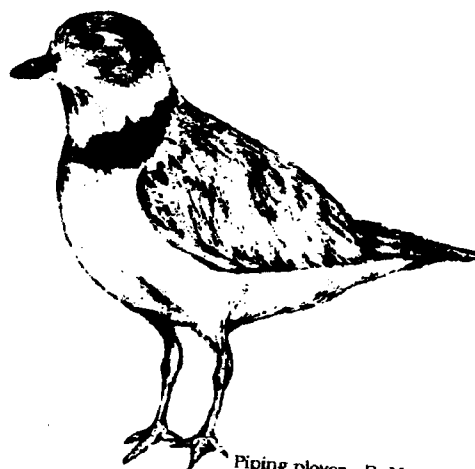


**U. S. FISH AND WILDLIFE SERVICE
CHINCOTEAGUE NATIONAL WILDLIFE REFUGE**

PIPING PLOVER MONITORING AND MANAGEMENT

SUMMER 1998



Piping plover - R. McCorkle

**U.S. FISH AND WILDLIFE SERVICE
CHINCOTEAGUE NATIONAL WILDLIFE REFUGE**

**ASSATEAGUE ISLAND, VIRGINIA
TABLE OF CONTENTS**

I. INTRODUCTION	1
II. MANAGEMENT AREAS	1
III. METHODS	4
A. <u>POPULATION MONITORING</u>	4
1. PRE-NESTING	4
2. NEST SEARCHES AND MONITORING	5
B. <u>MANAGEMENT TECHNIQUES</u>	5
1. PREDATOR MANAGEMENT	6
2. PREDATOR EXCLOSURES	6
IV. MANAGEMENT RESULTS	7
A. <u>POPULATION MONITORING</u>	7
1. EGG AND CHICK LOSS	8
2. HATCHING AND FLEDGLING SUCCESS	9
B. <u>MANAGEMENT TECHNIQUES</u>	10
1. PREDATOR EXCLOSURES	12
2. PREDATOR MANAGEMENT	12
V. DISCUSSION	13
VI. RECOMMENDATIONS	14
VII. REFERENCES	17

LIST OF FIGURES AND TABLES

FIGURES

FIGURE 1	Base map of Chincoteague National Wildlife Refuge (Assateague Island) southern portion.	2
FIGURE 2	Base map of Chincoteague National Wildlife Refuge (Assateague Island) northern portion.	3

TABLES

TABLE 1	Causes of Piping Plover Egg Loss On Assateague Island, 1998	9
TABLE 2	Piping Plover Hatching and Fledgling Success 1992-1998	11
TABLE 3	Piping Plover Productivity on Islands Owned/Managed by the Chincoteague National Wildlife Refuge, Summer 1998	12

PIPING PLOVER MONITORING AND MANAGEMENT SUMMER 1998

I. INTRODUCTION

The piping plover monitoring and management program for the 1998 breeding season followed the recommendations developed as a result of a three-year study that concluded in 1991 and experiences gained during the 1992 through 1997 field seasons. This report represents data collected in the 1998 season (February through August) and presents the results of this year's nesting success and offers recommendations that will promote nesting success and increased productivity in the 1999 nesting season.

II. MANAGEMENT AREAS

Chincoteague National Wildlife Refuge (CNWR) is a 5,691 ha (14,014 acres) wildlife refuge located almost entirely on Assateague Island in Accomack County, Virginia. Assateague Island is a barrier island that extends approximately 59 km (37 miles) along the Maryland/Virginia Coast. Assateague Island's portion of the refuge includes beach, dune, saltmarshes, freshwater impoundments, and maritime forest/shrub habitats. Adjacent islands that are a part of the refuge complex and support piping plovers include Assawoman, the northern end of Metompkin, and parts of Cedar Islands. Wallops Island, just south of Assateague, is administered by the National Aeronautics and Space Administration (NASA) and is included as part of the Wallops Island NWR under a Use Agreement (UA) with NASA.

