across the NPS Southeast Region. Removal of 700 raccoons by NPS lethal methods would represent less than 1% of the annual harvested population in coastal NPS Southeast Region states.

Impacts on Avian and Other Non-mammalian Predators
No lethal management tools and methods would be used for great black-backed gulls under the proposed action.

Management under the proposed action would adversely impact corvids (i.e., American crow or fish crow) through the use of the toxicant DRC-1339. After ingesting the toxicant, the corvid would get sick and die within 12 to 72 hours, likely experiencing stress in that timeframe (see Chapter 2). Based on data submitted by park units, it is assumed that approximately 20 corvids at 10 park units could be removed annually, resulting in approximately 200 corvids being removed annually across the NPS Southeast Region. Based on population estimates from 2016 to 2017, 9,461 American crows were observed in Florida, Georgia, Mississippi, and North Carolina. Removal of 200 corvids annually would represent 2% of the estimated crow population in these states.

The proposed action would include tools and methods, such as Fripp traps and manual removal, to manage ghost crab depredation. It is assumed that approximately 20 ghost crabs at 10 park units could be removed annually, resulting in approximately 200 ghost crabs being removed annually across the NPS Southeast Region. While regionwide population data are not available for this species, the species is thought to be abundant (SCDNR 2005; Henry, pers. comm. 2018). A study of ghost crab density in North Carolina found 1.5 ghost crab burrows per square meter across all sampling areas, indicating thousands of ghost crab burrows could be present in under one acre of beach habitat (Seyfried 2017). Research suggests that ghost crab density in North Carolina could be 7.7 times higher than densities found in Florida (Fraser, pers. comm. 2018). Based on this assumption, even in areas with lower ghost crab densities than North Carolina, hundreds of ghost crab burrows are likely to exist in one acre of beach habitat, depending on the location. As such, the removal of 200 ghost crabs across the region by NPS lethal methods would represent a small fraction of the regionwide population.

Due to issues related to shorebird protection, Cape Hatteras National Seashore has indicated a need to potentially remove much larger numbers of ghost crabs annually. Based on an assumption of an average density of 320 ghost crab burrows within a 40-foot radius (or roughly 5,026 square feet) around approximately 17.6 shorebird nests, Cape Hatteras National Seashore could remove up to approximately 5,600 ghost crabs annually (Fraser pers. comm. 2018). Assuming 67 miles of beach at a width of 33 meters (roughly 38 million square feet) at Cape Hatteras National Seashore, there are likely more than a million, and closer to two million ghost crabs within the Seashore. Removal of 5,600 annually would represent less than 1 percent of the population within the park unit. Cape Hatteras National Seashore would assess the impacts of any removal effort in park-specific tiered NEPA reviews and regularly reevaluate ghost crab control actions, as appropriate.

Cumulative Impacts

Cumulative impacts from state hunting and trapping and APHIS management would be similar to those described under the no-action alternative. Under the proposed action, management tools and methods would be available to park units to manage ghost crabs and avian predators through use of a toxicant.

Currently there are no hunting seasons for ghost crabs, and programs for this species' removal are not conducted by APHIS. Crows are hunted in most NPS Southeast Region states. State harvest numbers for crows considered in this PEA are unknown, but most states have no limit on the amount of take of this species, indicating that state wildlife agencies do not consider take by hunting to be suppressing population numbers of crows; therefore, hunting would not be likely to contribute to meaningful population declines for this species. Harvest of crows in some states is encouraged to reduce the spread of already abundant populations.

Consistent use of nonlethal and lethal management tools and methods under the proposed action could contribute meaningful adverse incremental impacts to the overall cumulative impacts, within specific park units implementing these tools and methods. At the state or regional level, the proposed action is not expected to contribute to cumulative impacts in a meaningful way. Despite an increased number of park units that could lethally remove predators under the proposed action, lethal removal by the NPS would represent a small proportion of the annual harvested population for these species. As a result, while local populations of some species would be reduced under the proposed action, it is unlikely that these impacts would result in any meaningful incremental change to the overall cumulative impacts.

Discussion

Impacts from the use of nonlethal tools and methods under the proposed action would have similar impacts as described for the no-action alternative. Nonlethal tools and methods available under the proposed action would prevent predator species from accessing individual coastal species of concern and their nests, eggs, and hatchlings. This is not expected to impact the ability of predator species to locate food sources, as most coastal species of concern are found in extremely limited numbers (as described in Chapter 3) and most do not contribute substantially to the diet of predator species.

The estimated annual lethal removal of each predator species by NPS park units in the NPS Southeast Region is presented in Table 5. The data presented in Table 5 show that if 10 park units in the region were to implement lethal control tools and methods and were to take the estimated number of each predator, it would represent a small fraction of the annual state harvested population.

Impacts from lethal management of predators under the proposed action would have similar impacts as described for the no-action alternative. However, there would be increases in the levels of take, as described above. Despite the increase in numbers of lethal take, total numbers of predators that would be removed by NPS management would represent only a small proportion of the overall harvest in the states in which the park units that would be conducting removal are located. Regionwide population numbers of predators would not be meaningfully affected.

For park units on barrier islands not connected to the mainland via bridges, the annual removal of the estimated species discussed above could result in slightly longer-lasting impacts locally, and greater impacts compared to the no-action alternative, as these populations are considered isolated from the mainland and new predators could not easily replace the removed individuals; predators are thought to reach unconnected barrier islands by swimming (NCWRC 2018a).

Consistent monitoring and reporting of the number and type of predators removed through the Monitoring Program described in Chapter 2 would help ensure that the number of predators removed is at a level that would not impact regional populations. In addition, the monitoring program could be

Table 5.
Estimated Lethal Control of Predators under Alternative B

Species	Estimated Number Removed at Each Park Unit	Number of Park Units	Total Estimated NPS Lethal Removal Numbers Regionwide	Total Annual Regionwide Hunter and Trapper Harvest Data or Population Estimate	NPS Removal Compared with State Harvest or Population (%)
Coyote	12	10	120	68,000 individuals over three states[1]	Less than 1%
Feral swine	100	10	1,000	375,000 individuals over four states[2]	Less than 1%
Armadillo	6	10	60	N/A	N/A
Red and gray fox	4	10	40	17,000 individuals over four states[3]	Less than 1%
Mink	8	10	80	800 individuals over three states[4]	10%
Opossum	67	10	670	33,405 individuals over three states[5]	2%
Raccoon	70	10	700	150,000 individuals over four states[6]	Less than 1%
Corvid	20	10	200	9,461 American crow (estimated population) [7]	2%
Great black-backed gulls	0	N/A	N/A	N/A	N/A
Ghost crab	20 (5,600 at Cape Hatteras)	10	5,800[8]	N/A	N/A

[1] MDWFP 2018; Killmaster, pers. comm. 2017; NCWRC 2012
[2] Bryant 2016; FWC 2018; NCWRC 2018b; Killmaster, pers. comm. 2017; SCDNR 2010
[3] MDWFP 2017; NCWRC 2012, 2018b; Bryant 2016; Waters 2015
[4] MDWFP 2017; Waters 2015
[5] MDWFP 2018; GADNR 2006
[6] MDWFP 2017; NCWRC 2018b; Bryant 2016; Waters 2015
[7] Pardieck et al. 2018
[8] 5,600 ghost crabs removed at Cape Hatteras National Seashore plus 200 ghost crabs removed from other park units

used to facilitate information sharing between park units and improve the management of predators as new techniques are developed and refined.

Overall, the proposed action could streamline the approach for predation management by providing consistent NEPA compliance across the region, resulting in a timelier and more efficient implementation of the nonlethal and lethal tools and methods. This could result in an increase in the number of predator species removed at the local level but is not expected to impact the population viability or habitat use by predators regionwide. Of note, all the predator species covered in this analysis with an IUCN status are

species of "least concern" (see Chapter 3), indicating they are at lowest risk of extinction and considered widespread and abundant.

ISSUE 2: IMPACTS ON COASTAL SPECIES OF CONCERN

Alternative A: No-Action Alternative

Nonlethal Management Tools and Methods Analysis for All Coastal Species of Concern

In general, the continued use of nonlethal management tools and methods for predator control would have mostly beneficial impacts on coastal species of concern in localized areas. Decreased depredation by denying predator access to nests and habitats, creating habitat avoidance, or removing feral cats would result in increased reproductive success and availability and use of habitat by coastal species of concern.

Nonlethal management tools and methods such as fencing, screening, effigies, chick shelters, or perch deterrents could cause short-term (lasting hours) and localized (less than approximately 2 acres) disturbances to breeding coastal species of concern when implemented. These disturbances include human presence and noise during construction of fences, screening, or cages around active nests and behavioral wariness from the introduction of new structures (i.e., nest exclosures, screening, perch deterrents, and effigies). Park personnel would implement structures infrequently (approximately once or twice per 1- to 2-acre area at the beginning of the breeding season) and in a way that minimizes direct disturbance to coastal species of concern (e.g., by avoiding direct disturbance to nests). Exclosures have the potential to impact coastal species of concern through nest abandonment or adult mortality from entanglement and attracting predators to exclosures, although these occurrences are very rare. (NPS 2015b).

Tools and methods such as frightening devices or disruptive harassment aimed at predators could inadvertently impact coastal species of concern through behavioral changes or habitat avoidance while these tools and methods are employed. Such effects would be more pronounced for sensitive and easily flushed shorebird species than sea turtles or beach mice. Experienced park personnel would continue to implement these tools and methods in a way that minimizes direct impacts to coastal species of concern, and disturbance would not be of a magnitude that would impact survival or reproductive success because it would typically last for a few hours or less or would be implemented at a time that does not influence nesting site location (Peterson and Colwell 2014).

Due to the localized and infrequent use of the above-mentioned tools and methods, impacts are not expected to be widespread or long-lasting and would not affect coastal species of concern in a meaningful way. As suggested by USFWS and described in Chapter 2, park personnel implementing nonlethal tools and methods would continue to have the appropriate training, authorizations, and experience.

