

**Management and Monitoring of Endangered Species
At Fire Island National Seashore, NY**

2003 Report

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ABSTRACT

A total of five threatened and endangered species are located on Fire Island National Seashore. The National Park Service has been monitoring these five species since 1986, and this season has proved to be the most productive. There were 20 breeding piping plover pairs, 52 breeding least tern pairs, 2 breeding roseate tern pairs, 805 seabeach amaranth plants, and 1077 seabeach knotweed plants. Thirty-five piping plover hatchlings and one least tern hatchling successfully fledged from the breeding shorebird species. Nesting activity and plant production also occurred in regions of Fire Island where they had never been observed before. Enhanced monitoring protocols and habitat protection were the two major contributors to this year's success. Human activity was the evident cause for this seasons shorebird nest disturbances and weather elements were the most documented problem for germination success of both vegetation species. It is projected that chick production and plant abundance will continue to increase in the upcoming years. Protocols must be continuously reviewed in order to sustain success.

INTRODUCTION

Fire Island was established as a division of the National Park Service on September 11, 1964, as authorized by the U.S. Congress (Public Law 88-587). Fire Island National Seashore (FIIS) is a thirty-two mile long barrier island located in Long Island, N.Y. (Figure 1). The seashore occupies a twenty-six mile stretch that consists of seventeen communities, predominately on the western half. The Otis W. Pike Federal Wilderness Area is a seven-mile stretch located on the eastern half of the Island. This area is closed to vehicles from March to September. Sections of Fire Island National Seashore provide suitable breeding/germination habitat for a number of federally and state listed threatened and endangered (T&E) species. The animal species are the piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), and roseate tern (*Sterna dougalli*). The plant species include seabeach amaranth (*Amaranthus pumilus*), and seabeach knotweed (*Polygonum glaucum*).

Of the five species located on FIIS, the piping plover constitutes a large portion of the program. Federally listed as threatened in 1986, FIIS has worked extensively toward their recovery. In order to do so, the recovery plans objective is, "to ensure the long-term viability of the Atlantic Coast piping plover population in the wild, thereby allowing removal of this population from the Federal List of Endangered and Threatened Wildlife and Plants (FWS 1995)." A recovery criterion will be reached when there is 2,000 breeding pairs, maintained over five years. Of the two thousand, 575 of those must be

located within New York and New Jersey. Other important delisting criteria include, achieving a five-year average productivity of 1.5 fledged chicks per pair and instituting long term agreements among cooperating agencies, landowners, and conservation organizations in order to maintain population and productivity. Prior to the piping plover, the least tern was listed federally endangered in 1985 not along the coastal boundaries, however, they are listed as a state threatened species in New York. The roseate tern was listed in 1987 as endangered both federally and state wide. According to the US Fish and Wildlife Service, once the northeast nesting populations of roseate terns reach 5000 in at least six large colonies with high productivity, they will be removed from the endangered species list.

Encompassing FIIS Threatened and Endangered vegetation species are seabeach amaranth and seabeach knotweed. Seabeach amaranth was believed to have been extirpated from New York for over three decades, until the early 1990's, when populations began to exist on Long Island. Listed federally threatened in 1993, seabeach amaranth is on its way to recovery. Seabeach knotweed is on the New York State vegetation species of concern list. In the year 2001, only 250 specimens were counted on FIIS, fortunately this number also continues to climb.

Objective

It is the objective of Fire Island National Seashore to follow the management goals set forth in the Endangered Species Habitat Management Plan (1998) and the US Fish & Wildlife Recovery Plan (1996). These guidelines include monitoring breeding/germination populations, documenting productivity, limiting human disturbance to areas with suitable habitat, protecting listed species from potential predators, and educating the public. The purpose of this report is to present the results of the 2003 Threatened and Endangered Species Program conducted on Fire Island National Seashore.

PROTECTION PROTOCOL METHODS

Pre-Season fencing is determined through a combination of data collected in previous years and visual assessments. In areas where nests/plants have previously been located, fencing is erected prior to the nesting/germination season. The shoreline is then assessed for any further suitable habitat and is then pre-fenced as well. Fencing is done using either steel or CarsoniteTM fiberglass posts. The posts are placed approximately 30-ft apart and are connected using twine. Tied to the twine approximately a foot apart is fluorescent flagging used in order to make the fencing more visible. On every fourth post, an endangered species sign is posted, informing the public of the reason for fencing. This form of fencing is referred to as symbolic fencing. In addition, larger signs are located at the public access entrances that educate the beachgoers about the piping plover.