The three principle monitoring areas within the Assateague Island portion of the refuge include the Hook Beach, Wild Beach, and North Wash Flats (Figures 1 and 2). The Hook is the southernmost portion of Assateague Island and extends for approximately 4.5 km (2.8 miles). The Hook is approximately 316 ha (780 acres) of multiple tidal flats and pools, small vegetated dunes, blowouts, and relatively wide beach areas. Since 1988, the Hook has been closed to all public use from March 15 to August 31, the piping plover's breeding season.

The Wild Beach nesting area extends from D Dike north to the North Wash Flats crossover for approximately 5.9 km (3.7 miles). The Maryland/Virginia state line is located approximately 4.8 km (3 miles) north of North Wash Flats crossover. The Wild Beach is also typified by small vegetated dunes, occasional tidal pools, and varying widths of beach. This area tends to be highly vulnerable to adverse weather

FIGURE 1 Base map of Chincoteague National Wildlife Refuge
 (Assateague Island) southern portion.

FIGURE 2 Base map of Chincoteague National Wildlife Refuge
(Assateague Island) northern portion.

conditions, i.e., flooding, wind gusts, and blowing sand. Areas behind the high tide line are posted and closed to public access during the nesting season. However, the intertidal zone is accessible to pedestrian traffic throughout the year.

The North Wash Flats is a 324 ha (800 acres) impoundment between the bay and the ocean. It is a brackish water impoundment that is managed according to the refuge's Marsh and Water Management Plan to allow nesting and feeding by piping plovers and other migrant shorebirds. Waterfowl use the impoundment extensively during the fall and winter months. In past years, the low elevation of this area has rendered it highly subject to flooding. All public access is prohibited year round.

The barrier islands of Assawoman, Cedar, Metompkin, and Wallops are composed of narrow sandy beaches with intermittent dunes and extensive saltmarshes. Public access is restricted during the breeding period (March through August) on most of the islands.

III. METHODS

The techniques employed to monitor plovers have evolved over the past ten years as more information became available and monitoring techniques improved. The procedures used are those that have proven to be the most cost-effective to date and yet provide the types of data needed to determine the effectiveness of the refuge's piping plover management program.

A. POPULATION MONITORING

Population monitoring included both the pre-nesting and nesting periods throughout the spring and summer months. Monitoring activities were confined to specific periods to lessen disturbance to territorial pairs, incubating adults, and adults with young.

1. PRE-NESTING

Prior to the nesting season, refuge staff and volunteers began surveys to document the arrival of migrant and resident plovers. Beginning in late February all beach areas were periodically surveyed for plover arrival, establishment of territories, courtship display, and preliminary nest scrapes. One to two surveys were conducted each week to obtain an idea of population density and dispersal. More

intense monitoring began in mid-April when territorial pairs were firmly documented.

2. NEST SEARCHES AND MONITORING

Locating nests was accomplished by observing territorial individuals or pairs from a distance until their behavior revealed the nest or approximate location. In vegetative concealed areas, tracks were followed to locate the nest once the general area was known. The time frame for searches was established between late April and the second week of July, with the second week of May set aside for intense nest searches. Search time was limited to less than 10 minutes when nest searches were held after 1000 hours or in extreme weather conditions such as mid-day heat, rain, wind, etc. The time restraint was adhered to even at the expense of not finding a new nest. During the rest of the season, nests were found only by observing territorial adults. Intense nest searches were defined as walking through potential nesting areas at a slow pace, looking for nests, scrapes, or plover tracks. Once a nest was located, the observer flagged the nest approximately 10 meters north and south of the nest and recorded it in the nest records so any observer could locate the nest. Throughout the season, visits to the areas were limited to once a day to minimize disturbance. Disturbance to incubating or territorial adult(s) was limited to a maximum of 20 minutes on any given day with most nests monitored with a spotting scope at a distance that did not disturb the incubating bird.