Continuing to use live traps to capture feral cats would have mostly beneficial impacts through a reduction in depredation potential and would have no adverse impacts on coastal species of concern because these traps are specifically designed to target the predator species, would not inadvertently capture coastal species of concern, and would be placed at a distance far enough away from nests, colonies, or individuals so as to not cause disturbance or habitat avoidance.

Lethal Management Tools and Methods Analysis for All Coastal Species of Concern

Lethal removal of predator species that have the potential to or are known to prey on coastal species of concern would have beneficial effects on coastal species of concern by increasing reproductive success through the reduction of loss of eggs or young and increasing the availability of safe habitat for nesting, foraging, and reproducing (Dinsmore et al. 2014; Jiminez et al. 2001; Isaksson et al. 2007; Winter and Wallace 2006; NPA 2013b, NPS 2015b). The USFWS conservatively estimates that in areas where predators are selectively removed, the long-term average productivity (the number of young produced per successful pair) of shorebird coastal species of concern could increase by 20% (USFWS 2010, in NPS 2015b). Beneficial effects could last from days to years, depending on what predator species is removed, whether new predator species move in, and if lethal management is paired with other predation management techniques.

Sea turtle, shorebird, and beach mouse coastal species of concern could be temporarily disturbed during implementation of some lethal management techniques. Disturbances would occur from the use of firearms for dispatching and the presence of people associated with setting traps, snares, and bait stations.

The use of shooting as a dispatch method for predators would cause loud noise lasting only a short time (several seconds). If shooting occurs near a coastal species of concern nest, the species, particularly shorebirds, would experience a startle response, stress, and potential flushing. These activities and impacts would occur intermittently (potentially several times per week during the breeding season), but are not expected to have long-term impacts given the short duration of the noise. Impacts would extend to areas in the vicinity of the shooting and return to normal levels once shooting stops and human presence subsides.

Likewise, increased human presence would cause low levels of disturbance because experienced park personnel would set traps infrequently (several times per week during the breeding season), avoiding the immediate vicinity of coastal species of concern nest sites. Although individuals could be temporarily displaced during implementation, they would return after management actions are completed, and colony or nest stability and viability would not be negatively affected by management actions.

BMPs discussed in Chapter 2 would continue to be implemented, including minimizing human disturbance near coastal species of concern, and ensuring proper training and experience of personnel authorized to lethally remove a predator species.

Combined Impacts on Sea Turtles

Feral swine depredation of loggerhead, green, leatherback, and Kemp's ridley sea turtle eggs on beaches in the southeastern United States is occurring, including in NPS Southeast Region park units (Table 1 in Appendix B). The USDA has reported feral swine destruction of up to 74% of sea turtle nests in some regions of Florida before predator removal (USDA APHIS 2015), and feral swine depredation of sea turtle nests has been consistently documented to affect two or three nests over 17 monitored beaches on the coast of Georgia each year from 2009 to 2015. Although there would be some potential for disturbance to sea turtles, the direct protection of nests or colonies through nonlethal and lethal management tools and methods would continue to reduce the rate of depredation and increase the presence of sea turtles, rates of survival, and reproductive success to some degree in the park units that take action to reduce predators.

The types of short-term adverse effects of non-lethal and lethal management tools and methods on sea turtles are described above, and mainly include noise and disturbance associated with human presence. There is limited information on the effects of human presence or above-water noise on sea turtles. One study showed that green sea turtle aerial sound pressure thresholds were lower than underwater thresholds (Piniak et al. 2016), indicating that sea turtles may be more sensitive to aboveground noise. However, because tools and methods would be implemented infrequently, as described above, and generally would not occur in the immediate vicinity of nests, potential impacts are not expected to adversely influence reproductive success or use of habitat by sea turtles.

Combined Impacts on Shorebirds

Feral cat depredation of birds and bird eggs is an issue nationwide (Bonnaud 2011; Jackson 1977; Rauzon 1985; Rauzon et al. 2011). In the recovery plan for the piping plover, feral cats are considered "significant predators" at some sites (USFWS 1996). In Florida, feral cats kill an estimated 30 million birds annually (FWC 2003). Therefore, live trapping of feral cats would have beneficial impacts on shorebirds by removing a primary predator of shorebirds and their eggs.

Continuing to use nonlethal and lethal management tools and methods that reduce the likelihood of depredation, particularly in nesting areas, would continue to have mostly beneficial impacts on shorebird productivity in some park units by increasing the potential for fledging chicks. Research from several managed shoreline habitats has shown that selective lethal predation management leads to higher productivity for shorebird populations (NPS 2015b).

As described above, the continued implementation of some nonlethal and lethal management tools and methods could cause disruption of shorebird habitat and behavior, as well as displacement during implementation. Increased human activity from installing fencing, setting traps, and other management tools and methods near shorebird colonies may increase egg and chick depredation by disturbing adults off their nests and by increasing the number of human-associated predators in the area, such as raccoons and feral cats (USFWS 1999a).

The use of shotguns and rifles for dispatching predators produces a loud bang followed by a "whirring" noise that may disperse birds. This disturbance would occur infrequently and be short in duration. Birds habituate to firearm sounds, especially in the case of species that are not widely hunted. For example, shooting at other bird species (cormorants, herons, and egrets) only temporarily repelled these species (EIFAC 1988; Burger 1983; Fellows and Paton 1988). Individual birds could be temporarily displaced during implementation of management actions, but would return after management actions are completed, and population stability and viability would not be negatively affected by management actions.

Tools and methods such as effigies and scare tactics could potentially negatively affect shorebird nest site selection (Colwell 2010), but this effect may depend on the time and location of implementation. For example, some shorebirds may avoid nesting areas where effigies are deployed in suitable habitat prior to their breeding season, but effigies established after the start of breeding would not influence habitat selection (Peterson and Colwell 2014).

Aside from a small increase in human presence associated with setting and retrieving traps, continuing to use live traps to capture feral cats in some parks is not anticipated to adversely impact coastal shorebird species of concern because these traps are specifically designed to target feral cats and not other species; it is unlikely that a shorebird would enter a trap designed to catch a mammalian predator.

Atlantic ghost crab depredation of coastal species of concern has been widely documented at multiple NPS Southeast Region park units (NPS 2014a, 2014e, 2016d, 2017a, 2017c, 2017d; FWC 2015a, 2015b; GSA 2015; Table 1 in Appendix B). Because the installation of tools such as predator exclosures or screens do not exclude ghost crabs (Kwon et al. 2018), this widescale depredation would continue without intervention.

Combined Impacts on Beach Mice

Reducing depredation through nonlethal and lethal tools and methods would increase population numbers of beach mice and could create self-sustaining populations, helping to achieve recovery criteria as listed in the species' recovery plans (USFWS 1993, 1999b, 2005a, 2008). Increased human presence and foot traffic during installation of fences could potentially disturb sensitive dune habitat utilized by beach mice or crush their burrows; park personnel, however, would minimize impacts by concentrating activities around habitat rather than directly on habitat. Once erected, fences could potentially increase depredation by avian predators, which may use fences as perches for hunting, but would overall decrease depredation events by excluding predator species from beach mice habitat.

Increased noise and human presence associated with nonlethal management tools and methods such as frightening devices and disruptive harassment could also cause disturbance to beach mice and lead to behavioral changes or habitat avoidance. Impacts would last minutes to hours and would be limited to the immediate area where the disturbance occurs. There is no information on the effects of these types of noise on beach mice; however, disturbance is likely not of a magnitude that would impact survival or reproductive success of beach mice because tools and methods would be implemented infrequently, for a short duration, and away from the immediate vicinity of burrows.

Cumulative Impacts

The actions outside the park units covered in this PEA and in surrounding regions that would have cumulative impacts on coastal species of concern are state hunting and trapping and APHIS management. Hunting and trapping and APHIS management activities have the potential to adversely impact coastal species of concern through noise and human presence in areas where trapping and shooting occur. These actions occur statewide and would not be concentrated in coastal habitat used by coastal species of concern. It is unknown what proportion of statewide hunting or trapping and APHIS management actions occur on coastal habitat, but NPS Southeast Region park units comprise only a small area of the region (less than 1%), while actions would be distributed across the region. Furthermore, sensitive areas such as shorebird colonies, sea turtle nest sites, and coastal dunes are often closed to public use.

Because hunting or trapping of predator species does not specifically target individuals that are causing damage, it is ineffective at positively affecting populations of species targeted for protection (NCWRC 2018), and potential benefits on coastal species of concern are limited. APHIS management may have larger beneficial impacts on coastal species of concern because APHIS would manage lethal take to remove individuals that are known to cause damage (USDA APHIS 2015), which could potentially reduce depredation events to some extent.

Use of nonlethal and lethal management tools and methods under the no-action alternative could contribute meaningful beneficial incremental impacts to the overall cumulative impacts, within specific park units that employ those tools and methods consistently. However, many parks would not consistently use these tools and methods under the no-action alternative, and therefore the no-action

alternative overall would not contribute any meaningful incremental impact to the overall cumulative impacts on coastal species of concern across the NPS Southeast Region.

Discussion

Coastal species of concern are protected by international, federal, and state laws; thus, to ensure the survivorship of these species, management activities must be implemented at international, national, regional, and local scales. Relevant laws include the international MBTA, the federal Endangered Species Act, and state laws, such as the Florida Endangered and Threatened Species Act and the Georgia Wildlife Action Plan. These laws and conservation status designations exemplify the need for land administrators, such as NPS, to engage in regionwide management approaches. Because actions would only be taken in some park units with the Southeast Region, neither the adverse or beneficial impacts discussed in this section would occur regionwide.

As discussed above, predation management tools and methods would have some adverse impacts on coastal species of concern in parks that take action to reduce predators, primarily in the form of increased disturbance from noise and human presence as tools and methods are implemented. These impacts would be infrequent and of short duration, lasting hours to days.