Beach closures also occur during the pre-season. In certain areas of FIIS, restrictions are put into place regarding driving on the beach and pets. Although the majority of Fire Island remains open to driving, the Otis Pike Wilderness Area is closed to off-road vehicles (ORV's) from March 1st until the last chick has fledged and Sailors Haven is closed year round. Closures to ORV's occur due to the documented effects they have on the nesting success of breeding shorebirds as well as the germination of threatened/endangered plants. As with driving, dogs have also proven harmful to the success of threatened and endangered shorebirds. Due to this, pets are prohibited within Sailors Haven and the Wilderness Area, as well as any area that birds have nested.

Once the nesting season has begun other protective measures are taken. In order to protect the birds from avian and mammalian predators an exclosure is erected. Exclosures are ten feet in diameter and are constructed using 2X4 inch galvanized welded mesh fencing. The fence is then buried approximately 8 to 10 inches deep and supported by four steel posts that are also buried and attached to the fencing. In order to deter avian predators, a ¾ inch nylon mesh is placed over the top of the exclosure and tied down using zip ties. All individuals involved in erecting exclosures had previously been trained on how to do so through the U.S. Fish and Wildlife Services.

MONITORING METHODS

Shorebird Population Monitoring

Piping plovers begin migrating to FIIS around early March, while both the least tern and roseate tern arrive later in the season around late April to early May. Special attention was given to areas of historical breeding ground. The area, which has previously yielded the highest productivity, is the seven-mile stretch known as the Otis Pike Wilderness Area (OPWA). By mid-April, monitoring was conducted at least five times a week by foot at the OPWA location. Secondary attention was given to the areas located in front of Sailors Haven and the Lighthouse. In the secondary transects, an all-terrain vehicle (ATV) is used to travel to the transect start point.

Monitoring and daily surveys are conducted by a small team of field biologists who walk parallel to the toe of the dune down to the shoreline. Initially, before nesting occurs observations of individual or pairs of birds are recorded. These observations include: time of day, weather, number of birds, and Geographical Positioning Coordinates. This continues until the end of April when the nesting season begins. Breeding pairs of plovers are identified by using binoculars and scanning for specific courtship and nesting behaviors. These behaviors include but are not limited to aerial displays, scraping, broken-wing display, vocalization and territoriality.

The species of terns located on FIIS are observed and monitored in the same fashion as the piping plover. However, breeding grounds are recognized when large colonies of terns arrive together. Once a colony is established, nesting occurs.

Shorebird Incubation Monitoring

After a breeding pair has established territory and laid their first egg, the field biologists began daily monitoring to ensure minimal disturbances and exact date of complete clutch. When a nest is located, an alphanumeric system is used to designate nest codes. A two-digit year, nest number assigned chronologically, and a “A” for first nesting attempt, “B” for second, and so on, are used (eg.1A-03). Universal Transverse Mercator (UTM) coordinates for each nest are also taken using a GarminTM Global Positioning System (GPS) unit.

Piping plovers generally lay one egg every other day until they reach a complete clutch or four eggs. In some cases, a nest may only contain three eggs. These nests are typically renests. All plover nests are maintained within symbolic fencing. If a nest was located outside or right along the fenced area then additional fencing was constructed up to a buffer zone of no less than 50 meters. In areas that are heavily populated by beachgoers, the buffer zone was enlarged in order to decrease human disturbance to the nest and allow for a greater foraging area. In addition to symbolic fencing, an exclosure was erected once a nest was complete. After the final egg had been laid an average hatch date of 28 days was determined using a chart produced by U.S. Fish and Wildlife. The nest is checked daily using binoculars from a distance of no less than 50 meters. One week before the estimated hatch date the nest was routinely checked for premature hatching. Daily records are taken on individual data sheets for each nest.

Incubation monitoring of the tern species on the island was maintained by the same symbolic fencing and buffer zones established for the piping plover. A tern clutch typically contains between one and three eggs, with an average incubation period of 25 days. Due to the fact that terns nest in such tight colonies, construction of exclosures around individual nests is not possible. Nevertheless, they are identified using 18” colored flags that are numerically labeled. They are given a UTM coordinate and are routinely monitored and recorded in the same fashion as the piping plover.