B. MANAGEMENT TECHNIQUES

Predator management for increased Piping Plover productivity has been performed on the refuge since 1988 and follows protocol as directed by the Piping Plover Recovery Plan and the refuge's annual Predator Control Program. The refuge incorporates refuge specific techniques fashioned by the piping plover recovery team for the refuge's individual predator problems. Several direct and indirect management techniques are currently in use to increase plover productivity. Direct predator management techniques include fox den gassing, shooting, leg hold and live trapping. Indirect techniques used to control predation levels of plovers and nests has been the use of predator-proof exclosures and predator proof fencing around North Wash Flats nesting area. Predator exclosures are utilized within the Hook and North Wash Flats nesting areas which excludes the Wild Beach nesting

area. In response to high predation rates on the Wild Beach in previous years, some members of the recovery team felt that leaving the Wild Beach nests un-exclosed would encourage renesting in the adjacent North Wash Flats nesting area.

1. PREDATOR MANAGEMENT

Predator management techniques utilized this year included den gassing, setting soft leg-hold traps, and shooting of some particularly troublesome avian species, which included grackles, crows and gulls. Fox den searches were performed several times throughout the spring and summer within plover nesting areas. Dens were gassed using carbon monoxide cartridges early in the season and whenever an active den was discovered within the plover nesting areas. Although the number of animals taken by den gassing cannot be accurately determined, this method has proven to be a quick and humane way to control the fox population. Because den gassing requires much less time and produces effective results, leg-hold trapping for foxes was very limited this year.

2. NEST EXCLOSURES

Nest exclosures are comprised of a 10.9 m (36 ft) piece of 122 cm (48 in) wide 5.1 cm by 10.2 cm (2 X 4 in) welded wire mesh. The wire mesh is placed around the nest forming a 3.7 m (12 ft) diameter circle surrounding the nest. Five-1.8 m (6 ft) pieces of 15.9 mm (five-eighths inches) rebar is evenly spaced around the perimeter and are driven into the ground to secure the wire mesh in place. The nest exclosure is then covered by 3.8 cm (1.5 in) mesh nylon netting to deter avian predation. Each exclosure requires approximately ten to fifteen minutes to construct and set up time is recorded for each nest to determine if abandonment could be caused due too excessive set up time.

A predator-proof exclosure is placed around each nest after the second egg is laid, or on smaller clutches, if no additional eggs are laid after three days. After exclosure placement, the nest is observed at a distance to allow the adult to return to the nest. The exclosure is removed if the adults fail to resume incubation within 60 minutes.

The 3.7 m (12-ft) diameter predator-proof exclosure used in past seasons was continued this year to

provide a greater distance between the nest and the exclosure. In addition, the single piece of 3.8 X 3.8 cm (1.5 X 1.5 in) mesh bird netting was also continued this season. The netting has proven to be effective in keeping out avian predators and facilitated a quicker and easier placement and handling during exclosure construction.

All nests found on the Hook and Wash Flats were protected by predator-proof nest exclosures. In addition, all nests found on the Wild Beach after May 27th were also exclosed due to standing water on the Wash Flats and the loss of five nests to predation on the Wild Beach.

IV. MANAGEMENT RESULTS

Results presented in this report were compiled from data collected throughout the 1998 nesting season. These data are from 25 weeks of monitoring: February 24th through August 17th. Tables are presented that depict data for the past seven years of plover monitoring to better facilitate comparisons between years.

In an effort to provide a more comprehensive report of piping plover productivity within the refuge complex, data from the refuge's Lower Island units of Assawoman, Cedar, Metompkin, and NASA's Wallops Island are also presented. Data on nesting pairs and productivity for Cedar, and Metompkin Island were obtained through the Virginia Department of Game and Inland Fisheries Division of Non-game.