Nonlethal and lethal management tools and methods would have beneficial effects on coastal species of concern in parks that take action to reduce predators by increasing reproductive success through the reduction or loss of eggs or young and increasing the availability of safe habitat for nesting, foraging, and reproducing (Dinsmore et al. 2014; Jiminez et al. 2001; Isaksson et al. 2007; Winter and Wallace 2006; NPS 2013b, NPS 2015b). The USFWS conservatively estimates that in areas where predators are selectively removed, the long-term average productivity (the number of young produced per successful pair) of shorebird coastal species of concern could increase by 20% (NPS 2015b). Beneficial effects could last from days to years, depending on what predator species is removed, whether new predator species move in, and if lethal management is paired with other predation management techniques.

Park units that are already implementing predation management tools and methods have reported positive effects on coastal species of concern. For example, nest screening helped reduce depredation rates on green sea turtles at Canaveral National Seashore from 90% in the early 1980s to current rates of 5% to 15%, and there have been no reports of adverse impacts on sea turtles (NPS 2013b). Preliminary results of predator control projects on Virginia's eastern shore showed increased nest success for at least 400 pairs of American oystercatchers at 9 sites (NFWF 2008). At Cape Hatteras National Seashore, predator exclosures have been used since 1994 to reduce impacts from predators on nesting plovers, and trapping is used to target predators near nests and chicks (NPS 2013d), leading to successful fledging (Table 19 in Appendix B). Canaveral National Seashore began implementing selective predation management in 2015 and has observed an increase from 1 to 2 shorebird nests per year to nearly 30 nests per year. Finally, trapping feral cats would benefit beach mice by reducing depredation rates and increasing reproductive success by allowing more adults and young to survive and reproduce (USFWS 2015b). These examples show that predation management positively impacts coastal species of concern.

Under the no-action alternative, each park unit would continue to take action on a case-by-case basis; therefore, large-scale, consistent actions across the region are not anticipated. This means that predation management tools and methods may not be used at all in many park units, or may not be used at optimized times, and therefore, adverse impacts resulting from predation may not be addressed in a

meaningful way across the NPS Southeast Region. Furthermore, while site-specific indicators or trends derived from reliable data could serve as triggers to apply certain management techniques in specific park units, there would not be consistent monitoring efforts across the NPS Southeast Region or oversight for data collection; therefore, managing depredation may be reactionary instead of proactive, providing less of a benefit to coastal species of concern regionwide, particularly for populations that are sensitive to reproductive failure.

Alternative B: Proposed Action

Nonlethal Management Tools and Methods Analysis for All Coastal Species of Concern

Nonlethal management tools and methods described in Chapter 2 could continue to be used under the proposed action except for effigies, conditioned taste aversion, biological odor repellents, disruptive harassment, and frightening devices. While effigies, frightening devices, and biological odor repellants temporarily cause predator species to avoid small areas, rapid habituation is likely; therefore, elimination of this tool would not deter predators from depredating coastal species of concern under the proposed action. The elimination of conditioned taste aversion and disruptive harassment would not change the way predators impact coastal species of concern, as these tools and methods are not widely used or are ineffective because predator species naturally adjust their home ranges in response to resource availability and new predator species can reinvade. The removal of these tools and methods is not expected to adversely impact coastal species of concern and may have a small beneficial impact on coastal species of concern compared to the no-action alternative through a reduction in noise and the presence of humans.

The types of adverse and beneficial impacts on coastal species of concern that could occur from the use of nonlethal tools and methods would be the same as those described for the no-action alternative. Adverse impacts would primarily include noise and disturbance associated with increased human presence as tools and methods are implemented or constructed. However, there could be a small increase in the frequency and extent of effects resulting from putting up fences, screens, or exclosures due to the expected increase in the number of park units implementing the tools and methods evaluated in this PEA regionwide.

As described for the no-action alternative, the magnitude of adverse impacts would not decrease species' reproductive success or survivability because actions would still be infrequent (several times a week or daily at the start of the breeding season when fences, screens, or exclosures are erected) and short in duration (lasting minutes to hours).

Compared to the no-action alternative, the potential for increased use of nonlethal tools and methods in more park units regionwide would have increased beneficial impacts on coastal species of concern. Decreased depredation by denying predator access to nests and habitats, creating habitat avoidance, or removing feral cats would likely result in increased reproductive success and availability and use of habitat by coastal species of concern.

Lethal Management Tools and Methods Analysis for All Coastal Species of Concern

The types of adverse and beneficial impacts from the use of lethal tools and methods would the same as those described for the no-action alternative, although impacts would be more widespread due to the expected increase in the number of parks using lethal management tools and methods regionwide. Increased lethal removal of predator species under the proposed action that have the potential to or are

known to prey on coastal species of concern would benefit these species by increasing reproductive success through the reduction of loss of eggs or young and increasing the availability of safe habitat for nesting, foraging, and reproducing (Dinsmore et al. 2014; Jiminez et al. 2001; Isaksson et al. 2007; Winter and Wallace 2006; NPA 2013b, NPS 2015b). Beneficial effects could last from days to years, depending on what predator species is removed, whether new predator species move in, and if lethal management is paired with other predation management techniques.

Adverse impacts would generally include disturbance from noise and human presence. There would be a slight increase in the frequency and extent of these types of impacts due to the expected increase in the number of park units implementing the tools and methods evaluated in this PEA regionwide. As is the case for the no-action alternative, these impacts would not decrease species' reproductive success or survivability because actions, including both trapping and dispatching, would be infrequent (several times a week or daily), short in duration (seconds to minutes), and located away from the immediate vicinity of coastal species of concern nests.

Management actions to trap and remove ghost crabs would cause a slight disturbance to sea turtles and shorebirds because traps would be established near or within nesting sites; however, they would be buried in the sand near burrows. Noise and human presence could temporarily disturb nesting individuals when traps are set up and retrieved, but impacts would be infrequent (several times a week during the nesting season) and short in duration, lasting only minutes to hours. There is little to no risk of inadvertent capture of coastal species of concern, because Fripp traps are designed to catch only ghost crabs and would be placed at the mouth of crab burrows (Florida Park Service 2013).

Combined Impacts on Sea Turtles

Proactive sea turtle nest management across the NPS Southeast Region would help to increase the chances of sea turtle hatchlings reaching the sea and surviving to return one day as breeding adults. Reducing nest depredation would cause nest numbers and hatching success (Tables 9 to 12 in Appendix B) of green, Kemp's ridley, leatherback, and loggerhead sea turtles to increase, which would help increase reproductive success, use of nesting habitat, and achieve objectives stated in the recovery plans for these species (NMFS and USFWS 1991, 1992, 2008; NMFS et al. 2010). Extending nest screening to all nests within a park unit while selectively removing other predators such as ghost crabs that can dig beneath screens would lower depredation rates even more, helping to achieve recovery goals for this species. This may in turn alleviate pressure from other rangewide threats, such as habitat degradation and human disturbance.

There would be a slight increase in adverse impacts on sea turtles such as noise and disturbance associated with human presence, but these impacts would not negatively affect sea turtle reproductive success or survivability because tools and methods would be implemented infrequently and generally would not occur in the immediate vicinity of nests.

Combined Impacts on Shorebirds

Management actions to trap and remove ghost crabs would have beneficial impacts on coastal species of concern through removal of these recurring, widespread predators (Table 1 in Appendix B) that are undeterred by nest screens, fences, or other nonlethal management methods (Kwon et al. 2018). The presence of ghost crabs was strongly and negatively correlated with the daily survival of plover nests (Kwon et al. 2018); therefore, reducing high depredation pressure from these predators (Table 1 in Appendix B) would ultimately improve the reproductive success of coastal species of concern,

particularly shorebirds. One study showed that crab removal resulted in increased success and daily survival rate of snowy plovers (Florida Park Service 2013). Similarly, the use of toxicants would positively affect coastal species of concern by reducing depredation by avian species that feed on eggs and hatchlings (NPS 2011d, 2015b, 2017a; Strickland 2015), which would help to increase reproductive success of these species by allowing more eggs to hatch and hatchlings to survive.

In addition to a slight increase in adverse impacts such as noise and other disturbance under the proposed action, the use of toxicants could potentially have negative impacts on shorebird coastal species of concern if an individual were to consume the toxicant. The specific toxicant that would be used (DRC-1339) has high toxicity to sensitive species, such as corvids, but low to moderate toxicity to many nonsensitive and predatory birds, intermediate sensitivity to waterfowl, and almost no toxicity to mammals (USDA 2001). Because the specific effects on shorebirds species covered in this PEA have not been studied, the exact response is unknown; it is possible that consuming the toxicant would cause illness or death.

However, the likelihood of a shorebird coastal species of concern consuming the toxicant is low for several reasons. First, the food items baited with the toxicant (i.e., coastal species of concern eggs) would not be the same types of food that shorebird species feed on (typically marine invertebrates). Second, only personnel trained and certified in the use of toxicants would be allowed to apply DRC-1339, which would reduce the risk of improper application and spread. Finally, DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation as well as water (USDA 2001), meaning that it would not linger long in the environment. Toxic eggs would most likely first be consumed by aggressive, opportunistic predators such as corvids that are selectively preying on shorebird nests (eggs and chicks).

Combined Impacts on Beach Mice

Effectively reducing depredation, particularly from predators such as feral cats and foxes, would help the Perdido Key beach mouse, southeastern beach mouse, and Anastasia Island beach mouse by increasing population numbers and creating self-sustaining populations, helping to achieve recovery criteria as listed in the species' recovery plans (USFWS 1993, 1999b, 2005a, 2008). Although it is not likely that Anastasia Island beach mice can fully recover or be delisted due to permanent destruction of most of its historical range (USFWS 2007b), increasing reproductive success would help maintain or increase the current population at Fort Matanzas National Monument (Table 14 in Appendix B).

There would be a slight increase in noise and human disturbance if tools and methods are applied more frequently and extensively under the proposed action due to increased ease of implementation. As with the no-action alternative, impacts under the proposed action are not expected to negatively affect beach mouse survival or reproductive success because they would be infrequent (weekly to monthly) and implemented by experienced park personnel, who would take caution to avoid direct impacts to beach mouse such as crushing of burrows during fence construction or trap setting.