Shorebird Brood Monitoring

Day one of brood monitoring occurs when the first chick has hatched. Broods are regularly monitored for approximately a 25 to 30 day period in which the chicks are unable to fly and they are most vulnerable to predators. Individual pair recording on data sheets continued after each brood hatched. Observations recorded for each brood consisted of the number of adults, chicks, location, and behavior. Monitoring a brood involves searching the surrounding territory previously established from each pair. This is where the chicks are most likely to be seen. In areas where multiple broods were observed, the locations and number of observed chicks were recorded and an identity was assigned to each, primarily based on past brood locations, the number, and relative age to chicks. Daily observations continue until all chicks are seen for each nest. If while monitoring a brood, a chick(s) is not located, the field biologist remains longer to

determine if the chick(s) is not in the area. A chick was considered dead if it had not been seen for at least five consecutive days. Once observed flying or seen after the 25-day period a chick was considered successfully fledged.

Unlike the piping plover, the tern chicks do not forage or move far from the nest after hatching. The parents fly off and gather food while the chicks tend to hide in vegetation. Chicks are extremely vulnerable during the 20 to 23 day period before they are able to fledge. Yet again, the tern broods were observed and recorded in an identical method as the piping plover. Once observed flying or seen after the 23-day period a chick was considered successfully fledged.

Vegetation Population Monitoring

Seabeach amaranth and seabeach knotweed began to germinate on FIIS during late June to early July. They tend to grow in large clusters, but isolated plants have been seen as well. Not all plants were protected behind symbolic fencing, although areas which possessed densely populated vegetation were protected with a buffer zone of 25 meters. The team of field biologist began on the east end of FIIS walking west parallel to the toe of the dune. Each plant was identified using 18" colored flags that were numerically labeled (i.e. K1, A1), and UTM coordinates were recorded for each species. Flowering and seed production begins August to early September, this continues until the death of the plant when reproduction was deemed successful.

RESULTS

Shorebird Results

The earliest piping plovers were observed on FIIS on March 31, 2003. Two weeks from their initial arrival the first pair of piping plovers were seen copulating in the OPWA on April 13. After they had been seen copulating this same pair initiated the first signs of scraping.

The nesting season began in early May and ended in mid June. The first three nests were located in the OPWA on May 5. Two nests were found with one egg, while the third nest had two eggs. The last nest for the season was found on June 15 with one egg.

A total of 22 piping plover nests were documented throughout the length of the island during the 2003 breeding season (Table 1). From these 22 nests (Figure 2,3), two were re-nests. The original nests of these two pairs consisted of, a one-egg nest that was abandoned, and a four-egg nest that was washed out. Including the previously mentioned five eggs that were lost, 76 observed eggs were laid.

Complete clutch size for the twenty nests ranged from a three-egg nest to a four-egg nest, with a mean average clutch size of 3.94. Nests that were located before the clutch was complete had an incubation range of 19 to 30 days (n=24.1 days); nests that were found as a complete clutch had a range of 19 to 29 days (n=25.0 days) (Table 2).

The first piping plover nest hatched on June 6 with the season lasting to July 15 when the last nest hatched. From the 71 remaining eggs that were observed a total of 64 chicks hatched, three eggs were unhatched, and a four-egg nest was abandoned. Five additional chicks from two broods were found during the season, however, the number of eggs prior to hatching was not observed. Together with these five chicks, there were a total of 69 hatchlings.

From the remaining 19 nests, 15 nests successfully fledged chicks, yielding a total of 35 fledglings. Chicks were first seen in flight on July 8 and continued until August 8 with a range between 24 to 37 days ($n=28.6$ days). With a nesting population of 20 breeding pairs, the productivity for FIIS was 1.75 chicks per pair. The number of nests found and chicks fledged in the 2003 season has surpassed the previous recorded ten years that Fire Island National Seashore has been monitoring the piping plover (Table 3).

The earliest least terns were observed on May 11. The terns began to congregate on May 14 when 19 birds were observed in the OPWA, east of Bellport Beach. On June 6 the first 21 nests were recorded, which was the start of a large colony. By June 23 the colony consisted of a total 49 nests, containing 89 eggs (Figure 4). These 49 nests did not produce any successful hatchlings for the reason that all of the nests were lost as of June 28.