A. POPULATION MONITORING

Plover surveys on Assateague Island began on February 26 with one bird sighted on the Hook. The first plover on the Wild Beach was sighted on March 24. Plovers were first observed on the Wash Flats on April 1. Surveys continued throughout the summer, with the last nest of the season found on July 15 on the Hook. Eight nests occurred in the overwash area adjacent to the ORV zone this year, an increase of five nests from 1997. This marks the first year more than three pairs of plovers initiated nesting on this portion of the refuge.

Plovers nested in all three of the major nesting areas, with the most nests (26) being located on the Hook. The Wild Beach had 11 nests, and the Wash Flats had five nests. The first nest initiation date for 1998 was approximately April 27 on the Wild Beach and Hook, which was similar to nest initiation in 1997.

Nesting plovers increased by seven pairs (32) on the refuge portion of Assateague Island this year. Assawoman Island had a decrease of four nesting pairs, for a total of eight pairs. One pair of plovers attempted to nest on Wallops Island this year, although the pair was not successful due to depredation of the eggs. Metompkin Island decreased by two pairs, for a total of seven nesting pairs.

Data for Cedar Island are for the entire island which has many privately owned areas. However, the Service has several beach easements scattered throughout the island and fee title to several portions of the island. A total of 15 nesting pairs was recorded again this year.

Surveys and monitoring activities were conducted throughout the spring and summer in all potential plover nesting areas with emphasis on the three known nesting areas. Most nesting activity occurred in traditional breeding areas with the exception of the eight nests found adjacent to the off-road vehicle zone on the Hook (overwash on bay-side) and two nests between North Wash Flats crossover and the MD/VA line.

1. EGG AND CHICK LOSS

Egg and chick losses were attributed to a variety of factors with many unknowns associated with chick losses. In all instances, direct and indirect evidence were used to attribute loss to a particular cause.

a. ASSATEAGUE ISLAND EGG LOSSES

A total of 145 eggs were produced in 42 nests on the refuge portion of Assateague Island this year. The eggs lost (45) were due mostly to predation and infertility (Table 1). The only weather related nest loss was due to high tides. Fourteen eggs were documented as infertile and five nests containing 18 eggs were lost to predation. One nest with three eggs on the Wash Flats was lost to an unknown predator before it was exclosed. One set of plover wings was found just outside of an exclosure again this year. Tracks found encircling the exclosure and in the immediate vicinity, indicated predation by a raccoon was the probable cause of the adult mortality.

b. **EXCLOSED NEST/EGG LOSSES**

A total of 32 nests were exclosed this year compared to 29 last season. All nests that were found on the Hook were exclosed after the second or third egg was laid. Nests on the Wild Beach were not initially exclosed, but with the loss of five nests and the presence of water on the Wash Flats, the decision was made to exclose all existing and subsequent nests on the Wild Beach.

TABLE 1
Causes of Piping Plover Egg Loss on Assateague Island, 1998

AREA	Number of Eggs (Complete nests) Lost To:					
	Predation	Weather	Infertile	Abandon	Unk	Total
Hook Beach	3(1)	0	11(1)	6(2)	2(1)	22(5)
Wild Beach	12(3)	4(1)	2(0)	0	0	18(4)
Wash Flats	3(1)	0	1(0)	1(0)	0	5(1)
Total	18(5)	4(1)	14(1)	7(2)	2(1)	45(10)

Of the exclosed nests, 88% were successful in hatching at least one chick and 70% fledged at least one chick. Of the eight unexclosed nests, 37% were successful in hatching at least one chick. Of the remaining unexclosed nests, 80% of the losses were attributed to predation, with the other 20% lost due to weather. The unexclosed nest figures include two nests not found by the biology staff prior to hatching.

c. **ASSATEAGUE ISLAND CHICK LOSSES**

Chick losses were similar to last year, with 58 chicks lost in the 1997 nesting season compared to 61 chicks lost in 1998. The Hook accounted for 69% of all losses with 42 chicks lost. The Wild Beach accounted for 30% (18 chicks) of the chick losses and the Wash Flats 2% (1 chick). Although plover chick losses were not directly observed on Assateague, avian predation is suspected in most cases. On Assawoman Island, a plover chick was observed taken by a laughing gull. On Assateague Island a Herring gull was observed taking a least tern chick in the Overwash area. Likely avian predators include gulls, crows and grackles. On the Hook, probable raccoon predation was a problem again this year causing the loss of one adult plover.