Cumulative Impacts

The types of cumulative impacts to coastal species of concern that would occur under the proposed action are similar to those described under the no-action alternative from state hunting and trapping and APHIS management. The proposed action would contribute only a very small incremental adverse impact to the overall cumulative impacts, and would contribute a meaningful beneficial incremental impact to the overall cumulative impacts on coastal species of concern across the NPS Southeast Region

due to the expected increase in the number of park units employing the tools and methods contained in the proposed action.

Discussion

Despite an increase in noise and disturbance associated with implementation of nonlethal and lethal predation management tools and methods, the benefits of increased use of nonlethal tools and methods across the NPS Southeast Region would result in increased reproductive success and survival of coastal species of concern regionwide (NFWF 2015; NPS 2015b).

Increased monitoring would facilitate information sharing between park units and improve management as new techniques are developed and refined. Triggering predation management based on site-specific data and properly timed use of predation management tools and methods, such as trapping predators during a species' nesting season, would more effectively reduce depredation of coastal species of concern and increase reproductive success. One study showed that live capturing and euthanizing raccoons, based on integrated data on predator monitoring, reduced depredation at a Florida beach; it fell from a 95% loss of marine turtle nests to 9.4% (Engeman et al. 2005). Beneficial impacts would occur throughout the park unit where management techniques are used and could last year-round.

Park units acting under a programmatic decision would be able to focus on effective, hands-on conservation efforts to protect coastal species of concern at a site-specific level. Furthermore, a programmatic approach would encourage more park units to participate in reduction efforts than under the no-action alternative and would therefore help protect species of concern more consistently on a regionwide level.

Because the approach to predation management would be more efficient under the proposed action, tools and methods could be implemented more quickly than under the no-action alternative. Furthermore, proactive management and the potential to establish triggers for predator control would help to increase efficiency of management actions and reproductive success of sea turtles, shorebirds, and beach mice that are highly susceptible to depredation.

Having a regionwide effort to protect coastal species of concern during the most critical phase of survivorship (nesting, hatching, and fledging) would increase the potential for species continued existence and recovery and help their populations become more resilient to other threats throughout their range. Results from monitoring programs would be shared among NPS Southeast Region park units tiering to this PEA in order to contribute to regionwide effective management strategies, track removal of predator numbers, and record coastal species of concern reproductive success.

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5. CONSULTATION AND COORDINATION

During preparation of this PEA, the NPS engaged with the state historic preservation offices in Mississippi, Florida, Georgia, and North Carolina. The NPS continues to work with the USFWS, including ecological services field offices in Raleigh, South Carolina, Georgia, North Florida, Panama City, South Florida, Mississippi, Louisiana, and the Caribbean; Southeast Region National Wildlife Refuge System; Migratory Bird Office; and Merritt Island National Wildlife Refuge. The NPS also engaged with the Seminole Tribe of Florida Tribal Historic Preservation Office, Miccosukee Tribe of Indians of Florida, and the Muscogee (Creek) Nation.

Other agencies or persons consulted were the Atlantic Flyway Shorebird Initiative; Departamento de Recursos Naturales y Ambientales (Puerto Rico); Florida FWC; Florida Department of Environmental Protection; GADNR; Mississippi Department of Wildlife Fish and Parks; National Aeronautics and Space Administration; National Oceanic and Atmospheric Administration; National Parks Conservation Association; NCWRC; North Carolina Division of Marine Fisheries; North Carolina Division of Environmental Quality; SCDNR; The Wilderness Society; USVI Department of Planning and Natural Resources; and Wilderness Watch.

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Appendix A
Figures

A. FIGURES

Figure 2. Piping plover nest exclosure at Cape Lookout National Seashore

Figure 3. Nesting snowy plover protected by fence exclosure at Gulf Islands National Seashore

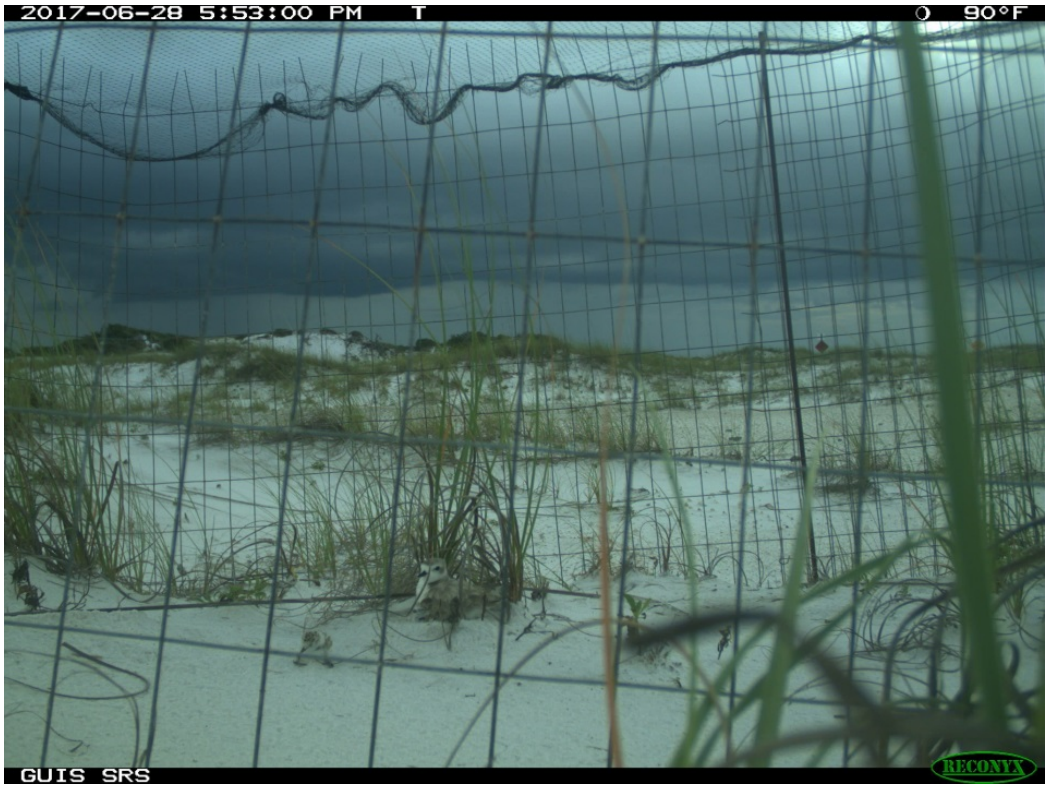


Figure 4. Research camera that chicks used for shelter from the sun

Figure 5. An example of a foothold trap; various types and sizes can be used to trap animals ranging in size from mink to coyotes