A second smaller tern colony was located in the OPWA, directly west of Old Inlet on July 4. This small colony consisted of three nests containing a total of five eggs. Nests that successfully hatched had an incubation range between 14 to 20 days ($n=17$ days). Out of these five eggs, three chicks hatched and only one chick fledged after 17 days. With a nesting population of 52 breeding pairs, the productivity for the season was .02 (2%). The number of tern nests found on FIIS for 2003 exceeded the 2002 count, however, the fledgling success rate declined by 3.5% (Table 4).

Two breeding pairs of roseate terns as well as an estimated 100-200 breeding common terns were located July 14 on Sexton Island, a small island within the boundaries of FIIS. The clutch size, incubation range, and productivity of these nests are unknown.

Vegetation Results

Seabeach amaranth began emerging on FIIS in late July, surveying started on August 8 and continued until August 29. Vegetation surveying was conducted within five locations: OPWA, Watch Hill to Cherry Grove, Sailors Haven, Point O'Woods to Kismet, and the Lighthouse track. The numbers of amaranth plants throughout these five locations were 94,178,250,62 and 221 respectively. The total amaranth population for the length of FIIS was 805. In relation to the 805 total number of amaranth plants, the exact number that reached seed set is unknown. The abundance of amaranth plants for the 2003 season was almost 22 times more than the 2002 season, which had a total number of 37 plants (Figure 5,6,7).

Seabeach knotweed began to bloom in late July with surveying also being conducted between August 8 and through August 29. Surveying knotweed was managed within the same boundaries as the amaranth, however, the individual counts for each location was not distinguished. The total number of knotweed plants for the length of FIIS was 1077. Again, the exact number of plants that reached germination is unknown. In comparison to the 2002 season, which had 106 plants, there were more than ten times as many plants in 2003 (Figure 8,9,10).

DISCUSSION

The 2003 Threatened and Endangered Species Program was exceedingly different to any year prior due to a variety of circumstances. In essence, pre-season should have started at the beginning of March, however, due to a change in personnel and a lack of staff, pre-season did not begin until mid April. It was in mid April when the staffing situation was no longer a concern, but exceptionally poor weather had delayed the onset of fencing. Strong easterly winds eroded large portions of the beach, while it continued to snow in late April and rain heavily throughout May.

Pre-season ORV closures, in the OPWA, occurred on March 1st so that the migrating plovers can safely establish their breeding habitat. Unfortunately, because of issues with homeland security, Suffolk County Marine Bureau continued to drive in the OPWA until early May. This avoidable driving came to an end when the National Parks Service agreed to patrol the area by foot. It was believed that the combination of the weather, lack of habitat, and continuous driving affected the piping plover by establishing territory late in the season. Consequentially, this had a domino effect that led to a late nesting season.

Despite the setbacks, regular surveys were in place by the first week in May. It was during this month that more than half the nests were located, already exceeding last year total number of nests. Not only were there more breeding pairs, but they had established territory in areas of FIIS where piping plovers have not previously been located. The program had not anticipated such a large number of breeding plovers for 2003, which once again led to the problem of limited personnel. Proper and regular monitoring of the 26-mile beach could not ensue, therefore, requiring the program to hire a fourth field biologist in the first week of June. This fourth biologist was crucial when it came to monitoring areas of special concern such as, Sailors Haven and Lighthouse Beach.

Sailors Haven and Lighthouse Beach has always maintained suitable breeding habitat for the piping plover, however, only one nest had been located prior to the 2003 season. This was believed to have occurred because of the abundance of recreational activities. Because of this, these areas required special attention. Three nests were found at Sailors Haven, two of which were located where driving was permitted. In order to protect these birds additional symbolic fencing was assembled and ORV closures were put into effect. Furthermore, intensive monitoring of the nests began once the chicks had hatched. Intensive monitoring involved surveying the nest twice daily, at sunrise and at sunset,

until the chicks had fledged. Despite the closures, the lifeguards continued to drive ATV's throughout the closed area during the crucial period prior to fledging.

At Lighthouse Beach three nests were found where there had never previously been any productivity. New protocols had to be established in order to protect these new nesting grounds. These procedures consisted of additional symbolic fencing, as well as new beach closures to ORV's and pets. Volunteers were added to the monitoring program at Lighthouse Beach because of its large population of beachgoers. This section was monitored seven days a week throughout incubation up until they had fledged.