2. HATCHING AND FLEDGLING SUCCESS

The Wild Beach had mediocre hatching success again this year. Of the 41 eggs from eleven nests, 23 chicks hatched for an average of 2.09 chicks hatched/nest; that was down from 2.36 chicks hatched/nest in 1997. Hatching success increased on the Hook from 1.80 chicks hatched/nest in 1997 to 2.58 in the 1998 nesting season.

Fledgling success on the refuge portion of Assateague Island was slightly higher in the 1998 season, with 1.22 chicks fledged/pair for a total of 39 chicks fledged (Table 2). The Hook was the most productive area in 1998 with 63% of all the plovers nesting on the island found in this area. A total of 20 pairs of piping plovers nested on the Hook and produced 25 fledglings for an average of 1.25 fledglings/nesting pair. The success rate on the Wild Beach was 0.56 (5 chicks) fledglings/nesting pair. That was an increase over the 1997 nesting season when two chicks fledged from this area. Only 27% of the chicks hatched on the Wild Beach survived to fledgling age. The number of plover pairs on the Wild Beach increased in 1998 to nine pairs from seven pairs in 1997. In 1997 there were two pairs of plovers nesting on the Wash Flats, compared to three pairs this year with five nest attempts. The three pairs on the Wash Flats produced nine fledglings for an average of 3.0 chicks fledged/nesting pair.

Monitoring of the Lower Island units continued this year with a cooperative agreement between the Virginia Department of Game and Inland Fisheries and the U.S. Fish and Wildlife Service. During the summer months, Commonwealth and refuge biologists conducted periodic surveys on breeding success of plovers on the barrier islands of Assawoman, the northern end of Metompkin, Cedar, and Wallops. Table 3 provides a summary of this year's data. The fledgling success on these islands combined with the Assateague Island portion of the refuge resulted in an overall total of 69 chicks fledged, or 1.09 chicks fledged/nesting pair.

B. MANAGEMENT TECHNIQUES

Management techniques employed to enhance the success of nesting plovers included the continued placement of predator-proof exclosures and predator trapping within and adjacent to known plover nesting areas. The use of CO₂ cartridges to gas fox dens was continued. Plover exclosures were placed around

TABLE 2
Piping Plover Hatching and Fledgling Success, 1992 - 1998

AREA	YEAR	NESTS	NESTING PAIRS	TOTAL ¹ EGGS	HATCHED/ NEST	CHICKS FLEDGED	FLEDGLINGS/ NESTING PAIR
Hook	1992	25	17	87	1.44	19	1.12
	1993	21	17	60	2.33	21	1.24
	1994	17	15	64	2.65	41	2.73
	1995	22	21	73	2.45	21	1.00
	1996	20	16	60	2.15	28	1.75
	1997	26	15	96	1.80	23	1.50
	1998	26	20	89	2.50	25	1.25
Wild Beach	1992	16	12	55	2.55	0	0.00
	1993	12	10	44	3.71	8	0.80
	1994	10	7	35	2.20	2	0.29
	1995	5	5	19	3.80	0	0.00
	1996	9	8	32	2.89	7	0.88
	1997	11	7	39	2.36	2	0.28
	1998	11	9	41	2.09	5	0.56
Wash Flats	1992	15	7	57	0.00	0	0.00
	1993	0	0	0	0.00	0	0.00
	1994	4	3	15	2.75	10	3.33
	1995	6	5	17	2.50	4	0.80
	1996	0	0	0	0.00	0	0.00
	1997	4	2	11	2.50	3	1.50
	1998	5	3	15	2.00	9	3.00
T O T A L	1992	56	36	199	1.36	19	0.53
	1993	33	27	104	3.08	29	1.07
	1994	31	25	114	2.52	53	2.12
	1995	33	31	109	2.67	25	0.81
	1996	29	24	92	2.38	35	1.46
	1997	41	25	145	3.52	28	1.12
	1998	42	32	145	2.43	39	1.22