Figure 6. Snares

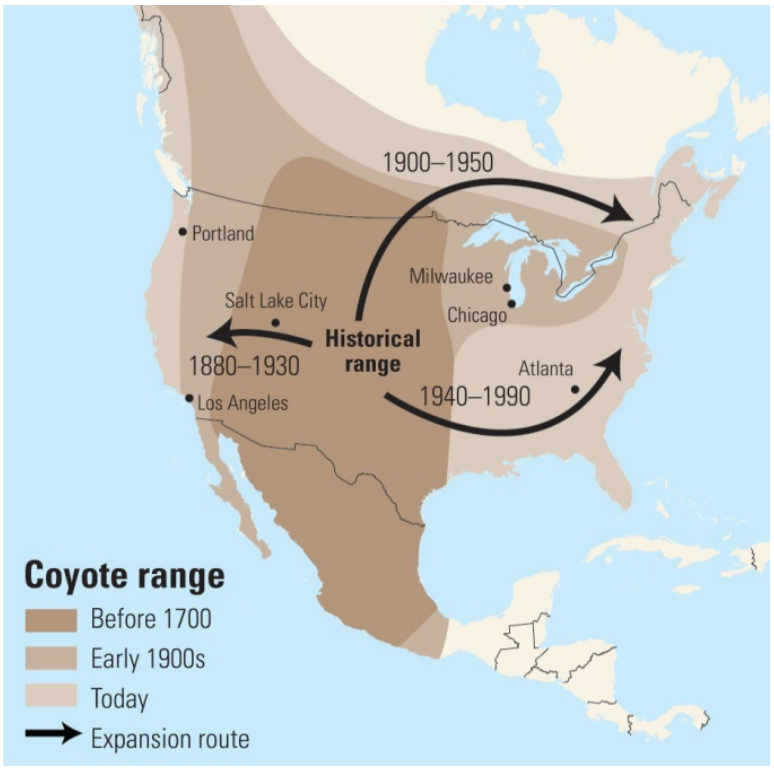
Figure 7. Walk-in Cage Trap

Figure 8. Two Types of Dog-proof Traps

Figure 9. Feral Swine Box Trap

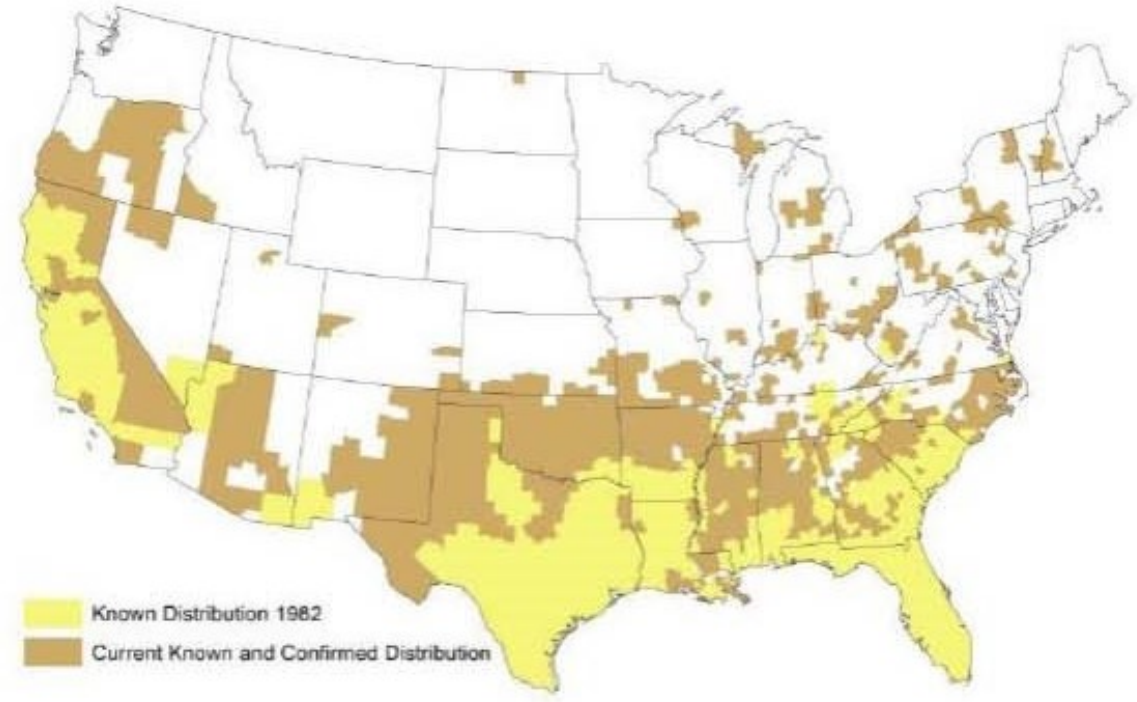
Figure 10. Feral Swine Corral Trap

Figure 11. Coyote Expansion throughout the United States



Source: Morell 2013

Figure 12. Known and Confirmed Feral Swine Range in the United States in 2012 Compared with the Historic 1982 Range



Source: USDA APHIS 2015

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Appendix B
Additional Species Information

Recent Predation Events Documented at NPS Southeast Region Park Units

B. ADDITIONAL SPECIES INFORMATION

Table B-1
Recent Predation Events Documented at NPS Southeast Region Park Units

	Cape Hatteras National Seashore	Cape Lookout National Seashore	Canaveral National Seashore	Cumberland Island National Seashore	Gulf Islands National Seashore	Fort Matanzas National Monument
Armadillo				Predation reported during 6 of 13 seasons since 2005, peak of 654 eggs from 22 nests depredated in 2015 (Hoffman, pers. comm., 2017)	5, 4, and 3 plover eggs, 2012–2017 (NPS 2017a)	
Avian Species	American oystercatcher nest depredated by American crow, 2015 (NPS 2015c)	2 black skimmers and 1 common tern chick depredated by great black-backed gulls, 2011 (NPS 2011d).		80 Wilson's plover nest failures from coyotes and crows, 2014, 2015 (Strickland 2015)	15, 32, and 28 plover eggs lost to avian predators, 2012–2017 (NPS 2017a)	
Coyote	Perpetual predators of nesting shorebirds (NPS 2016b); tracks commonly observed in areas closed for sea turtle nesting (NPS 2010a); 28 documented colonial shorebird interactions, 2015 (NPS 2015e); 3 American oystercatcher incidents (NPS 2015c)	Total or partial predation of 31 sea turtle nests, 2017 and 5 in 2016 (NPS 2016c, 2017b); predation on common tern and gull-billed tern eggs and nests since 2015 (Altman, pers. comm., 2018; NPS 2015f); 48 American oystercatcher nests, 2017 (NPS 2017c)		"Very high" predation rates, potential cause of 2 least tern colony failures, 2015 (GSA 2015); loss of 13 American oystercatcher nests (Hoffman, pers. comm., 2017); documented sea turtle nest depredation, 2011–2015 (NPS 2016a)	37 plover eggs, loss of at least 5 black skimmer nests and one gull-billed tern nest, predation at 5 established least tern colonies, repeated disturbances in colonial nest areas throughout the season, 2014 (NPS 2014b, 2014c); known predation on least tern nests (Nicholas, pers. comm., 2018); documented depredation on marine sea turtle nests 1992–2010 (Nicholas, pers. comm., 2018)	Prints observed in dunes, where Anastasia Island beach mice are known to occur (Foote, pers. Comm. 2018)

Table B-1
Recent Predation Events Documented at NPS Southeast Region Park Units

	Cape Hatteras National Seashore	Cape Lookout National Seashore	Canaveral National Seashore	Cumberland Island National Seashore	Gulf Islands National Seashore	Fort Matanzas National Monument
Feral Cat	4 American oystercatcher nests in 2016 (NPS 2016b); 3 documented colonial shorebird interactions, 2015 (NPS 2015e)	1 piping plover nest, 2017 (NPS 2017d)			Known predators to beach mice and have been documented in beach mouse habitat; have also been documented in shorebird nesting habitat, but no confirmed predation within park boundaries (Hardin, pers. comm., 2018)	
Feral Swine			Depredated up to 45 percent of all sea turtle nests prior to control efforts (NMFS and USFWS 1991); documented sea turtle nest depredation (FWC 2015a, 2015b)	Documented sea turtle nest depredation, 1992–2015 (NPS 2016a)		
Fox (Gray, Red)	At least 1 red fox depredating American Oystercatcher nest, 2014 (NPS 2014e)				Documented depredation on marine sea turtle nests 1992–2010 (Nicholas, pers. comm., 2018)	Foxes likely prey on Anastasia Island beach mice (Foote, pers. comm., 2018)
Ghost Crab	9.6 percent of piping plover nests monitored from 2008 to 2015 (Kwon et al. 2018); 3 piping plover eggs, 2016 (NPS 2016b); 12 sea turtle hatchlings and 55 eggs, 2014 (NPS 2014f); at least 1 least tern egg (Kwon et al. 2018)	4 piping plover nests, 2015 (NPS 2015h), 9 in 2017 (NPS 2017d); 36 sea turtle nests in 2016, 27 in 2017 (NPS 2016c, 2017b); 5 American oystercatcher nests, 2017 (NPS 2017c)	Substantial sea turtle nest predation in the early 1980s from raccoons and ghost crabs (NPS 2011c); documented sea turtle nest depredation, 2015 2014 (FWC 2015a, 2015b)	Known losses to sea turtle eggs and hatchlings 1992 to present; confirmed predation of American oystercatcher chick (Sabine 2006)	15 percent of snowy plover nest loss, 2012 (Durkin 2012); 25, 23, and 21 plover eggs, 2012–2017 (NPS 2017a)	

Table B-1
Recent Predation Events Documented at NPS Southeast Region Park Units

	Cape Hatteras National Seashore	Cape Lookout National Seashore	Canaveral National Seashore	Cumberland Island National Seashore	Gulf Islands National Seashore	Fort Matanzas National Monument
Mink	Perpetual predator of water bird colonies (NPS 2014f, 2015e); 1 Wilson's plover nest, 2015, 1 Wilson's plover nest in 2013 and 2015 (NPS 2013d, 2015g); sea turtle nest depredation (NPS 2013c, 2014d, 2016b)					
Opossum	1 American oystercatcher nest, 2015 (NPS 2015c); sea turtle depredation (NPS 2013c, 2014d, 2016b)			Confirmed depredation of 3 American oystercatcher nests (GADNR unpublished data)	6 plover eggs lost to opossum in 2017; tracks have been observed on numerous occasions within nesting colonies, but unknown how many eggs have been lost (Hardin, pers. comm. 2018)	
Raccoon		28 sea turtle nests in 2016 and 3 in 2017 (NPS, 2016c, 2017b); 41 hatchlings in 2015 (NPS 2015d); 21 American Oystercatcher nests, 2017 (NPS 2017c); 1 piping plover nest in each 2015 and 2016 (NPS 2015h, 2016d); heavy predation on black skimmer and tern eggs in 2012 (NPS 2012d); predation on common tern and gull-billed tern eggs and nests since 2007,	Documented sea turtle nest depredation, 2014, 2015 (FWC 2015a, 2015b); Over 90 percent of sea turtle nests depredated by ghost crabs and racoons in the early 1980s (NPS 2011c)	1 American oystercatcher nest lost, 2017 (Hoffman, pers. comm., 2017); documented sea turtle nest predation, 2009–2015 (NPS 2016b) and 1992-2008 (Cumberland Island annual sea turtle project reports)	Predation on 1 plover nest (3 eggs) documented this season (2018); tracks have been noted in nesting habitat, but confirmed predation had not occurred until recently (Hardin, pers. comm. 2018)	

Table B-1
Recent Predation Events Documented at NPS Southeast Region Park Units

	Cape Hatteras National Seashore	Cape Lookout National Seashore	Canaveral National Seashore	Cumberland Island National Seashore	Gulf Islands National Seashore	Fort Matanzas National Monument
		causing common tern nest abandonment in 2008 (Altman, pers. comm., 2018; NPS 2007, 2008)				

Table B-2
Cumberland Island National Seashore Sea Turtle Nest Totals and Depredation Rates 2001–2018

Year	Number of Nests[1]	Feral Swine Depredation (Percent of Nests)	Racoon Depredation (Percent of Nests)	Coyote Depredation (Percent of Nests)	Armadillo Depredation (Percent of Nests)
2001	196	5	11	0	0
2002	188	0	3	0	0
2003	353	0.6	2	0	0
2004	53	0	0	0	0
2005	232	0.9	8	0	1
2006	325	0	0	0	1
2007	177	0	3	0	0
2008	336	0	0	0	0
2009	252	0	0	0	0
2010	486	0	0	0.2	0.2
2011	372	0	0.2	1.8	0
2012	700	0	0	0.4	0
2013	588	0.7	1.1	0.8	0.1
2014	319	0	0.3	0.6	0
2015	583	0	0	10.8	3.7
2016	867	0	0	0.1	0
2017	528	0.5	0.7	0.3	0
2018	469	0	1.5	0	0

Source: Hoffman, pers. comm. 2018
[1]Total number of nests from all turtle species

Available Predator Harvest Data By State

Table B-3
Gray Fox Harvest Numbers from Trappers and Hunters in Mississippi, North Carolina, Alabama, and Georgia