Human, *Homo sapiens*, activities were the most documented form of nest disturbances. It is believed that they are responsible for the abandonment of 15A-03 nest located at Lighthouse Beach. On several occasions beachgoers were observed inside the symbolic fencing and approaching the enclosure. One specific incident that was recorded involved a set of golfers teeing off in front of three nests located at the Old Inlet Marina. From these three complete clutches only three chicks successfully fledged. The highest productivity and success rates occurred in areas where little or no human activity was present. This area located approximately 1km east of Bellport Beach contained 19 hatchlings and 12 successful fledglings.

Additional predators and tracks that were witnessed by field biologist included: great black-back gulls, *Larus marinus*, herring gulls, *Larus argentatus*, crows, *Corvus spp.*, red fox, *Vulpes vulpes*, raccoons, *Procyon lotor*, white-tailed deer, *Odocoileus virginianus*, ghost crabs, *Ocypode Quadrata*, and domestic dogs, *Canis lupus familiaris*. Avian predators were often seen disrupting piping plover broods. In particular, crows were recorded harassing nest 9A-03 in Sailors Haven. On numerous accounts there were large groupings of gulls perched along the berm of the beach, in turn flushing the parents from their nests. Of the non-avian predators, red fox, and raccoons were not visually observed, however, their tracks were recorded inside the symbolic fencing and at times circling the enclosures. On the other hand, field biologists noted ghost crabs significantly distressing four particular broods. Of these 19 hatchlings only five chicks successfully fledged. Domestic dogs off leashes continued to be a problem on FIIS throughout the 2003 season. They were reported inside symbolic fencing and believed to be the cause of 1A-03's abandoned nest.

As much as the NPS had constructed extensive protective measures, the piping plovers also demonstrated a number of defense tactics in response to being threatened. In particular, 4A-03 moved their nest after it was believed that high tide washed out one egg and moved another approximately one foot from its original location. In order to salvage their nest the parents rolled the remaining eggs to the new position. On another occasion, one brood that had just hatched traveled approximately three miles in order to reach an area that was not heavily crowded by people. It is thought that these efforts led to their success of fledging all four chicks.

The highest rate of loss took place in the large tern colony. This tern colony, which was established by the first week in June, was entirely lost by the third week. Located within

this colony was piping plover nest 5A-03 that hatched three chicks on June 11. One week later these chicks were no longer seen, and their absence confirmed their loss.

It was evident that fox were present in this area, due to the number of tracks encompassing these boundaries. It is believed that the fox was the cause of death for 5A-03 and more than half of the tern colony. In addition, one-fifth of the terns nested near the shoreline, and was later confirmed lost from high tides and washouts. The combination of the presence of fox and loss from washouts may have caused the remaining terns to flee and abandon their nests.

There were no observations of roseate terns recorded for the 2002 season. However, for the 2003 season there were at least two roseate terns seen on Sexton Island. The boundaries consist of a larger island with residential homes and piers, and a smaller undeveloped island. The smaller undeveloped island is located 100 to 200 feet to the northeast of the larger island, and is comprised of spartina marsh and high marsh areas.

The island is owned by the Town of Islip and is within the FIIS jurisdictional boundary. On July 14, NPS and U.S. Fish and Wildlife personnel conducted a site inspection. Although visibility was limited due to the dense vegetation, many shorebird species including the roseate and common terns were observed. They appeared to be nesting and/or rearing young. Unfortunately, lack of transportation prevented further monitoring of this area and their outcome was unknown.

In comparison to prior years the number of recorded plants was extraordinarily high. As a result of the conservative population of plants over the years, there was little or no structured protocol for protecting vegetation. In response to this increase, we found that erecting exclosures around individual plants would not be conducive to the survival of this year's quantity. Instead, additional symbolic fencing was constructed and found practical to support the plethora of plants. Symbolic fencing was found effective against vehicle and human damaging; however, it did not deter predation by white-tailed deer and herbivorous insects. White-tailed deer were observed grazing on the amaranth on more than one occasion. In addition to predators, natural weather elements buried and/or removed some of each plant species.

Both the seabeach amaranth and knotweed were individually identified with red flags. The purpose of the flags was to inform the public of their presence, as well as, to record the plants that successfully germinated. However, this procedure was not as affective as it had been anticipated. Flags were removed by weather and beachgoers, therefore this protocol was deemed unsuccessful for determining exact productivity.