1. Includes chicks from broods found after hatching.

all nests found on the Hook, Overwash, North Wash Flats and Wild Beach after the second egg was laid.

To provide greater protection to plover nests, a Section 7 Permit was approved to exclose all plover nests with two eggs in order to protect the nests from depredation. Prior to this year all plover nests were afforded protection with predator proof exclosures following the laying of the third egg of a clutch. Data is inconclusive to determine if placing exclosures around nests with two eggs instead of three is a detriment to plover production.

TABLE 3
Piping Plover Productivity on Islands Owned/Managed by the
Chincoteague National Wildlife Refuge, Summer 1998¹.

ISLAND	NO PAIRS	% OF ISLAND POPULATION ²	CHICKS FLEDGED	CHICKS FLEDGED/ NESTING PAIR
Assateague	32	37	39	1.22
Wallops	1	100	0	0.00
Assawoman	8	100	7	0.87
Metompkin	7	10	7	1.00
Cedar	15	100	16	1.07 ³
TOTAL	63	--	69	1.09

1. PREDATOR EXCLOSURES

Of the 40 nests found prior to hatching, 32 received predator exclosures. Five unexclosed nests were located on the Wild Beach, an area where exclosures are not normally used. Five nests on the Wild Beach were predated during incubation. Of the 32 exclosed nests, 88% (28 nests) successfully hatched at least one egg. Of the four exclosed nests that were unsuccessful, three were abandoned, and one nest was infertile. One of the abandoned nests was due to predation of an adult plover. All exclosures were accepted under 60 minutes of placement.

¹ Data were provided by Robert C. Cross, Biologist, 1523 Live Oak Drive, Tallahassee, FL for the islands of Metompkin and Cedar.

² These percentages represent the portion of the island's population on Service owned or Managed lands. On Assateague Island, the Assateague Island National Seashore accounted for 71% (60 pairs) of Assateague's total population, and on Metompkin Island, The Nature Conservancy portion represented 90% of the island's population.

³ Data for Cedar represents the entire island. The Refuge retains fee title and easements scattered throughout the island.

2. PREDATOR MANAGEMENT

The predator program this year continued to emphasize red fox and raccoon control within and adjacent to plover nesting areas. Trapping continues to be the least desirable control method with more emphasis placed on early detection and gassing of fox dens.

Fox control was performed by den gassing, therefore, the total number of animals taken is unknown. Only one den was treated with CO² on the refuge. The den treated was a new den, with no dens from the previous year being reopened. The den was treated two separate times with unknown success. Following the second treatment, the den was not reopened, however, fox tracks were seen in the area following the treatment.

With the emphasis on den gassing and having only a brief trapping period, results for 1998 were only two red fox pups captured on Assawoman Island using soft leg-hold traps during the trapping period.

Raccoon control was emphasized on the refuge this year during the early nesting season. Night shooting was conducted for two nights with the taking of five raccoons in the nesting areas of the refuge. No raccoon predation was confirmed after these animals were removed from the area. Live traps were set on the Hook for three consecutive nights on four separate occasions. Four raccoons removed from the nesting areas during these trapping efforts.

