

Piping Plover (*Charadrius melodus*) Management Plan



National Park Service
Assateague Island National Seashore

Piping Plover (*Charadrius melodus*) Management Plan

Assateague Island National Seashore

(Amended May 2001)

Prepared By: _____
Wildlife Resource Specialist Date

Recommended By: _____
Chief, Division of Resource Management Date

Approved By: _____
Superintendent Date

Assateague Island National Seashore
7206 National Seashore Lane
Berlin, MD 21811 (410) 641-1443

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	BACKGROUND	2
	Site Description	2
	Overview of Past Practices	2
	Historic Breeding Success	3
III.	BREEDING BIOLOGY	4
	Reproductive Requirements	4
	Breeding Chronology	5
IV.	MANAGEMENT ISSUES	6
	Management Zoning	6
	Off Road Vehicle Use	6
	Habitat Dynamics	7
	Predation	8
	Disturbance	9
	Recovery Plan	9
V.	RECOMMENDED MANAGEMENT PROGRAM	10
	Pre-Season Surveys	10
	Monitoring	10
	Injured and Dead Specimens	11
	Public Use Area Closures	11
	Predator Exclosures	12
	Internal Controls	13
	Public Information	13
	Enforcement	14
	Consultation and Coordination	14
	Annual Reporting	14
VI.	REFERENCES	15
VII.	APPENDICES	16
	Chronology of NPS Plover Management at Assateague Island	16
	Location Map of Management Zones	23

I. INTRODUCTION

Congress authorized Assateague Island National Seashore (ASIS) as a unit of the National Park Service (NPS) in the Act of September 21, 1965 (Public Law 89-195). A general statement of purpose for the park was included in Section 1 of the Act, which called for the protection and development of Assateague Island for outdoor recreational use and enjoyment.

This purpose was amended by the Act of October 21, 1976 (P.L. 94-578) which directed the Secretary of the Interior to prepare a "comprehensive plan" which would include, among other things, "measures for the full protection and management of natural resources and natural ecosystems of the seashore." The General Management Plan (GMP) (National Park Service 1982) which evolved from this mandate reflects a systematic approach to park management whereby recreational use and development is balanced with the need to ensure long term preservation of natural resources, processes and values.

In 1986, the Atlantic Coast population of the Piping Plover (*Charadrius melodus*) was added to the United States List of Endangered and Threatened Wildlife and Plants as a threatened species. The term "threatened species" means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Consistent with the purposes of the Endangered Species Act of 1973 (ESA), the National Park Service will seek to identify and promote the conservation of all federally listed species within park boundaries and their critical habitats. As necessary, NPS will control visitor access to and use of critical habitats, and may close such areas to entry for other than official purposes. Manipulative activities such as habitat or species restoration are encouraged if such activities would result in a more representative distribution of the species within the park (National Park Service 1999).

Sections of ASIS provide suitable breeding habitat for beach-nesting birds. The northern 9.5 kilometers (km) of ASIS, the "north end", is zoned as a natural-primitive area and supports the majority of plover nesting activity within the Seashore. Since surveys began for Piping Plover in 1985, all nesting activity within the state of Maryland has been confined to Assateague Island, primarily on the north end.

Consistent with NPS policies, ASIS has implemented a comprehensive management program to conserve breeding populations of Piping Plover that occur within ASIS boundaries. This program will strive to create favorable conditions needed to enhance site selection, nesting, and productivity levels for this threatened species. The purpose of this document is to review and summarize past practices, current knowledge, and planned management activities regarding the protection of Piping Plover breeding activities in the Maryland portion of ASIS.

Due to the highly variable nature of plover breeding biology, predation pressure, habitat availability, and fiscal resources, changes in the management of breeding plovers at ASIS will likely become necessary over time. This plan will be reviewed and updated on an as-needed basis to reflect changing circumstances, incorporate new information, and address unforeseen exigencies.

II. BACKGROUND

Site Description

Assateague Island is located along the Maryland/Virginia Atlantic coastline. The Virginia portion of Assateague Island is federally owned and managed by the U.S. Fish and Wildlife Service (FWS) as the Chincoteague National Wildlife Refuge (CNWR). Under a Memorandum of Agreement with the FWS, the NPS manages recreational activities within the upper Toms Cove Hook portion of CNWR. Areas within and adjacent to the NPS-Virginia recreational beach and housing area support a breeding population of Piping plovers. NPS activities are reviewed annually as part of a CNWR Section 7 Evaluation.

The 35 km Maryland portion of Assateague is also federal property and is managed by the NPS, except for a 3.2 km section that lies primarily south of MD Rt. 611 comprising the state of Maryland owned Assateague State Park (ASP). The NPS has concurrent jurisdiction over the lands and waters within ASIS, whereby both the NPS and State of Maryland have the legal obligation and authority to enforce criminal law in the park. The NPS boundary includes the waters surrounding the entire island to one-half mile offshore, except where adjoining land masses restrict that distance and jurisdiction is reduced to reflect the natural landscape or proprietary interests.

The 3.2-km section of the island immediately south of ASP is managed by ASIS as a developed recreational area, and includes campgrounds, day-use facilities and interpretive trails. The 19 km section south of the developed area, to the MD/VA state line, is managed as a primitive and traditional recreation area, which permits regulated off road vehicle (ORV) use, back-country camping and hunting.

The northern 9.5 km of Assateague is managed as a primitive area. Public access is limited to foot and boat-in traffic. Vehicular traffic is limited to park service patrols and authorized research activities. The northern tip of the island, at the Ocean City inlet, is stabilized with a jetty and breakwater system in order to maintain a commercial navigational channel. These structures, in place since the 1930's, have contributed to accelerated shoreline erosion and island migration along the northern portion of the island. Spoils resulting from inlet and bay maintenance dredging in the 1960's and 1970's were placed along the northern-most kilometer of the island and in scattered locations to approximately 3 km south of the inlet.

Assateague's natural environment is typical for a mid-Atlantic barrier island. An intermittent primary dune line supporting beachgrass, panic grass and goldenrod borders high energy beaches. Scattered secondary dunes and wide overwash fans grade to bayberry shrub thickets and Loblolly pine stands. Saltmarsh cordgrass and other saltmarsh herbaceous species make up the island's extensive bayside wetlands. The northern 9.5 km of the island is frequently overwashed by storm activity and features few dunes or woody plant communities, except for the old dredged material disposal areas which support a thick growth of upland plant species.

Overview of Past Practices

The first systematic survey for Piping Plover on Assateague Island was made in 1985, followed by a two-year breeding study in 1986, and a three-year ecology and behavior study beginning in 1988. These studies were specific to the breeding population of Piping Plover on ASIS, and have formed the core scientific knowledge that guides management practices. A chronology of plover research and management activities conducted at ASIS may be found in Appendix A.

In 1988, ASIS initiated management efforts for the protection of breeding Piping Plovers. Since that time, the majority of breeding activity has occurred on the northern 9 km of the island, although limited nesting has occasionally taken place at isolated locations along the ORV zone. Routine management activities have included the use of exclosure cages to protect nests from predators, and recreational use restrictions to reduce human disturbance in breeding areas.