Year	Mississippi	North Carolina[1]	Alabama[1]	Georgia
2007	1,843	5,560 (trappers) 6,472 ±1,468 (hunters)	1,300	N/A
2008	1,547	4,212 (trappers) (hunters: N/A)	5,900	N/A
2009	1,555	3,313 (trappers) (hunters: N/A)	1,900	2,938
2010	1,066	3,995 (trappers) 7,416 ± 3,242 (hunters)	2,100	4,037
2011	1,435	5,335 ± 1,375 (hunters)	600	4,502
2012	1,609	5,335 ± 2,007 (hunters)	800	7,508
2013	2,139	5,547 ± 2,277 (hunters)	1,651	5,679
2014	2,632	10,101 ± 8,836 (hunters)	3,045	N/A
2015	1,860	4,596 ± 1,958 (hunters)	1,113	4,484
2016	1,716	4,324 ± 2,533 (hunters)	N/A	4,120

Sources: MDWFP 2017; NCWRC 2012, 2018b; Bryant 2016; Waters 2015

[1]Data for fox not separated by species
N/A= not available

Table B-4
Mink Harvest Numbers from Trappers in Mississippi, North Carolina, and Georgia

Year	Mississippi	North Carolina	Georgia
2007	315	N/A	N/A
2008	177	N/A	N/A
2009	105	N/A	19
2010	143	N/A	30
2011	93	N/A	38
2012	171	444	35
2013	133	529	28
2014	135	237	N/A
2015	95	161	12
2016	35	165	68

Source: MDWFP 2017; Waters 2015; NCWRC 2018c

Table B-5
Raccoon Harvest Numbers from Trappers in Mississippi, North Carolina, Alabama, and Georgia

Year	Mississippi	North Carolina	Alabama	Georgia
2007	13,481	N/A	67,200	N/A
2008	11,539	N/A	80,700	N/A
2009	12,917	N/A	53,600	7,294
2010	8,390	72,727 ± 14,663	79,500	9,347
2011	12,569	92,104 ± 20,036	79,500	9,787
2012	10,608	70,854 ± 13,669	38,000	11,774
2013	12,397	69,278 ± 12,514	52,311	13,551
2014	18,423	60,544 ± 11,558	56,288	N/A
2015	13,804	86,107 ± 22,038	40,114	11,271
2016	14,456	51,092 ± 13,767	N/A	10,022

Sources: MDWFP 2017; NCWRC 2018b; Bryant 2016; Waters 2015

Table B-6
Red Fox Harvest Numbers from Trappers in Mississippi, North Carolina, Alabama, and Georgia

Year	Mississippi	North Carolina	Alabama[1]	Georgia
2007	386	1,180 (trappers) 6,472 ±1,468 (hunters) [1]	1,300	N/A
2008	306	838 (trappers) (hunters: N/A)	5,900	N/A
2009	329	769 (trappers) (hunters: N/A)	1,900	1,057
2010	174	872 (trappers) 7,416 ± 3,242 (hunters) [1]	2,100	1,130
2011	229	5,335 ± 1,375 (hunters) [1]	600	1,081
2012	238	5,335 ± 2,007 (hunters) [1]	800	1,448
2013	316	5,547 ± 2,277 (hunters) [1]	1,651	1,266
2014	564	10,101 ± 8,836 (hunters) [1]	3,045	N/A
2015	350	4,596 ± 1,958 (hunters) [1]	1,113	994
2016	403	4,324 ± 2,533 (hunters) [1]	N/A	998

Source: MDWFP 2017; NCWRC 2012, 2018b; Bryant 2016; Waters 2015

[1]Data for fox are not separated by species.
N/A = not available

Available Population and Trend Data for Coastal Species of Concern

Table B-7
Individuals Observed During 1991, 1996, 2001, and 2006 Piping Plover Winter Censuses in the Southeast Region

Location	1991	1996	2001	2006
North Carolina	20	50	87	84
South Carolina	51	78	78	100
Georgia	37	124	111	212
Mississippi	59	27	18	78
Florida	551	375	416	454

Source: USFWS 2009

Table B-8
Red Knot Relative Abundance on North Core Banks, Cape Lookout National Seashore, 1992–2017

Year	Date	Peak Count[1]	Kilometers	Abundance[2]
1992–1993[3]	NA	NA	34	34
2006	May 5	618	30.3	20
2007	May 15	718	30.6	23
2008	April 15	1,287	30.6	42
2009	May 25	525	36	14
2010	May 15	927	36	26
2011	May 15	1,012	36	28
2012	April 25	1,370	29.8	46
2013	May 25	854	29.8	29
2014	May 15	2,666	29.8	89
2015	May 15	2,201	29.8	74
2016	May 15	2,124	29.8	71
2017	May 15	1,741	29.8	58

Source: NPS 2017e

[1]Peak count
[2]Abundance = birds per kilometer
[3]Early (pre-2006) monitoring of red knots at Cape Lookout National Seashore limited to surveys as part of a broader shorebird study in 1992 and 1993 (NPS 2017e)

Table B-9
Canaveral National Seashore Sea Turtle Nest Totals 2000–2017

Year	Loggerhead	Green	Leatherback	Kemp's Ridley	Unknown	Total
2000	3,892	662	9	0	0	4,563
2001	3,257	7	10	0	0	3,274
2002	3,161	856	8	0	0	4,025
2003	3,229	74	16	1	0	3,320
2004	2,281	255	6	0	0	2,542
2005	2,547	1,040	13	0	0	3,600
2006	2,470	396	1	1	0	2,868
2007	2,356	1,249	21	0	0	3,627
2008	3,637	899	5	2	0	4,543
2009	2,729	301	26	0	0	3,056
2010	4,250	1,343	26	0	0	5,619
2011	3,742	1,374	24	0	0	5,140
2012	5,154	816	27	1	0	5,998
2013	3,758	4,152	23	0	0	7,933
2014	3,322	420	20	0	0	3,767
2015	3,905	3,571	34	0	0	7,510
2016	5,057	381	9	0	0	5,437
2017	4,556	7,736	23	0	0	12,315

Source: NPS 2013b; Kneifl, pers. comm. 2018.

Table B-10
Cape Hatteras National Seashore Sea Turtle Nest Totals 2009–2016

Year	Loggerhead	Green	Leatherback	Kemp's Ridley	Total
2009	101	2	1	—	104
2010	147	6	—	—	153
2011	137	9	—	1	147
2012	219	2	1	—	222
2013	229	24	—	—	254
2014	122	2	—	—	124
2015	277	10	—	—	289*
2016	313	11	—	1	325

Source: NPS 2009, 2010c, 2011b, 2012c, 2013c, 2014d, 2015h, 2016b

*Includes 2 hawksbill nests

Table B-11
Gulf Islands National Seashore Sea Turtle Nest Totals 2001–2017

Year	Loggerhead	Green	Leatherback	Kemp's Ridley	Unknown	Total
2001	22	0	0	1	0	23
2002	12	5	0	1	0	18
2003	31	2	0	0	0	33
2004	22	0	0	2	0	24
2005	10	2	0	0	0	12
2006	16	0	0	3	0	19
2007	7	2	0	0	0	9
2008	32	1	0	6	1	40
2009	28	0	0	3	0	31
2010	1	0	0	1	0	18
2011	64	4	0	1	0	69
2012	50	5	0	2	0	57
2013	40	2	0	0	0	42
2014	35	1	0	1	0	37
2015	56	3	1	2	N/A	62
2016	67	0	0	2	0	69
2017	134	9	0	0	N/A	143
Total	643	36	1	25	1	

Source: Nicholas, pers. comm. 2018

Table B-12
Cumberland Island National Seashore Sea Turtle Nest Totals 2001–2018

Year	Number of Nests[1]	Year	Number of Nests[1]
2001	196	2010	486
2002	188	2011	372
2003	232	2012	700
2004	53	2013	558
2005	232	2014	319
2006	325	2015	583
2007	17	2016	867
2008	336	2017	528
2009	252	2018	469

Source: Hoffman, pers. comm. 2018

[1]Total number of nests from all turtle species

Table B-13
Canaveral National Seashore Sea Turtle Predation Rates, 2007–2017[1]

Year	Number of Nests Predated	Percentage Loss
2007	413	11.4%
2008	650	14.3%
2009	323	10.6%
2010	352	6.2%
2011	554	10.8%
2012	482	8.03%
2013	640	8.1%
2014	660	17.5%
2015	983	13.1%
2016	562	10.3%
2017	580	4.7%

Source: Kneifl, 2017, pers. comm. 2018.

[1]All sea turtle species present at the park unit (Loggerhead, Green, and Leatherback)

Table B-14
Monthly Counts of Anastasia Island Beach Mice at Fort Matanzas National Monument Based on Camera Traps[1]

	Number of Mice
2017	
May	7
June	110
July	127
August	74
September	58
October	167
November	3,489
December	2,191
2018	
January	1,221
February	4,127

Source: Foote, pers. comm. 2018.

[1]Data recorded as images of mice.

Table B-15
Percentage of Perdido Key Beach Mice in Track Tubes on Public Lands

Year	Gulf State Park	Perdido Key State Park	Gulf Islands National Seashore
2009	N/A	2.9	48
2010	48	55	84
2011	88	96	94
2012	N/A	99	95
2013	93	97	94

Source: USFWS 2014c

N/A = not available

Table B-16
Causes of American Oystercatcher Nest Failure at Cape Lookout National Seashore, 2013–2017[1]

Year	Total Nests	Nests Lost	Cause of Nest Failure				
			Predation (Percent)[2]	Flooding/ Storms (Percent)	Human Disturbance (Percent)	Abandoned (Percent)	Unknown (Percent)
2013	104	72	21	3	1	1	46
			(29)	(4)	(1)	(1)	(64)
2014	87	49	15	6	0	1	27
			(30)	(12)	(0)	(2)	(55)
2015	112	75	41	0	0	4	30
			(55)	(0)	(0)	(5)	(40)
2016	121	104	68	2	2	2	30
			(65)	(2)	(2)	(2)	(29)
2017	133	128	78	16	1	7	33
			(61)	(13)	(1)	(5)	(26)

Source: NPS 2017c

[1]Management actions for oystercatchers included closing the area around a nest with "Bird Sanctuary" signs and establishing a 600-foot buffer around each nest.
[2] Percentage shows the proportion of nests lost by each cause.