Increased importance was placed on gull control this year. Gulls were observed harassing, and in some instances, taking piping plover and least tern chicks. Shooting gulls, using a 22 caliber rifle, was deemed the safest and best method for removal of problem gulls. Following the increased effort in removing problem gulls, fledglings survival rates appeared to increase slightly, however, data is inconclusive to reach any sound conclusions concerning gull control on the refuge. For safety reasons, no gull control was employed in the Overwash area due to the high volume of visitors using the adjacent areas.

V. DISCUSSION

Plover productivity on Assateague Island increased slightly in the 1998 season after a fair season in 1997. Thirty-two pairs of plovers, up seven pair from 1997, fledged 39 chicks compared to 28 chicks in 1997. The increase is due to a

number of factors; the increase in pairs and the better productivity on the Wash Flats and Wild Beach. Weather had very little affect on the plover season this year.

Nests on the Overwash area adjacent to the ORV zone of the Hook continued to be monitored intensively. High public use in the area, both on the ocean and bay, continued to warrant close monitoring to prevent disturbance to feeding chicks. For the first time in many years, black skimmers and common terns nested in the closed area of the Overwash, along with the plovers and least terns.

Raccoons were again a problem this year. During the mid-nesting season, evidence of a raccoon killing an adult was documented again this year. The initiation of trapping within this problem area adjacent to the lost nest resulted in no further adult mortality. Raccoons were also believed to be the culprits in the five nests lost on the Wild Beach due to tracks found in the areas around the nest.

This season marked the 11th year of intense monitoring and management to protect this threatened species on Assateague Island. During this 11-year period, the adult breeding population has fluctuated from year to year as has the number of young produced to fledgling stage. In 1990 the population was at its highest with 42 nesting pairs. During the last four years, the refuge population has been at its lowest with a low of 24 pairs recorded during the 1996 season. The best production year was 1994 when 25 pairs produced a record 53 fledglings (2.12/nesting pair). The worst year was 1992, when 36 pairs produced only 19 fledglings (0.53/nesting pair).

This year showed the highest number of breeding pairs since 1992 with a modest 1.22 chicks fledged/pair.

VI. RECOMMENDATIONS

When implemented, these recommendations will provide protection to nesting birds and their habitat, minimize disturbance to plovers during the early spring migration, nest site selection, incubation, and chick rearing stages, and to secure additional potential nesting areas. Deviations from any established procedure or protocol will be implemented only to provide more protection or less disturbance to nesting birds.

1. Continue the predator control program through use of soft catch leg-hold, live traps, and den gassing, with emphasis on fox den gassing and raccoon live trapping. Red fox and raccoon will continue to be the target species. Initiate the raccoon trapping and fox den gassing program in early

February to reduce the potential of predation on nests during the early nesting period.

Only experienced trappers familiar with island trapping techniques will be used. All trappers will be required to have pre-exposure rabies inoculation prior to any trapping activity. Trapping and fox den gassing will be confined to areas adjacent to known piping plover nesting areas.

Initiate fish crow and boat-tailed grackle control by trapping or establishing lethal bait stations within the Hook and Wild Beach nesting areas. Obtain assistance from APHIS's Wildlife Management Division to implement the most effective program.

Develop a plan to control gulls in the Overwash area of the ORV zone. Use volunteers to harass gulls with pellet guns. This method would be non-lethal and less likely to cause enormous public criticism. Enforce current regulations prohibiting feeding gulls and other wildlife in the heavily used beach area adjacent to the Overwash.