As research findings have been made, the management program has evolved to reflect the particular conditions found at Assateague. Predator exclosure designs have changed, and recreational use restrictions altered to reflect actual mean disturbance distances for nests, and the protection of critical feeding areas. Due to the magnitude of areas closed for individual nesting pairs and the disturbance related to installation of signs, the park adopted a public use area closure encompassing all critical nesting and foraging habitats on the north end. Discrete nest-site closures have continued to be the most appropriate mechanism for protecting the occasional nest sites located in the ORV zone.

Cooperating researchers from 1986 through 1990 provided population monitoring efforts. In 1991, ASIS assumed monitoring responsibilities in addition to management efforts. In that year the Maryland Natural Heritage Program (NHP), which later became the Heritage and Biodiversity Conservation Program (HBC) and is now referred to as Maryland Department of Natural Resources (DNR) Forest, Wildlife and Heritage Service, entered into a cooperative relationship with ASIS to assist in the monitoring and management program. That cooperative effort continues to provide staffing and advisory support to the NPS.

Historic Breeding Success

The definition for breeding pair has been defined in two ways by former investigators at ASIS. Patterson (1988) defined breeding pair as birds that have demonstrated breeding behaviors; e.g., courting, nest scraping, etc. Loegering (1992) defined breeding pair as a pair, which produces at least one egg. To avoid future confusion in ASIS literature, pairs that are documented producing at least one egg will be referred to as a nesting pair, while pairs which exhibit breeding behaviors are referred to as breeding pair.

Nest surveys have been the basis for breeding population estimates and have been conducted for Piping Plover at ASIS since 1985. These estimates assume that all pairs are found and re-nesting attempts are correctly identified. Breeding success is measured by the average number of fledged young per adult pair for the local population. For Piping Plovers, the reproductive output believed necessary to provide stability for the ASIS population is 1.4 chicks fledged/nesting pair (Loegering 1992). The breeding population at ASIS remained fairly stable between 1985 and 1993, with a mean of 20 pair (Table 1). The breeding success rate during that period fluctuated between 0.4 and 1.2 chicks fledged/pair. Physical changes to the north end habitat which began following overwash events in October 1991 and January 1992, are believed to be responsible for an acclivity in breeding success following those events. By 1996 the breeding population had increased to 61 pair, and the breeding success rate between 1992 and 1996 averaged 1.7 chicks/pair. Since 1997, the number of breeding pair has ranged from 56 to 61 with a mean of 59, while the breeding success rate during this period averaged 1.1 chicks/pair.

Table 1: Historic Breeding Results			
Year	Breeding Pair	Total Nests	Chicks Fledged Per Breeding Pair
1985	19	?	?
1986	17	23	1.1
1987	23	33	1.2
1988	25 ^a	34	0.5
1989	20 ^a	27	0.9
1990	14 ^a	20	0.8
1991	18	20	0.4
1992	24	30	1.0
1993	20	30	1.7
1994	32	42	2.4
1995	44	45	1.7
1996	61	72	1.5
1997	60	100	1.0 ^b
1998	56	71	1.3
1999	58	74	1.1
2000	60	96	0.8
^a Calculated from nesting pair (Loefering 1992)			
^b Fledging predicted from 15 day survival (Kumer 1997)			

III. BREEDING BIOLOGY

Much of the ecological information available for the Piping Plover specific to Assateague was obtained through the Loefering study (Loefering 1992). The following sections briefly summarize the results of that study and also what is presently known regarding the reproductive requirements and breeding biology of Piping Plover at Assateague Island.

Reproductive Requirements

Piping Plover nest in a variety of habitat types on Assateague Island, including ocean beaches above the high tide line, gently sloped dunes, sparsely vegetated back-beach sand flats, and overwash fans. In general, nests are located on flat portions of the island (70%) devoid of vegetation (81%). Availability of quality nest sites may change year to year due to storm events or vegetation succession. It has been predicted, and recently observed, that the ASIS breeding population will increase in years following major winter storm events due to the reduction in woody vegetation or the creation of new overwash flats. Reproductive success may also increase following these events.

At ASIS, it appears that foraging areas, together with suitable nest site habitat, may determine where the plovers prefer to breed. Early during the courtship process, plovers select open back beach and overwash flats for their apparent value as both nest and forage habitat. When these features are absent or limited, open ocean-side areas, especially those with access to bay beaches or adjacent mud flats, are selected. This habitat preference coincides with available plover prey as determined by surveys. Prey items were found to be most abundant along bayside shorelines, bay mudflats and moist vegetative edges along overwash fans and island interior wetlands. Comparatively little prey was documented along the ocean beach, and plovers were observed less frequently than expected on the berm and ocean tidal zone.

When open interior and overwash fans are lacking, foraging rates and invertebrate prey abundance both indicate that poor chick survival may be the result of low food availability. Young chicks forage at greater rates in bay beach and island interior habitats, weigh more, and have a higher probability of survival (>70%) than those in other habitat types. Broods reared primarily on the ocean beach have the lowest survival (19%). Chicks restricted to habitats without sufficient forage appear to lag in weight gain, and may succumb to exposure or predation at a greater rate.

From 1988-1990, Loegering documented that 75% of plover chick mortality occurs within the first 6 days of life. Combining his data with that of 1992-1996 indicates that 81% of mortality occurs by day 7. Specific causes of this early chick mortality are poorly understood, but are known to include predation by mammals, birds and crabs. A similar rate of chick mortality has been observed at the southern end of Assateague Island within CNWR where 70% of losses occur in the first week.

On average, plover chicks move less than 200 m from their nest site in the first 10 days of life, although one brood was documented moving to bayside mudflats 1.5 km from the nest site. Broods generally confine their feeding activity to an area several hundred meters in length. A 1993 observation of 11 successful broods showed brood use areas ranging from 2.6 to 16.2 ha.

Loegering (1992) observed that plovers on ASIS appear to be more sensitive to disturbance than at other East Coast sites. The reasons are unknown, but were speculated to be due, in part, to the local population being acclimated to a relatively undisturbed nesting area, or because the generally flat terrain allows plovers to see approaching people sooner. The greatest nest flush distance was found to be 174 meters with an additional 50 meter agitation distance. For management purposes, the recommended buffer zone for protecting nest sites was 200 meters.

Subsequent annual observations indicate that while many of the nesting adults have a disturbance distance closer to the 100 meter norm for the species, a portion of the ASIS plovers do show behavioral responses at or beyond 200 meters.

Breeding Chronology

Piping Plover arrive on the breeding grounds in mid to late March, more than a month prior to nest initiation. During this period, the birds initiate courtship, select territories, and forage in preparation for the breeding season.

Plover spend from days to weeks in pair-bonding rituals and mating prior to initiating an actual nest. Nest scrapes may first be observed in early-April, with egg laying beginning in mid to late April (earliest record 4/11). The latest recorded (re)nest initiation occurred on July 3. Eggs (average 3.8/nest) are laid over about a 7 day period. Incubation begins after the third or fourth egg is laid and lasts approximately 28 days.