PROJECTIONS FOR 2004

The 2003 T&E season was by far Fire Island National Seashore's most productive to date. In order to sustain this rate of success the program must continue to make provisions. This section is provided to highlight specific suggestions and concerns pertaining to the Threatened and Endangered Species Recovery Plan.

Pre-season activities are the primary concern and the most critical time period for the program. Establishing an efficient and organized pre-season protocol sets the foundation for the upcoming year. The most important of these protocols is the construction of pre-season fencing. The essential purpose of symbolic fencing is to preserve suitable habitat, as well as, to provide safe breeding/germination grounds for all threatened and endangered species. Given that beach closures occur on March 1st it is suggested that that pre-season fencing be erected prior to this date. However, if circumstances such as inclement weather and lack of habitat do not facilitate fencing, materials should be stowed in designated areas throughout the OPWA. These materials should consist of posts, string, flagging, and all public awareness signs. Fencing material should also be stored for any adjustments that need to be made throughout the season.

When considering materials regarding symbolic fencing, Carsonite™ fiberglass posts should be used in place of steel. Through the use of both products this year, Carsonite™ has proven to be more environmentally sound and cost effective. Steel posts were found to be extremely heavy to carry, prone to rust, and dangerous to vehicles and people if washed out. Whereas, Carsonite™ has an extremely long life expectancy, does not deteriorate, and therefore its benefits outweigh the expenses.

It is anticipated that the abundance for the 2004 season will continue to increase and additional fencing will be essential. In conjunction with the extra fencing, increased monitoring will also be required. To accommodate this, the Resource Management Division of FIIS must hire additional personnel. It is recommended that three Student Conservation Association (SCA) interns be hired prior to the onset of the season. Once the breeding season has begun, another two SCA's should be hired. At least one experienced BioTech is also needed, preferably two. It is recommended that management talk with NPS units like Cape Cod, Gateway, and Assateague about staffing requirements for an area and population of this size. It would also be more feasible that personnel be located at both Watch Hill and the Lighthouse. This would allow for more overall observations throughout the 26-mile beach. Three SCA's should be housed at Watch Hill, given that the OPWA is the most productive, while the remaining two should live at the Lighthouse and monitor from Sailors Haven west.

Due to the nature of the Threatened and Endangered Species program it is recommended that a majority of the personnel, especially SCA's, be boat certified. Boat certification would allow for all areas within FIIS jurisdictions to be monitored. This includes Sexton Island where roseate terns were observed this season. It is imperative that all FIIS boundaries, that deem suitable habitat for any of the T&E species, be consistently monitored, for the recovery of the species.

The program found that it was not viable to individually record every plant this year because of the unexpected number of vegetation. It is highly recommended that if the combination of both plant species exceeds 500 that a procedure known as sweep counting be put into practice. Boundaries should be distinguished, approximately 50' by 50'; in which each plant species can be tallied. It should than be within these margins that UTM coordinates are recorded

The presence of law enforcement and their efforts to patrol the entire beach will aid tremendously in ensuring that beachgoers stay out of fenced areas and adhere to species protection laws. Law enforcement agents play a crucial role in educating landowners, user groups, and others about their responsibilities with regard to protection of threatened and endangered species. Because the OPWA is a secluded 7-mile stretch of beach it is understandable that the rangers attendance may be minimal. It is suggested, that for the safety of the field biologists, rangers can patrol the region daily. The ranger's time is valuable to the NPS, and the program hopes to implement a system that will accommodate both the safety of the biologists and protection of all T&E species. If this should commence driving, it is suggested that vehicle types be reduced to only quads, and/or ATV's, permits only be approved for NPS and emergency vehicles, speed regulations be set at five miles per hour especially during chick season, and all staff be trained in identifying shorebirds. All driving regulations would need to follow USFWS guidelines for essential vehicles.

Experience over the last ten years has shown that Threatened and Endangered Species populations can increase dramatically in response to intensive protection efforts. These efforts are time-consuming, costly, and sometimes require temporary restrictions on off-road vehicles, and/or recreational activities, nevertheless they are highly effective and extremely rewarding.

ACKNOWLEDGEMENTS

The 2003 Threatened and Endangered Species Program personnel consisted of The Chief of Resource Management: Michael Bilecki, Seasonal Bio-tech: Dawn Wiley, and Student Conservation Interns: Adrienne Frisbee, Paula Muellner, Sandra Wiley, and Heather Bosserman.