Table B-17
Breeding Pair, Colonies, and Average Pairs Per Colony for the Gull-Billed Tern

	Number of Pairs	Number of Colonies	Average Pairs per Colony
Florida (2000)	17	3	6
North Carolina (2001)	258	7	37
South Carolina (2003)	239	7	34
Georgia (2003)	2,003	54	1
Mississippi (2004)	2,004	150	1

Source: USFWS 2013c

Table B-18
Plover Predation at Gulf Islands National Seashore[1]

Year	Percentage of Management Areas Depredated	Percentage of Eggs Depredated
2013	91	15
2014	100	42
2015	100	37
2016	100	40

Source: Hardin, pers. com. 2017

[1] Includes both snowy plover and Wilson's plover

Table B-19
Summary of Wilson's Plover Reproductive Success at Cape Hatteras National Seashore from 2009 to 2015

Year	Breeding Pairs	Total Nests	Nests Hatched	Successful Pairs[1]	Number of Chicks Fledged	Fledge Rate
2009	1	1	1	0	0	0
2010	2	2	2	1	2	1.0
2011	1	1	1	0	0	0
2012	4	4	2	2	4	1.0
2013	4	4	3	3	3	0.75
2014	3	3	2	0	0	0
2015	4	3	2	0	0	0

Source: NPS 2015g

[1]At least one chick fledged

Appendix C

Acronyms, Glossary, and References

C. ACRONYMS, GLOSSARY, AND REFERENCES

ACRONYMS AND ABBREVIATIONS

	Full Phrase
AFWA	International Association of Fish and Wildlife Agencies
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BMP	best management practice
CEQ	Council on Environmental Quality
DPS	distinct population segment
DRC-1339	3-chloro-4-methylbenenamine hydrochloride
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
FWC	Florida Fish and Wildlife Conservation Commission
GADNR	Georgia Department of Natural Resources
IUCN	International Union for Conservation of Nature
MBTA	Migratory Bird Treaty Act
MDWFP	Mississippi Department of Wildlife, Fisheries, and Parks
NCWRC	North Carolina Wildlife Resources Commission
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NPS	National Park Service
PEA	programmatic environmental assessment
SCDNR	South Carolina Department of Natural Resources
SOP	standard operating procedure
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WS	USDA APHIS Wildlife Services

GLOSSARY

Best management practices: A suite of techniques that guide or may be applied to management actions to aide in achieving desired outcomes. BMPs are often developed in conjunction with land use plans, but they are not considered a planning decision unless the plans specify that they are mandatory.

Corral trap: Used to capture such predators as raccoons, opossums, feral cats, and in some instances, foxes. These traps are set in areas where foothold traps cannot be used, or when it is deemed more efficient to use them.

Chick shelter: A type of cage or exclosure placed around individual bird nests to prevent predation.

Depredate: To act as a predator of.

Distinct Population Segment (DPS): A vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species.

DRC-1339 (3-chloro-4-methylbenenamine hydrochloride): Toxicant to control avian predators.

Exclosure: Area from which unwanted animals are excluded.

Foothold trap: A key device used for trapping coyotes and are constructed as two metal jaws which are closed by a spring when triggered.

Opportunistic: A style of feeding where the species can sustain itself from several different food sources and could shift their territory and find alternate sources of food.

Predation: The action of one animal preying on others.

Species of concern: Those species in need of conservation actions based on their rarity, declining population trends, or susceptibility to threats. These species may be included on state or federal lists of endangered species, or they may be protected by other laws or regulations such as the Migratory Bird Treaty Act.

Subadult: An individual that has passed through the juvenile period but not yet attained typical adult characteristics.

Toxicant: A substance introduced into the environment that is intended to have a toxic effect on a target species.

Track tube: A baited polyvinyl chloride pipe lined with paper and an inkpad that records footprints as mice enter the tube; this provides an indirect method of determining beach mouse presence by indicating areas occupied by beach mice and temporal fluctuations in mouse distribution.

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Appendix D

Issues and Alternatives Dismissed from Detailed Analysis

D. ISSUES AND ALTERNATIVES DISMISSED FROM DETAILED ANALYSIS

IMPACT TOPICS DISMISSED FROM FURTHER ANALYSIS

Impact topics dismissed from further analysis are described below.

Vegetation

No vegetation manipulation is planned under any alternative. Driving would be limited to designated routes, and no new trails or roads would be created. Use of traps or other predation management tools would not affect vegetation to the extent that it could not recover naturally. If, through predation management, coastal species of concern populations were to increase, it would not substantially affect vegetation. Suitable habitat for these species is generally restricted to unvegetated beach habitat; therefore, this topic was dismissed from further analysis.

Wildlife

Predation management could impact nontarget wildlife species by capturing them in traps. To reduce the likelihood for this impact, BMPs have been developed (see Chapter 2). For example, to reduce the risk of impacts on nontarget species, the NPS will select predation management tools that are as target-selective as possible; alternatively, it will apply such methods in a way to reduce the likelihood of capturing nontarget species. Before trapping begins, the NPS will select trapping locations that are extensively used by the target species and will use baits or lures that the target species prefer. Traps will be checked at least every 24 hours. Ideally, trap checks will be performed early in the morning to remove any captured animals prior to periods of high public use. Timely removal of captured animals will reduce the chance that the public and park staff may see and/or interact with captured animals. At times, it may be necessary to check traps several times daily depending on wildlife patterns and visitor use patterns. It may also be necessary to shut down or remove traps during busy times of day to complete avoid public interaction. Any nontarget species captured would be released.

Because impacts on nontarget wildlife would be addressed through BMPs, this impact topic was dismissed from further analysis; however, predator population impacts are analyzed further in this PEA.

Historic/Prehistoric Structures

Proposed predation management controls would not have the potential to introduce visual, atmospheric, or audible elements that could result in impacts on the character or use of historic properties. The methods proposed under this plan are not generally the types of activities that could affect historic properties; therefore, this issue was dismissed as an impact topic.

If, during site-specific NEPA compliance, a park unit manager determines that actions related to coastal species of concern protection would impact a historic property, site-specific consultation would be conducted, as required by Section 106 of the National Historic Preservation Act (NHPA).

Archaeological Resources

Trampling and ground disturbance associated with some predation management actions, such as setting traps and increasing patrols, could damage the integrity of archaeological sites. If an NPS unit proposes an action in the future related to coastal species of concern protection that would impact archaeological resources, site-specific compliance and consultation would be conducted, as appropriate, under NEPA and Section 106 of the NHPA. In addition, the following mitigation measure has been included in the PEA:

> Mitigation measures such as conducting cultural and archaeological surveys and implementing avoidance measures would be applied before predation management is implemented. If any cultural or archaeological resources were inadvertently discovered during a predation management activity, all work would be halted until the resources could be evaluated and an appropriate mitigation strategy developed to preserve the information and artifacts to the fullest extent.

With implementation of this mitigation measure, there would be no impacts on archaeological resources, and this topic was dismissed.

Cultural Landscapes

A cultural landscape is defined as "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (NPS 2006). Actions proposed in this plan would not change the way land is organized and divided, nor patterns of settlement and land use, systems of circulation, or the types of structures that are built. Because there would be no impacts on cultural landscapes, this issue was dismissed as an impact topic.

Ethnographic Resources

Predation management would not impact any site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significance in the cultural system of a traditionally associated group; therefore, there would be no impacts on ethnographic resources.

Water Quality or Quantity

Implementing predation management actions in this PEA would involve species surveying and management. These activities would not occur in the water and would not create sedimentation or erosion, increase runoff, or cause any other situations that could impact water quality. Water resources would not be consumed as part of proposed management activities; therefore, there would be no impacts on water quantity from implementing this PEA. The topic of water quality and quantity was dismissed from further analysis.

Floodplains and Wetlands

The alternatives evaluated in this PEA that protect coastal species of concern and their habitat depend on the habitat being in the 100-year floodplain; however, none of the alternatives would add any structures to the floodplain that would change its ability to convey water. Also, none of the alternatives would elevate the areas above the floodplain or reduce the capacity and function of the floodplain; therefore, the impact topic of floodplains and wetlands was dismissed from further analysis.

Wilderness

Some park units in the NPS Southeast Region have proposed and designated wilderness. There is a potential for some predation management tools to occur in wilderness and to affect wilderness characteristics due to an increased human presence and changes to naturalness through installation of temporary traps or the removal of a predator species.

Should a park unit determine there is a need to employ lethal or nonlethal management tools in wilderness, a minimum requirements analysis would be necessary for prohibited uses. NPS policy requires that all management decisions affecting wilderness must be consistent with the minimum requirement concept. This is a documented process to determine if administrative actions, projects, or programs undertaken by the park and affecting wilderness character, resources, or the visitor experience are necessary, and if so, how to minimize impacts. Park units would analyze impacts on wilderness character, if applicable, in site-specific NEPA compliance. Accordingly, this impact topic has been dismissed from further analysis.

Visitor Use and Experience

Some predator species are managed at the state level through hunting and trapping, and some park units authorized hunting and trapping, including hunting and trapping of predator species. Recreational hunting and or trapping are authorized in the following NPS Southeast Region parks:

- Canaveral National Seashore (hunting and trapping)
- Cape Hatteras National Seashore (hunting only)
- Cape Lookout National Seashore (hunting only)
- Cumberland Island National Seashore (hunting and trapping)
- Gulf Islands National Seashore (hunting only)
- Big Cypress National Preserve (hunting and trapping)
- Timucuan Ecological and Historic Preserve (hunting only)
- Jean Lafitte National Historical Park and Preserve (hunting and trapping)

Predation management would not change access to federal lands for hunting or fishing per Secretarial Order 3356. However, the management of predation through lethal actions in park units could impact the public's ability to hunt and trap these species on or off park unit lands, and use of nonlethal actions could impact the public's experience in the park units due to the disruptive nature of fencing and scare devices interfering with the ambience of the park. However, predation management could also indirectly allow for wildlife species populations, such as nonnative ring-necked pheasant, rabbit, and dove, to increase due to the removal of predators. Nonlethal management would be designed in such a matter as to reduce disruption to visitor experiences; for instance, fencing in certain area would be temporary to protect offspring and would be removed once offspring have left the nesting area. Overall, predation management is not expected to substantially affect hunting opportunities, as the number of predators removed from a park unit would be a small percentage of the total population (see Chapters 3 and 4 of the PEA).