Plover chicks are precocial and leave the nest site for feeding habitats after 1-2 days. After the third week, parents become less attentive and chicks feed further apart. Chicks fledge at about 25 days of age but may stay within the brood foraging area until about 31 days old. In general, most chicks have fledged by mid to late August. The length of time that fledged birds need to forage before they begin migration is unknown, but may be related to forage quality and availability, and disturbance levels prior to fledging.

Post-fledgling surveys in 1992 and 1993 indicate that most of the local breeding plovers begin to migrate away from the nesting grounds within one week after brood fledging.

IV. MANAGEMENT ISSUES

Management Zoning

ASIS's approved GMP established management zones to guide protection and use of seashore lands. Piping Plover management, and general park management activities, which may influence plover habitat, will vary dependant upon management zone. Three primary zones were designated by the plan: natural, development, and historic (Appendix B). The natural and development zones were further subdivided into primitive and traditional recreation zones, and general recreation development areas and administrative sites, respectively. The few areas zoned historic contain cultural resources and are generally located in the interior portions of the island.

The natural zone comprises 91% of all land in the Maryland portion of ASIS. Eighty two percent of this zone is managed as primitive, with the remainder designated as a traditional recreation zone. ORV use is permitted within the traditional recreation zone, an area which consists of a narrow strip of ocean beach and adjacent land 19 km long extending from the developed area south to the MD/VA state line.

Two of the park's six backcountry campsites are located within the traditional recreation zone, in areas with potential as Piping Plover nesting habitat. These two sites are subject to movement or temporary closure should conflicts with breeding plovers occur.

In general, dune construction and maintenance are considered incompatible with management objectives for the primitive and traditional recreation zones. The only exception occurs at the "Bull Pen"; a designated 150 x 300 meter self-contained vehicle parking area located approximately 6 km south of the developed zone. At this site, dune formation may be minimally encouraged through the placement of sand fencing.

The general recreation development zone includes all parking areas, picnic areas, campgrounds, lifeguard protected beaches, bathhouses, interpretive trails and ranger/visitor contact stations. These facilities are concentrated along the 3.2 km developed area known as North Beach, immediately south of Assateague State Park. An active program of dune construction and maintenance will be conducted within this area to protect facilities and infrastructure from storms and overwash events.

The administrative development zone includes the NPS headquarters/visitor center complex on the mainland and a number of structures on the island set aside for administrative uses including research support.

Off Road Vehicle Use

ORV use has occurred on the island since the late 1920's. This traditional recreational use was acknowledged in the Park's enabling legislation, and use limits were described in the GMP.

In 1972, Executive Order 11644 set forth use stipulations for ORV's on public lands, including considerations for the protection of resources. Executive Order 11989, in 1977, further stipulates that federal agencies should close areas to ORV use when (it) determines that said use will or is causing considerable adverse effects on resources.

Primarily, fishermen used ORV's to access the length of the ocean beach. A secondary route known as the "back trail" followed the mid-island path of a former paved road, and a number of spur roads led to hunting cabins or popular bay access points. These off-beach trails have been maintained on an as-need basis, primarily to fill in significant holes or provide localized drainage.

Most of the retained-use hunting properties converted to NPS ownership in 1999. With that in mind, the back trail was formally closed to ORV traffic after significant roadway damage occurred in a 1998 overwash event. Several spur roads were also removed from service in 1999 since they did not serve a vital function.

As of 2001, the traditional recreational zone along the ocean beach will remain open to ORV traffic. In addition, a set number of dune crossing spurs will be kept active to provide access to administrative facilities, backcountry campgrounds, and centralized parking areas for hunters.

In recent years, Piping Plover use of the ORV zone has been sporadic. Signed buffers were adequate in reducing human disturbances to the nests. ORV traffic was limited to either the back trail or ocean beach in order to safeguard brood foraging areas.

Under the current ORV zone setup, nests will be afforded adequate protection. Based on brood foraging behaviors on the north end, it is believed that any broods will likely target the wider overwash fans for foraging. In the event that a brood in the ORV zone utilizes the ocean beach, the site will be assessed and traffic temporarily routed to the former back trail or traffic prohibited from traveling past the site until the brood is independent of the beach habitat.

Minimal maintenance of dune crossings, including occasional leveling, grading or ditching, will be used to provide for safe travel. Whenever possible, maintenance activities are conducted during the non-breeding season. When work is required during the plover breeding season, appropriate precautions (enhanced monitoring, site surveys, construction monitors, etc.) are taken to ensure that activities do not impact plover territory establishment and reproduction.

Habitat Dynamics

The wide, flat, sparsely vegetated beaches preferred by the Piping Plover are a transitory habitat, dependent upon natural forces for renewal and susceptible to degradation by human activities. Much of the plover's historic habitat along the Atlantic Coast, including Maryland, has already been destroyed or permanently modified by development and shoreline stabilization activities.

A variety of past activities occurring within or adjacent to ASIS have played a significant role in shaping the present configuration and character of the island. In some instances, these perturbations have resulted in a deterioration of habitat quality for Piping Plover breeding activity.

Records show that Assateague Island has transformed over time from numerous smaller islands, to a continuous barrier spit, to its present configuration. In 1932, the island was a continuous spit, connected to what is now known as Fenwick Island/Ocean City. Following the hurricane of 1933 that severed the island, the U.S. Army Corps of Engineers (COE) stabilized the newly created inlet with jetties. Since that time, maintenance of the navigation channel and jetty system has disrupted natural longshore sediment transport resulting in a sediment deficit on Assateague Island.

As a consequence of the diminished sediment supply, the northern portion of the island has experienced unnaturally accelerated rates of shoreline erosion and landward migration. While

generally regarded as a major negative impact, this situation may have benefited plovers through the resultant loss of dune fields and woody vegetation. At present, most of the northern 9 km of the island is very low and susceptible to storm overwashing. While this condition favors the maintenance of habitat qualities favorable to plover nesting, nest sites are more susceptible to extreme high tide flooding and the lack of vegetation reduces cover for chicks.

A sand by-pass system has been proposed to offset the sediment deficit along the north end due to the inlet stabilization structures. The project has been designed to place an annual sediment load into the near-shore waters off of the north end, permitting the longshore currents to distribute the sediment in a natural manner. Based on an analysis of the current literature, the FWS has issued a biological opinion that the project is not likely to jeopardize the species (Wolflin 1999).

A second issue related to habitat dynamics involves dune stabilization. Until recently, the 19 km ORV zone was bordered by a continuous man-made dune constructed in the late 1960's. Seventy percent of that dune has now degraded through natural events, and that portion of the island is reverting to a normal barrier island topography. With these changes has come an increase in open inter-dune habitat and overwash fans. As natural processes reshape this area, the potential for plover use may increase.