2. Continue plover population monitoring using the same procedures employed during the 1993 through 1997 seasons. No more than two surveys per week will be conducted beginning no later than the last week of February.
3. Maintain closures and area posting consistent with previous years (March 15 through August 31). Delay reopening of the Hook at the end of the nesting season if conditions warrant. Continue the closed area on the Hook to include the overwash area adjacent to the ORV zone, north of the old Coast Guard station, on the bay side north to the entrance to the ORV zone. Sign and rope off the north, south, and east sides of the closed area to keep pedestrians from entering the area. This would provide protected nesting habitat for plovers, least terns, common terns and black skimmers.
4. Confine intense nest searches to a one week period between mid May and mid June. The time table for the intensive nest searches will be based on the number of potential nesting pairs observed on the surveys. During this time, staff will conduct walk-throughs in all three refuge nesting areas. During the rest of the season, nests should be found only by observing territorial adults. Limit disturbance to incubating or territorial adult(s) to a maximum of 20 minutes on any given day. Search time will be limited to less than ten minutes when nest searches are held after 1000 hours or in extreme weather conditions such as mid-day heat, rain, wind, etc. This time limit should be adhered to even at the expense of not finding any new nests.

5. Nest monitoring will be limited to direct observations at a distance that does not disturb the incubating bird. The incubating adult will not be flushed from the nest until approximately two to three days prior to the estimated hatching date. At nests that contained complete clutches when found, nest checks will be made six to seven days prior to the estimated hatch date.
6. Limit vehicle activity (nest monitoring, trapping, etc.) within nesting areas to survey routes established at the beginning of the nesting season and to no more than one trip each day. Limit visits to the Hook by law enforcement personnel to only those requiring direct contact. Patrols for trespassing violations should be conducted by boat whenever possible. Any person who may be required to enter the nesting area during the season should be accompanied by a plover monitor to determine the safest route to be followed.
7. Continue predator-proof exclosures on plover nests, with the exception of the Wild Beach nesting area adjacent to the North and South Wash Flats impoundments (Fig 2). Consider exclosures on the Wild Beach on a year to year basis, based on hydrological conditions within the North Wash Flats impoundment and predation problems on the Wild Beach. Continue to carry exclosures in the trucks at all times and exclose a new nest immediately if found with two or more eggs.

Continue procedure to not place predator-excllosures around nests on the Hook which occur behind primary dunes in dense vegetation, areas naturally protected by at least 75% vegetation. Exclosures around hatched or lost nests will remain within the nesting area and removed at the end of the field season.

8. Trap and remove all predators detected within the enclosed section of the North Wash Flats nesting area.
9. Expand the nesting areas of the North Wash Flats area by placement of additional lines of shells (located further east) to encourage more birds to move from the Wild Beach to the Flats.
10. Monitor nests on the Wild Beach intensively for at least three days immediately after the first chick hatches, as this appears to be the most critical time period in determining whether or not a chick will survive to fledge. Initiate a more extensive study of the Wild Beach plover population to determine the reason(s) for low survival rates. Use additional interns as plover wardens to observe and/or help reduce plover interactions with potential predators. Explore

funding options available through Challenge Grants or Fish and Wildlife Coop Units of nearby Universities.

11. Create shallow depressions behind foredunes on the Wild Beach to create ephemeral pools to provide feeding habitat for plover chicks as recommended by Melvin 1993. These pools would provide high quality feeding habitat and increased access to potential hiding cover for the chicks.
12. Continue to prohibit kite flying on the Overwash area during the plover nesting season due to the disturbance to nesting birds.
13. Initiate an experimental nest protection procedure by placing a protective boom or sand bags around nests that are in danger of being washed over during a high tide event. Booms or bags will be covered with sand to prevent birds from abandoning the nest. Protection devices will be removed once danger has passed. Continue to mound nests within the North Wash Flats nesting area if water conditions dictate.
14. Continue to remove or reduce, by disking, vegetative areas to enhance and increase plover nesting habitat on the southern tip of the Hook. The disking should be completed in the fall following the nesting season to allow the sand in the area to settle. Disking needs to be more frequent to reduce re-vegetation. Allow horses access to the North Wash Flats during the fall and winter to graze. All horses will be removed from the compartment by February 15 to insure no disturbance to nesting plovers.
15. Repair the fence around the North Wash Flats compartment to discourage mammalian predators from entering the area.

VII. REFERENCES

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