Predation management could also impact visitor experience at park units since some visitors enjoy viewing predators, while others value the experience of seeing coastal species of concern. Since

management actions may not completely eliminate predator species from park units, predation management is not expected to substantially impact a visitor's ability to see predators and coastal species of concern are expected to increase in numbers. Therefore, this impact topic has been dismissed from further analysis.

Human Health and Safety

The alternatives presented in this document have the potential to pose increased threat to human health and safety. Specifically, the lethal removal of predators using firearms could pose a risk to the NPS professional engaged in the activity. In addition, some nonlethal control measures may impact human health and safety, like the placement of foothold traps in areas visited by humans. Examples of BMPs park units may employ to reduce impacts on human health and safety include:

- Ensure proper personal protective equipment is utilized during predation management activities.
- Ensure only personnel with proper training and experience conduct predator management activities.
- Notify supervisor, night shift personnel, or law enforcement personnel when predator management activities commence and end.
- NPS staff will be familiar with visitor use patterns in the park. Staff will coordinate with visitor use personnel to identify factors that impact wildlife control operations taking place such as high public use areas, times of day or seasons of high visitor use, etc. In some instances, the amount or type of visitor use may negate the implementation of control operations.
- NPS staff will be familiar with park infrastructure, including structures, roads, trails, campgrounds, bodies of water, parking lots and any feature that presents a safety hazard during control operations involving discharging firearms. Staff will make all possible efforts to discharge firearms in a safe, discreet, manner utilizing safety as the primary concern.
- When necessary, utilize NPS visitor use staff to notify visitors of certain operations and educate them on the details in a manner that will reduce potential safety hazards.
- When deemed necessary, notify park's law enforcement division of specific activities and coordinate any necessary or anticipated actions relative to visitor safety.
- Implement employee time management protocol for staff subject to working night hours to avoid fatigue and increased potential for accidents.
- Ensure NPS staff working with wildlife have a rabies vaccination.
- Ensure NPS staff have all necessary safety equipment to employ predation management techniques.
- Trap devices and related equipment will be stored safely in a locked building when not in use. Traps can be stored in a locked container in NPS vehicle during trapping operations if staff feel it necessary to prevent public from potentially accessing the devices. Otherwise, traps can be transported open in a vehicle. Traps will be transported in an unset condition and set on site just prior to being put out for capture. Cautionary signage may be utilized for traps transported in a vehicle or stored to warn of possible danger to people unfamiliar with their use.

Socioeconomics

Predation management is not expected to have a noticeable effect on the opportunities for hunting around NPS Southeast Region park units or surrounding regions and populations; therefore, this issue was dismissed from further analysis.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to analyze disproportionately high and adverse environmental impacts of proposed actions on minority and low-income populations. All actions proposed in this PEA would occur within park units in the NPS Southeast Region, which are distributed along the Atlantic coast of the US. Impacts would similarly be spread throughout these areas and impacts would not be concentrated in areas with minority and low-income populations. As such, the NPS has determined that implementation would not have adverse human health or environmental impacts on low-income or minority populations, so this issue was dismissed from further analysis.

Indian Trust Resources

Secretarial Order 3175 requires that any anticipated impacts on Indian trust resources from a proposed project or action by the US Department of the Interior agencies be explicitly addressed in environmental documents. There are no known Indian trust resources in the plan area, so Indian trust resources and sacred sites were dismissed from further analysis.

ALTERNATIVES CONSIDERED BUT DISMISSED

Alternatives considered but dismissed are those that are not technically or economically feasible, do not meet the purpose of or need for action, would create unnecessary or excessive adverse impacts on resources, or would conflict with the overall management of a park unit.

Translocating Predators Outside of Parks

With the exception of feral cats, translocating wildlife outside of park units was dismissed. Most states do not allow or discourage wildlife to be transported within the state, often due to disease transmission concerns or other unintended consequences. Further, this alternative presents humaneness concerns, due to increased competition in the area where the animals would be relocated.

Nonlethal Control Only

Under this alternative, the NPS would implement nonlethal methods only in order to manage predation on coastal species of concern. The NPS would not intentionally lethally remove predators. The nonlethal methods used or recommended by the NPS under this alternative would be the same as those identified under Alternative A.

Nonlethal control of predators is an important component of an overall program to protect coastal species of concern. Park units currently implement a variety of nonlethal control methods, such as fencing and screening; however, there are situations when nonlethal control methods are ineffective. For example, when a predator can circumvent protective barriers; when adults, chicks, and hatchlings move outside of an area protected by nonlethal means; and when the number of nests that need protection exceed the number of staff or materials available. Some nonlethal control methods require staff to intervene immediately, such as caging nests as soon as eggs are laid or hazing predators when they are active throughout the night. This may not be possible when staffing is limited or when coastal species of concern are remote and dispersed.

Nonlethal harassment often has a high rate of habituation[1] after multiple applications (Gilsdorf et al. 2003; Shivik 2004). To lessen habituation, nonlethal harassment and dispersal techniques should be used only when predators are present. This can lead to elevated costs from increased monitoring of vulnerable resources. As a result, this alternative alone would not meet the purpose of and need for action.

The proposed action incorporates the use of nonlethal methods to manage predation. In those instances where nonlethal methods would effectively control predators, they would be used or recommended under the proposed action. Since nonlethal methods would be available for use under the alternatives analyzed in detail, this alternative would not expand the range of alternatives beyond those that are analyzed in detail.

No Predation Management

There are a number of methods to protect coastal species of concern, such as through habitat restoration, light pollution control, and management of human disturbance; however, these methods are most effective when used in conjunction with predation management. In this PEA, the NPS chose to focus on predation management. Without predation management or control, coastal species of concern would continue to be depredated, regardless of other protection efforts that are implemented. This could cause populations to continue declining and could prevent species management objectives or recovery to be achieved.

This alternative was dismissed because it would not meet the purpose of and need for action. Moreover, it would not meet the requirements of the parks' enabling legislation to protect natural resources or other federal, state, and county policies pertaining to coastal species of concern.

Habitat Restoration as a Stand-Alone Element

While habitat restoration is critical to coastal species of concern protection, it is just one component of it. No management in this plan would preclude parks from taking additional action, such as habitat restoration, and park units will continue to restore habitat. Nevertheless, the purpose of and need for this PEA is focused solely on predation management for coastal species of concern; habitat restoration is not the intent of the PEA. As such, this alternative component would not meet the purpose of and need for action, so it was dismissed.

Management of Predator Species Solely Based on Home Range

Under this alternative, the NPS would manage predation based on predator species' home ranges. If a predator's home range overlaps with a known coastal species of concern nest or population, the NPS would remove the predator because it could prey on the coastal species of concern.

While a species' home range is an important consideration in determining whether to implement predation management, this approach may not always be effective when used as the only determining factor for taking action. Specific locations of individual nests are not always immediately known, making it difficult to determine when they might fall within a known predator's home range. If basing an action on the overlap of a predator's home range and a coastal species of concern nest or population, protection becomes more difficult. Further, home ranges vary by species and region, and other factors may influence a species' home range and the likelihood of predation, such as habitat quality, available

[1] When an animal becomes accustomed to something, in this case human presence or actions.

food, and the geography of a park unit or barriers to movement. Such factors would limit the effectiveness of this approach. This alternative was dismissed, because it would not meet the purpose of and need for action.

Predation Rate Threshold

Under this alternative, action would not be taken until a certain threshold of predation was observed. The predation rate would be the only factor taken into consideration when conducting predation management. It would be a reactive approach, based on known predation of coastal species of concern. In addition, more predation could occur during the lag time between measuring a certain rate of predation and taking predation management actions. While the NPS recognizes that predation is a natural ecological function, predation may conflict with the recovery of some federally and state listed species under the Endangered Species Act.

Further, this approach would not resolve the purpose of and need for taking action for all park units. For instance, the USFWS recovery plan for the loggerhead sea turtle (NMFS and USFWS 1991) states that ecologically sound predator control programs should be implemented to ensure that the annual rate of predation on sea turtle nests is 10 percent or less. If applying a 10 percent threshold for predation management action for sea turtles across the Southeast Region, some park units that have high concentrations of sea turtle nests, such as Canaveral National Seashore, may experience significant loss of sea turtle nests.

While park units will continue to work toward recovery goals specified by the USFWS, the threshold-based approach to predation management was dismissed as a standalone alternative. Predation rate is one of several factors that has been incorporated into Alternative B as a trigger for taking action.

Seasonal Predation Management during the Nesting or Breeding Season Only

Under this alternative, predation would be managed only during nesting or breeding seasons. Predation management is most effective when it is done year-round. While predation management for some species is used only during the nesting season, such as using screens to protect sea turtle nests, management outside of the breeding or nesting season may be critical to protecting some coastal species of concern. For instance, predation management for shorebirds is most effective when done before the breeding season. This alternative was dismissed, because it would not meet the purpose of and need for taking action.

Predation Management Tools Considered but Dismissed

Fertility Control for Predator Species

Predator fertility control was dismissed due to technical infeasibility and because it would not meet the purpose of and need for action. This method is difficult due to the need to capture one gender of a breeding species and due to the number and variety of predators under consideration. Fertility control does not exist for all predator species and would not immediately remove predators from park units. If it were used, any predators remaining in the park could still prey on coastal species of concern. Fertility control techniques often have proven uneconomical or infeasible for practical implementation even in small, localized populations (Fagerstone et al. 2002). Further, fertility control can take a long time and require repeated applications to achieve population reduction consistent with objectives, requiring additional expertise and staffing that many park units do not currently have.

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