With the exception of development areas where primary dunes will continue to be maintained, natural events and processes now dictate habitat dynamics along the majority of the Maryland portion of the Seashore.

Predation

Under the NPS Organic Act and ASIS legislation, the National Seashore is charged with maintaining the natural resources and processes inherent to the barrier island ecosystem. Predation is an integral component of that ecosystem and, in general, will be allowed to occur unless clearly evidenced to present a significant threat to the survival of a federally listed species. This is considered to be the case with Piping Plovers. Past research at ASIS has shown that nest survival and hatching success (no. of eggs hatched/no. eggs found) was low compared to other areas (Loefering 1992). This low nesting success was attributed to predation pressure.

In order to enhance Piping Plover reproduction efforts, attempts will be made to limit losses from intended harassment or depredation. Specifically, management efforts will attempt to protect plover nests. This will be accomplished through the installation of predator exclosures around individual nests. It is believed that if broods have the opportunity to hatch and move to primary forage habitat, and if unfledged plovers can avoid natural predation pressures, a fledging rate may be achieved which will stabilize or increase the local population. This assumption is based on the belief that through adaptation and related behavioral responses, plover broods are able to survive in their selected habitat.

The species, number or behavior of any potential predator is likely to fluctuate over time, depending on population ecology and broader environmental circumstances. Weather events, disease and depredation success rates have all been observed to influence nesting success at ASIS.

During periods of infrequent overwash events, expansion of woody vegetation may inhibit plover chicks from accessing the preferred wetland foraging habitats. Broods would then be forced to forage along the ocean beach, where known depredating species appear to be more abundant. Because of the poor forage potential along the ocean beach, starvation induced weakness may increase the rate of predation.

Actual predation on Piping Plover and their eggs is difficult to document. Usually, tracks or other site evidence give some indication of the depredating species. Species known to cause nest abandonment or predation at ASIS include: horses, red fox, raccoons, crows, falcons, gulls, grackles, herons and ghost crabs.

Because of the variety of potential predators, eradication efforts are not justified or appropriate. However, if targeted harassment or depredation by a specific individual or intra-species group of animals was documented as having a significant impact on the Piping Plover breeding population, management, including lethal control, would be justified.

Disturbance

Behavioral responses, such as flushing from a nest or cessation of foraging activity, reflect the inherent sensitivity of plovers to human disturbance. Even at distances greater than those resulting in actual behavioral response, plovers undergo physiological changes related to the stress of human presence. Disturbance can result in unnecessary expenditures of energy through flight, decreased foraging efficiency, and increased risk of egg/chick loss through exposure and predation.

Disturbance to plovers on breeding grounds by humans is one impact on productivity that can be readily controlled. In order to provide reasonably undisturbed nesting and foraging areas, ASIS has set a human disturbance buffer zone of 200 meters around most nest sites and primary forage areas. The only situation where the 200 meter buffer is not provided occurs when north end nest sites are established close to the ocean inter-tidal zone corridor which remains open to foot traffic and occasional official vehicle travel.

Vehicular traffic in the ORV zone is another potentially impacting disturbance to breeding Piping Plovers. In most cases, however, this threat has been successfully mitigated at ASIS. As breeding is detected during early season monitoring, critical portions of the ORV zone are closed to public use, with traffic routes altered depending on scrape, nest or brood location. During a review of the ORV situation, the FWS found that current use and management of the route was acceptable in terms of plover protection (Pisapia, 1991).

All pets are prohibited year round from the primitive management zone on the northern end of Assateague Island where the majority of plover breeding activity takes place. In other areas, such as the development and ORV zones, pets are permitted but must be physically restrained by a leash at all times. All feral pets are removed from the island whenever found.

Recovery Plan

The FWS Piping Plover Atlantic Coast Population Revised Recovery Plan (1996) seeks as primary recovery criteria: a breeding population of 2,000 pair, distributed among four recovery units (400 pair in the Southern unit), and a five year average productivity of 1.5 fledged chicks per pair, among other criteria.

Recovery tasks include:

1. Manage breeding Piping Plovers and habitat to maximize survival and productivity.
2. Monitor and manage wintering and migration areas to maximize survival and recruitment into the breeding population.
3. Undertake scientific investigations that will facilitate recovery efforts.
4. Develop and implement public information and education programs.
5. Review progress towards recovery annually and revise recovery efforts as appropriate.

Section 7 (a)(2) of the ESA requires that "...each federal agency shall, in consultation with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered or threatened species or results in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical..."

V. RECOMMENDED MANAGEMENT PROGRAM

A wildlife resources specialist will supervise the Piping Plover monitoring and management program. A wildlife technician will coordinate all field activities. Annual monitoring and management goals will be presented to cooperators in DNR. Monitoring or management activities which deviate from recommended procedures defined in the Recovery Plan, or activities which could impact the breeding success of the plovers will be presented through informal consultation with the FWS Piping Plover recovery biologist and/or the FWS regional endangered species biologist for approval.

The NPS expects to provide a consistent, but minimal level of field staffing and logistical support. The NPS will continue to coordinate with DNR in securing field assistance for the wildlife technician. The level of monitoring and management for the annual program, beyond the minimum necessary to document breeding success, will be based on the availability of staff through additional funding sources.

The primary annual monitoring goals are to estimate the local breeding population and to estimate the fledging success in terms of an average number of fledged chicks per breeding pair.

The primary management goals are to reduce disturbance by humans other than plover monitoring staff, utilize predator exclosures around nests when necessary to reduce depredation of eggs, and to alter ORV traffic to reduce direct threats to incubating adults and foraging broods.

Pre-Season Surveys

A late fall/early spring survey of the island will be made to document vegetative patterns and high probability plover use areas. As needed, a map will be generated for the primary breeding habitat to assist in the monitoring and documentation of plover nesting and foraging area use. Based on the survey findings and past plover use, a determination will be made each Spring on which areas will be closed to public access for the breeding season. These areas are subject to change due to actual breeding distribution and habitat requirements.

Monitoring

Piping Plover begin migrating through ASIS in early March; the same time that local breeding birds arrive on territory. Past monitoring indicates the local breeding plovers will select their nesting habitat based, in part, on the availability and proximity of foraging habitat. The public use area closures determined by the pre-season habitat survey should insure the protection of both nesting and critical foraging habitat without the need to perform extensive pre-nesting surveys of birds. This will reduce disturbance of early courtship activity by plover monitors. However, field staff will document plover sightings made during the installation of area closure signs, which begins in early April.

In general, systematic surveys of all potential plover nesting habitats will be initiated by mid-April. The surveys will concentrate on the north end, where historically all or nearly all nesting has occurred.

Less frequent surveys will be conducted in the ORV zone. The number of available, trained personnel will dictate the exact frequency and intensity of nest searches in any given year. All established territories will be monitored regularly once identified.

As nests are located, each site will be monitored for incubating adults and reproductive activity. Documentation during this period will include information on the number and timing of eggs laid, incubation activity, disturbance events, timing and success of hatching, and possible causes of nest failures.

Once hatched, attempts will be made to locate each brood and count chicks on a regular basis to facilitate identification of the broods, track movement patterns, and predict fledging success. At low population levels, broods will be monitored until the 25th day or the chicks are seen flying. At higher populations and without adequate staffing, broods may be followed until day 15, which is the calculated date when chicks have a 99% chance of survival through fledging age (Kumer 1997).

Additional monitoring efforts necessary to determine breeding population and fledging success will be dependent on priority information needs and available workforce.

Injured and Dead Specimens

50 CFR Section 17.21(c)(3) provides that any employee or agent of a Federal land management agency may take endangered (or threatened) wildlife without a permit, if the action is necessary to: (i) aid a sick, injured, or orphaned specimen; or (ii) dispose of a dead specimen; or (iii) salvage a dead specimen that may be useful for scientific study. Section (c)(4) requires that any such taking must be reported in writing to the U.S. Fish and Wildlife Service, Division of Law Enforcement, P.O. Box 19183, Washington, DC 20036, within 5 days.

Any injured Piping Plover discovered within ASIS will be assessed for the extent of injury. Minor injuries that do not appear to be life threatening will simply be noted in the annual report. Seriously injured or sick Piping Plover will be recovered and transferred to Tri-State Bird Rescue Center or a similarly FWS approved rehabilitation center for treatment. Rehabilitated birds will be released on site, unless timing or extent of injuries requires other handling procedures or deposition. The regional FWS Endangered Species Biologist and/or the DNR Endangered Species Biologist will be consulted in such matters.

Ordinarily, eggs abandoned on the nest will be allowed to recycle naturally. Dead birds will be recovered and preserved until the FWS determines if a necropsy or other scientific use is warranted.

Public Use Area Closures

The potential disturbance by humans of Piping Plovers during the breeding season will be controlled at ASIS through the use of enforced public use area closures. Area closures will include both nesting and critical foraging habitats as defined by past research, pre-season surveys and routine monitoring. The level of enforcement is dependent upon staffing. Ideally, enforcement rangers trained for plover protection will patrol critical habitat by foot, boat and vehicle from April through August.

In consideration of past levels of plover use, most of the north end of Assateague is likely to require public use closure on an annual basis. Because of the observed numbers, distribution, movement between re-nesting attempts, mobility on feeding grounds, and potential disturbance by staff installing signs, the most effective protection on the north end is afforded by a continuous closure around all

probable nesting and feeding areas. However, public use and access will be permitted when and where it can take place without impacting Piping Plover breeding activity.

Certain areas on the north end of Assateague can be made available for public recreation without adversely affecting plover reproduction. Currently, these areas include a small bay side beach located on the island's northwest tip, a dredged material upland located on the bay side near channel marker 3, and the ocean beach intertidal zone. Of these three areas, plovers occasionally use the ocean beach intertidal zone primarily as adult and migration foraging habitat. However, the current low level of visitor use in this area is believed to minimize the potential for any significant human-plover interaction.

As closed areas are designated, an assessment will be made to determine if public access between an open bay side beach and ocean beach can be accommodated without adversely affecting breeding plovers. If a pathway can be provided without interfering with breeding birds, then a designated and marked path may be installed across the island. Any such path will be subject to closure if unexpected nesting or critical foraging occurs during the breeding season.

In the southern portion of Maryland, where nesting activity is sparse, discrete area closures will be used on an individual nest basis. As nesting sites are established in the ORV zone, an area 200 meters radius around the site will be closed. Once forage areas for unfledged birds are identified, the area closure will be modified to protect those areas. To the extent possible, recreational use of the ORV zone will be provided by re-routing traffic, depending on the location of the nest or foraging area. If a complete closure is necessary, the route will be reopened after the brood is found to be independent of the traffic route.

The actual north end closure posting and signing will be accomplished by mid-April. Although workers will disturb some plovers on their feeding grounds, this disturbance should be far less impacting than waiting until actual nests are established before signing an area. The spacing of signs will correspond to the density of visitor use and mode of travel, i.e., close spacing in high visitor use, foot traffic areas, and wider spacing along water corridors for boaters. The goal is a clearly evident demarcation of closed areas, visible upon approach from any direction. Signs will be checked periodically and replaced when necessary.

In general, public use area closures will remain in effect until post fledging monitoring determines that any plovers remaining on site are unlikely to be adversely impacted by human disturbance. The criteria used in making this decision will include the distribution and abundance of birds, patterns of foraging habitat use, and anticipated levels of public use. Areas will not be opened to public use until at least one week after the final brood fledges. ORV zone closures for breeding plover will continue until fledged birds appear to be independent of the protected site(s).

Predator Exclosures

Predator exclosure cages have routinely been used to afford a measure of protection to Piping Plover nests from predation. Because egg predation has historically been documented to be high at ASIS, exclosures were placed around as many known nests as practical, given the number of nests, workload for higher priority tasks and available staff. While there is a trade off between risk of predation and risk of disturbance, the placement of exclosures will generally be timed to occur late in the egg-laying cycle when the resident pair is less likely to abandon the site. Assuming adequate personnel and no logistic conflicts, exclosures will be placed around nests when they are found to contain 3-4 eggs, or incubation has begun.

Experience has demonstrated that the efficiency of exclosures is largely dependent upon proper design and construction, and consideration of the species to be excluded. At ASIS, the design has evolved from a circular 0.9 m high open top exclosure (to exclude fox), to one with twine tops (to prevent avian predation), to a 1.5 m high, 6 m side triangular shape with the top .3 m bent out and twine top (to counteract fox climbing), to the current 1.2 m high circular exclosure with plastic netting top (for increased protection from avian predators).

It is expected that depredating species, predator population fluctuations and learned behaviors will continue to force exclosure evolution over time. As part of the overall plover monitoring program, efforts will continue to document behavioral responses to exclosures by both plovers and predators, and exclosure related nest failures. Benefits of exclosure use will continue to be evaluated at ASIS and decisions on the use of exclosures will be made based on observations and available data.

Internal Controls

At the beginning of each breeding season, ASIS will coordinate with DNR staff in the training of all employees and researchers authorized to enter plover breeding habitats. The park's monitoring staff will receive the most intensive training, including information on research history, behavior and ecological status of Assateague's plover population, island habitats, proper monitoring techniques, use of exclosures, monitoring goals, and predator management.

Other park staff including the signing crew, patrol and visitor contact rangers, maintenance crews and cooperative researchers will be trained on plover identification and breeding biology, monitoring efforts, safe vehicle operation, and limits to their activities in plover habitats.

All park staff will be provided a summary report of the local plover biology and management program. Plover monitors will prepare periodic summaries that will alert all ASIS staff of breeding status, current sensitive areas, and modifications to normal operating procedures.

Although corridors surrounding closed breeding areas will remain open, the types and amounts of staff use will be reviewed annually to assure a low level of disturbance or habitat disruption. Vehicular patrols will be kept to a minimum and alternative transportation (boats and ATV's) should be used when feasible. Access into closed breeding areas will be limited to authorized activities cleared through the resource management division. The type of allowed activity will depend on the habitat in question, the proximity to actual nesting or feeding locations, and the action's priority or the immediacy of need.

Only research activities which directly benefit ASIS and are connected with plover management or other high priority management issues and which can be carried out without interfering with plover breeding activities will be permitted within the closed breeding areas. Cooperative or contractual researchers will be required to contact the park before initiating any fieldwork, and weekly thereafter to keep the park informed of their activities and for them to receive information on plover breeding status.

Public Information

Press releases will be issued during the breeding season to alert the public of area use closures and provide general information on Piping Plover activity and breeding success. An initial press release will be issued after a determination has been made on which areas will be closed to public access. This release will describe the need for the closure, approximate dates, and locations. Notices will also be issued for any major change in management practices, and at the end of the season. Press releases

will be provided to local officials, the press within a 50 mile radius, local marinas, surf shops and special interest groups.

Plover exhibits will be displayed at major entry points for boat-in and walk-in visitors accessing the north end. Information brochures will be available at NPS interpretive talks and visitor contact stations. A mounted adult specimen, a mock plover nest with inviable eggs and informational text describing the species and its breeding habits will be displayed at the main visitor center.

If available, trained volunteer bird wardens coordinated through DNR will be used to assist in monitoring both plovers and visitor use around closure areas, to disburse written material about shorebird protection, and answer plover-related questions.

Enforcement

Enforcement of plover management regulations fall primarily under Title 36 Code of Federal Regulations. Public use area closures and wildlife protection violations are described under 36 CFR 1.5 and 2.2(a)(2) respectively. Violations are addressed using the full spectrum of enforcement options, ranging from verbal warnings to citations requiring a mandatory court appearance.

Enforcement activities within the ORV zone will be carried out by vehicle. In order to lessen potential disturbance from vehicle operation, law enforcement activities on the north end will be conducted using boats whenever possible.

Consultation and Coordination

The U.S. Fish and Wildlife Service will be advised of all management actions that have the potential to adversely affect Piping Plover nesting activities or habitat. Formal or informal consultation will be initiated, as needed, dependant on the advice of the Regional FWS contact.

The CNWR staff will meet with ASIS staff on an annual basis to review plover activity in and around the designated NPS recreational area within the refuge. The scope of NPS activities and conditions to safeguard plovers will be addressed and drafted into the annual Section 7 evaluation.

ASIS will continue to consult and cooperate with representatives of DNR on all plover issues. This includes pre-and post-breeding season discussions, joint monitoring efforts, training, and advisories on other management actions. Data and reports will be exchanged.

DNR will coordinate with the MD Boating Administration on the placement of water-based closed area buoys. The informational/closure buoys are placed in navigable waters adjacent to bayside foraging habitats to increase visibility and effectiveness of area closures.

Annual Reporting

Following each breeding season, ASIS will synthesize all data on habitat use, nesting, fledging and behavior, along with management efforts, into a comprehensive report on the plover management program. Copies will be forwarded to the appropriate NPS, FWS, DNR and CNWR personnel.

VI. REFERENCES

- Dyer, R. W., et. al. 1988. Atlantic Coast Piping Plover Recovery Plan. U. S. Fish and Wildlife Service, Newton Corner, MA. 74 pp.
- Hoffman, M. 1985. Status of the Piping Plover in Coastal Maryland. 1985. Proposal. Maryland Department of Natural Resources.
- Kinser, G. 1987. December 22, 1987 letter to Robert Gift, National Park Service, Mid-Atlantic Regional Office, Philadelphia, Pa.
- Kumer, Jack, S. Ramsey, T. Earl, D. Brinker, P. Railey. 1997. Management and Monitoring of the Piping Plover at Assateague Island National Seashore, Maryland. Unpublished Report. Assateague Island National Seashore. 46 pp.
- Loefering, J. 1992. Piping Plover Biology, Foraging Ecology and Behavior on Assateague Island National Seashore, Maryland. Masters Thesis. Virginia Polytechnic Institute and State University, Blacksburg, VA. 248 pp.
- National Park Service, 1982. General Management Plan, Assateague Island National Seashore Maryland/Virginia. NPS-Denver Service Center, Denver, CO. 93 pp.
- National Park Service, 1986. Environmental Assessment: Erosion Control Management Alternatives for the North End of Assateague Island National Seashore. Draft. National Park Service Cooperative Research Unit, Center for Coastal and Environmental Studies, Rutgers University. 52 pp.
- National Park Service, 1988. Management Policies. Office of Policy, National Park Service, Washington, D.C. 1988.
- National Park Service, 1999. Natural Resource Management Guidelines (NPS-77). Office of Policy, National Park Service, Washington, D.C. 1999.
- Patterson, M. 1988. Piping Plover Breeding Biology and Reproductive Success on Assateague Island. Masters Thesis. Virginia Polytechnic Institute and State University, Blacksburg, VA. 129 pp.
- Pisapia, R. 1991. February 21, 1991 letter to Roger Rector, Superintendent, ASIS.
- U.S. Fish and Wildlife Service, 1982. Letter to Mary Magee, National Park Service, Denver Service Center, from John Green, Area Manager, Delmarva Area Office, Fish and Wildlife Service.
- U.S. Fish and Wildlife Service. 1986. Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 & 17.12.
- U.S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*), Atlantic Coast Population, Revised Recovery Plan. Hadley, Massachusetts. 258 pp.
- Wolflin, J. 1999. February 5, 1999 letter to Colonel Bruce Berwick, Baltimore District Engineer, U.S. Army Corps of Engineers.

VII. APPENDICES

Appendix A: Chronology of NPS Plover Management at Assateague Island

September 21, 1965 - Congress establishes Assateague Island National Seashore.

June, 1982 - the General Management Plan (GMP) for Assateague Island National Seashore is published (National Park Service 1982). The GMP describes management zones and future development plans. FWS comments on the GMP include acknowledgement that a Biological Assessment was not required, due to the date prepared (June 1978), and general information on peregrine falcons and loggerhead turtles, both listed species at that time which use the island's habitats during the year (Fish and Wildlife 1982). FWS recommends not maintaining the artificial dune along the island in order to insure prime peregrine falcon habitat.

May 1985 - The first systematic survey was made for nesting Piping Plover along the Maryland section of Assateague Island (Hoffman 1985).

January 10, 1986 - The Atlantic coast population of the Piping Plover is added to the United States List of Endangered and Threatened Wildlife and Plants (1986).

May, 1986 - The first long-term monitoring and breeding study of Piping Plover at ASIS begins (Patterson 1988).

December 22, 1987 - FWS comments on the draft Environmental Assessment for Erosion Control Management Alternatives for the North End of Assateague Island National Seashore (National Park Service 1986). FWS tentatively concludes that maintaining the existing shoreline, Alternative B, would probably be the best for the plover over the long-term, if beach nourishment can be conducted in such a way that plover nesting is not adversely affected. Also acceptable would be no action, Alternative A, or an additional alternative that would employ a sand by-pass system to continuously add sand in order to restore the natural sediment flow (Kinser 1987).

March 1988 - Atlantic Coast Piping Plover Recovery Plan published (Dyer 1988).

Summer 1988 - A three-year study on the breeding ecology and behavior of Piping Plover at ASIS begins (Loefering 1992).

Researcher tests exclosure use on 50% of nests and conducts all monitoring efforts. ASIS signs 100 meters of beach berm in front of each nest location on the north end with breeding area closure signs. A single nest located behind the ORV zone near the MD/VA line is also posted with closure signs.

November 4, 1988 - Piping Plover Breeding Biology and Reproductive Success on Assateague Island published (Patterson 1988). Study performed during 1986 & 1987 breeding seasons, and covered both Maryland and Virginia portions of Assateague Island.

Summer 1989 & 1990 - Researcher continues study and monitoring of breeding plover. In 1989, due to the high predation rates along the ocean beach, all nests within sight of the ocean beach were protected by exclosures. 50% of all other nests received exclosures. All 1990 nests were exclosed.

In 1989, closure signs were placed along the beach berm adjacent to each nest, and nest sites (exclosures) visible from the ocean beach were completely surrounded by signs placed at a 100 meters radius from the nest to lower human disturbance. In 1990, closure signs were placed around every

nest location. Despite the signing efforts on the north end, researcher and ASIS personnel observed several exclosed nests that were disturbed by visitors and other researcher's students.

Fall 1990 and Winter 1991 - Discussions between FWS and ASIS regarding areas suitable for inclusion in the FWS critical habitat proposal result in recommendation of two areas, the north end, from the north boundary of the McCabe property to the Ocean City inlet, and the ORV zone, east of the back access trail, from dune crossing one to the MD/VA state line, and determination that current management of ORV's is "reasonable and prudent" (Pisapia 1991).

Summer 1991 - HBC (Now MD DNR Forest, Wildlife and Heritage Services) provides ASIS with a summer technician to monitor Piping Plover within ASIS. NPS is unable to fund personnel to assist in monitoring of breeding activities. As occurred during the research phase, all areas on the north end and the ORV zone were searched for breeding plover.

Due to initial recommendations by researchers on the importance of protecting from human disturbance all nest sites and bayside shoreline for foraging plover, ASIS signs closed each nest site. North end nest site closures include an area 100 meters north and south of the nest, from the ocean beach berm west to and including the bayside shoreline to the low tide line. In addition, all bayside shoreline with wide beaches and immediately adjacent to cross-island overwash fans are signed closed to provide undisturbed foraging. Only four such areas existed in 1991, each 50 - 150 meters long.

The nest site behind the southern ORV zone was signed at a distance of 200 meters from the nest, due to that brood's limited ocean beach forage habitat and disturbance distance observations.

The HBC technician, with ASIS assistance, was able to construct exclosures around most nests. At least one red fox learned to climb into the exclosure, despite the twine tops. Most exclosed nests within the home range of an active fox den were depredated. Modifications to the exclosures were only partially or temporarily successful. The fox in question probably died during a flood in January, 1992.

January 4, 1992 - A storm surge alters the primary dune line along the entire island and removes a significant portion of the north end vegetation. Developed areas which underwent changes include: McCabe house, boat house and parking lots, McCabe road, Sinepuxent hike-in site, North Beach developed area dune, ORV zone hike-in sites, ORV overnight parking area, and the ORV zone back trail.

March, 1992 - Piping Plover Breeding Biology, Foraging Ecology and Behavior on Assateague Island National Seashore, Maryland published (Loefering 1992). Study conducted during the 1988 - 1990 breeding seasons.

Summer 1992 - Several significant changes were made in 1992 based on five factors: findings from the Loefering report, logistics of signing major areas with limited personnel, repeated visitor violations of single-nest exclosures, steady fall in Piping Plover reproductive success, storm-creation of a significant increase of potential plover nesting and foraging habitat.

ASIS made the decision to attempt a major closure of all potential nesting and foraging habitats on the north end. Areas with little potential for plover use were not closed, and thereby open to the public for recreation. Due to jurisdictional responsibilities of inner-tidal lands, ASIS consulted with HBC, Maryland Boating Administration and MD Tidewater Administration who oversee species protection, navigable waters and shellfishing regulations, respectively.

As agreed to by the state agencies, ASIS closed the area north of the McCabe gut to and including the inlet beach at the Ocean City inlet, a distance of 9 km. The eastern boundary of the closure was placed at approximately the April ocean berm line, leaving the ocean inner-tidal beach open for visitor foot travel and authorized NPS vehicle traffic. The western extent of the closure was placed at the extreme low tide line of exposed lands along the bay side of the north end, including mudflats and sand beaches adjacent to the island proper. Two areas adjacent to significant vegetated dune systems, totaling 1.2 km were open for public use, primarily boat-in traffic. The northern open area was provided an access path that connected to the ocean beach to allow for varied recreational use.

A 2 km inner-dune area south of the McCabe gut was also closed to provide safe nesting of a plover pair that nested north of ASP.

The pair historically nesting in the southern ORV zone split up soon after arriving on location. Another pair initiated nest scrapes along the, then closed, back trail near the Fox Hill Levels. Neither location produced nests in 1992.

The park received special funding to hire three seasonal protection rangers for the period from April through mid-August. Over 100 violations were documented, primarily for closure violations and pets in prohibited areas. Patrols were made primarily by boat around the north end closure, and vehicle in the ORV zone.

All nests were exclosed with a new triangular design fencing. No exclosures were entered by fox.

July, 1992 - The park hired a permanent biological technician who was dedicated to plover management from April through August each year.

Summer 1993 - HBC again was able to fund a technician position. The park successfully competed for a matching grant that allowed it to also hire a seasonal technician. Three employees (2 NPS, 1 HBC) were available to monitor the plover breeding season. In addition, several other seasonal staff employees were hired on a few weeks early to assist the plover staff with signing and early season nest searches and exclosure construction. The resource protection staff was also able to dedicate in part, two law enforcement rangers to patrol the north end.

The closure was again installed to include the island interior from the inlet south, to midway between the former McCabe site and the State Park. The closure extended from the ocean spring high tide line to and including adjacent mudflats on the island's bay side. The bayside boat-in beach at the inlet was extended south an additional 0.5 km because plovers had not utilized a particular beach as previously expected. A path was again installed to provide visitor traffic between the bay boat-in beach and the ocean beach. The boat-in beach adjacent to the large dredge spoil dune was opened at its former length.

Plover's concentrated their activities on the northern 8 km of the north end. A pair also showed some interest in breeding near the Fox Hill Levels in the ORV zone, but a nest was never laid. The back trail adjacent to the Fox Hill Levels was closed to public use during the breeding activity.

Due to reconstruction of the back trail during the breeding season, surveys were made biweekly along the entire back trail to insure that construction activity would not interfere with breeding attempts.

Enforcement rangers patrolled the north end primarily by boat. Violations were down about 50% over 1992.

The triangular enclosure design from 1992 seemed to keep fox from climbing into nest sites, but avian predators, primarily fish crow and boat-tailed grackles, were able to jump through the twine enclosure tops. Small mesh netting was obtained to exclude avian predators, but the limited netting width required going back to a 3 m diameter round enclosure. Fox were not observed attempting to climb the new round enclosures.

Summer 1994 - The monitoring staff (2 NPS, 1 DNR), and areas closed to public use continued as in 1993. Closure violations continue to drop, to 50% of the 1993 level and 75% of the 1992 level. Fish crows began to obviously target enclosures. The use of mesh tops on enclosures becomes mandatory, and the top horizontal wire was removed to prohibit perching. No enclosed nests are depredated, but crows are observed following broods for the first time this year. One plover was found entangled in the top netting, and was successfully released with no long-term problems. The nest was one which crows were known to harass on a regular basis.

Interactions between two horse bands leads to the apparent abandonment of several localized nests after repeated harassment over several weeks.

Two pairs of plovers were documented as successfully raising two broods of chicks each, a rarely observed behavior in this species. The use of common forage areas for broods is also noted.

Summer 1995 - Staffing levels are maintained at 3 employees, 2 NPS and 1 DNR. For the first time under the program, basic observations have become a limiting factor due to the complexity of the habitat and the size of the breeding population. Nest searches are completed over a longer period of time, with low activity areas skipped for several weeks. Broods cannot be followed daily due to numbers, mobility, overlap of ranges and mixing on common forage areas. Overestimating chick mortality rates probably began in 1995 and became more probable as the population continued to grow.

One of the females documented rearing two successful broods in 1994 repeated the feat in 1995.

The current 1.5 m high round enclosure with net top continued to successfully protect eggs. Crows, and to a lesser extent gulls, were observed attempting entry.

This was the fourth and final year for an assessment of habitat use by post-fledged and migrating plovers. Plover broods appear to vacate their rearing areas from days to two weeks after fledging. Broods become more mobile with age, but they tend to stay fairly close to their rearing areas, then do not return once post-fledged movement begins.

Broods reared on site tend to use interior habitat at a much higher rate than either ocean or bay intertidal habitat. Conversely, migrating plovers tend to forage and rest along or immediately adjacent to the ocean and bay intertidal zones. Many of the migrating plovers also tended to amass in groups, making their presence more obvious. The migration peaked in all four years around the first week in August.

While it is rare to find a sick, injured or dead plover, four such birds were observed in 1995. Two chicks from the same brood were found on consecutive days suffering from symptoms suggesting botulism toxicosis. One was successfully treated. Over a three week period, two chicks were observed with broken wing bones and injuries suggesting an attack by an avian species. One was successfully treated and released.

Summer 1996 - Although the monitoring staff was maintained at 3 individuals, a continued increase in breeding pairs resulted in a continued decrease in monitoring abilities. The slower pace resulted in several nests that remained unexclosed, resulting in the loss of some nests. The number of entire broods that disappeared with their adults on the same day suggests that brood mobility may be greater than our ability to track and observe all broods.

One chick death was attributed to monitoring efforts. Apparently one of the staff stepped on a chick while searching for broods in an area with one active nest and five overlapping broods.

For the first time in four years, plovers successfully bred in the ORV zone. One pair occupied a wide shell beach formerly used by plovers near the MD/VA state line. A second successful nest was located adjacent to the Fox Hill Levels area, on a recently formed overwash fan which reached the back trail.

Summer 1997 – NPS secures funds for an additional seasonal technician and DNR provided additional volunteer assistance.

In the developed area at the southern boundary of Assateague State Park west of the primary dune, one plover pair successfully hatched a nest. This was the first known breeding attempt in this area, and in somewhat marginal habitat of herbaceous and woody vegetation interspersed with small open sand areas.

In the ORV zone, one pair of plovers nested near the MD/VA state line and a second pair nested near Fox Hill Levels.

Two adult plover deaths were documented. One was found entangled in exclosure netting after the nest was overwashed during a storm. That carcass was mounted in a permanent educational exhibit at ASIS. The second bird was found dead on the sand and necropsy report from the National Wildlife and Health Center showed cause of death was blunt trauma to chest.

After consultation with FWS, two new monitoring tools were used to reduce workload associated with the high number of breeding pairs. Egg floatation was employed to estimate the incubation period of nests found with complete clutches. Historic chick survival data was used to build a predictive model for fledging success. Chick survival was only monitored through 15 days, with fledging success based on historic rates.

January/February 1998 - Two nor'Easters passed the island over a two week period. On the north end, a 2.5 km section of island was lowered to 1-2 meters above sea level. Daily high tides washed across the lowest area for an extended period of time and occasional overwash continued in some locations throughout the summer.

An Emergency Response Action was initiated through the COE to reduce the threat of a breach. That project placed a 30m wide berm to eight feet above sea level (NGVD), the elevation of the natural berm north of the critically erode area. Construction of the berm was delayed until August, after all plover chicks had fledged from the area.

Summer 1999 – A two-year NPS study was initiated to investigate Piping Plover brood survival and brood habitat characteristics.

To assist with brood identification in overlapping brood habitats, Rhodamine 6g or Malachite Green dye was discreetly applied to seven chicks from four broods. DNR approved the marking following consultation with FWS.

Gulls predated two exclosed incubated nests by ripping through the top netting, also successfully entered a third exclosure following a successful hatch, and were thought to be responsible for the abandonment of nine other exclosed nests.

One physically deformed chick was found abandoned in the exclosure, and the carcass was sent to USGS-Biological Resources Division at Oregon State University for a conservation genetics program.

In the ORV zone, two plover pair nested in the same two areas as in previous years. The brood at Fox Hill Levels used both the ocean intertidal zone and the back trail overwash fan, with chicks often split between the two areas. After initial efforts to reduce disturbance through an adjustment to travel lanes and providing vehicle escorts, the ORV zone south of the brood area was closed to all traffic until the brood fledged and became independent of the area. The brood was monitored daily and it was apparent the chicks developed slowly, resulting in a delayed fledging period lasting up to 36 days of age. This delayed development was not attributed to vehicular/human disturbance, but may have been forage related.

Summer 2000 - Due to the high levels of gull disturbance directly associated with predator exclosures in 1999, exclosures were not used in 2000. Gulls were observed in the breeding area and depredated both plover and tern nests in 2000. Two empty exclosures were deployed during the season, and tracks proved that gulls had immediately and repeatedly investigated them.

In the state park, a Red Fox pair successfully raised kits and fox activity was frequently noted on the north end. By late summer, it was obvious that kits had learned to work dense plover and tern nesting areas. Three sub-adult fox were removed from the north end late in the nesting season.

In addition to the Piping Plover monitoring program, the Piping Plover brood habitat study and Least Tern nest monitoring project continued simultaneously through the breeding season, therefore researcher disturbance was increased. Both special studies concluded this season.

Appendix B. Location Map of Management Zones at Assateague Island National Seashore, MD.