We would like to thank individuals from the different divisions who dedicated their time and labor to the T&E program, including: George Leone, Dick Ramsdell, Andy Blake, Mary Beales, Paul Czachor, Kim McCrary, Stacey Kopitsch, Adam Bissonette, Jason Flynn and Kristin Santos. In addition, we are incredibly grateful to our volunteers: George Kiesel, Sue Greer, and Marliese Kneis. Special thanks must be extended to two individuals whom without, the program would have been at a loss. Both Marie Lawrence and Steve Finn displayed incredible amounts of dedication to the program.

We extend our sincere gratitude to all employees at FIIS. Without your help and understanding the program could not have been as successful as it was.

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Figure 1. Fire Island National Seashore, LI, NY

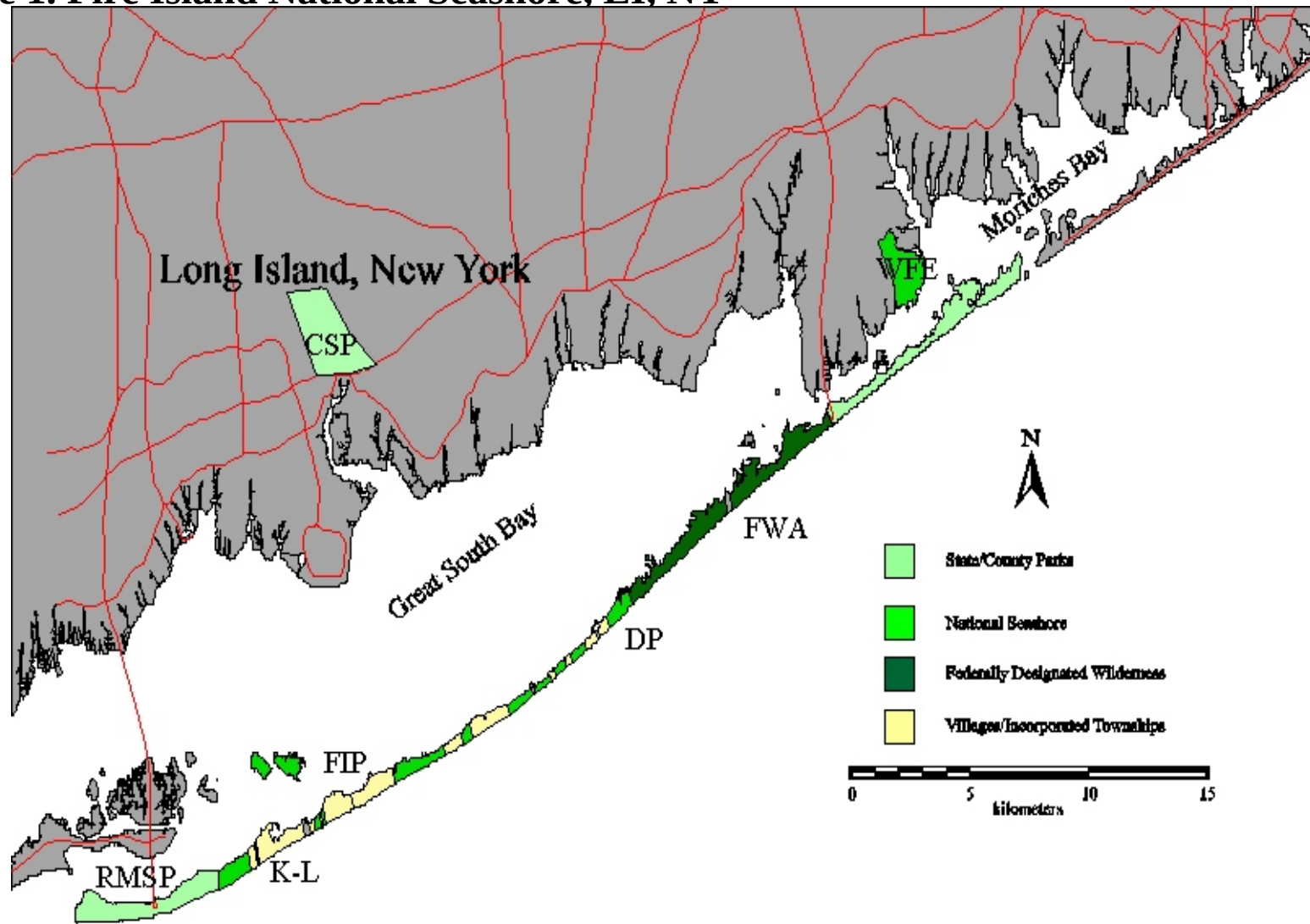


Figure 2: 2003 FIIS Plover Nests
Otis Pike Wilderness Area

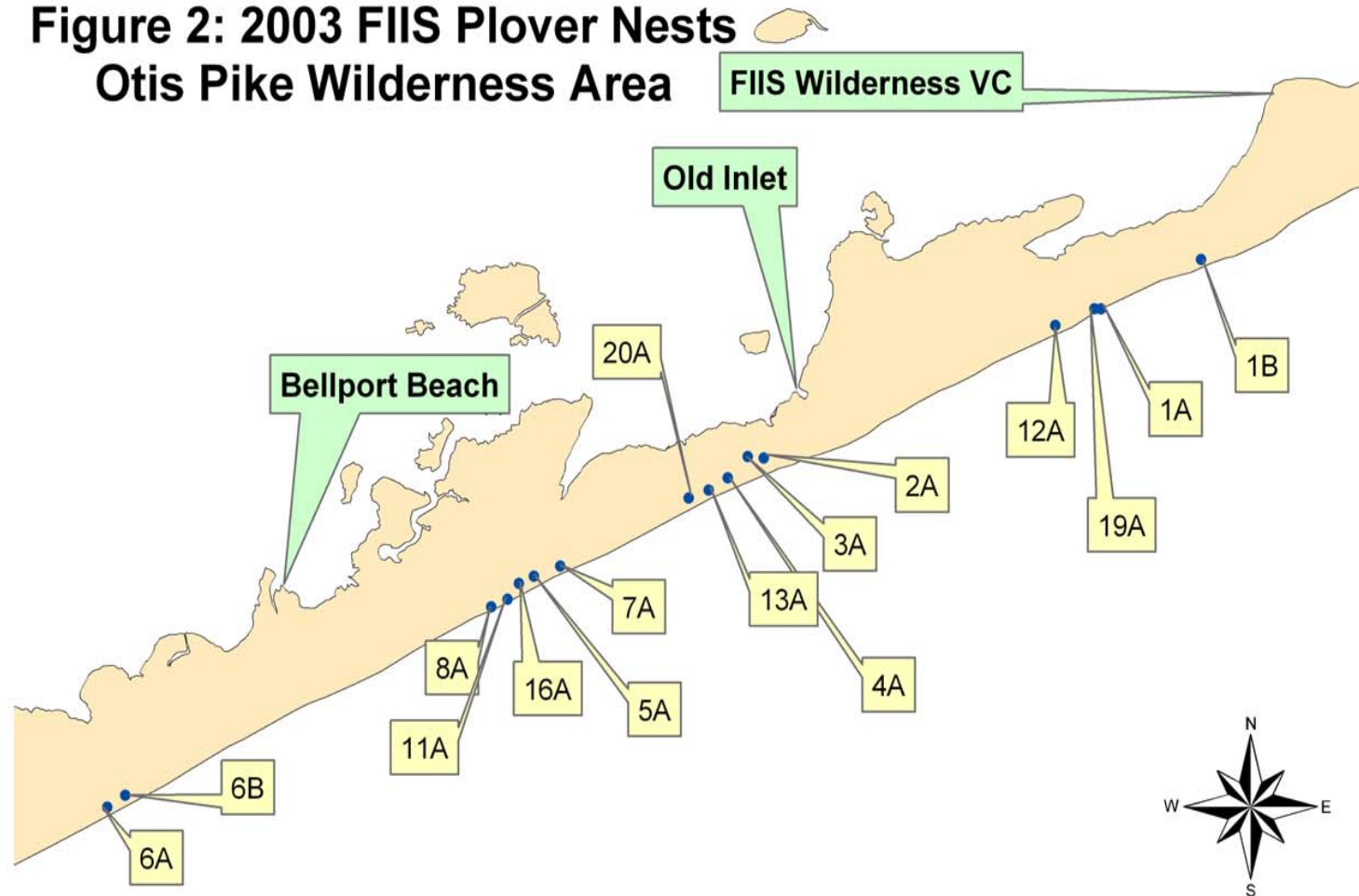


**Figure 3: 2003 FIIS Plover Nests
Sailors Haven and Lighthouse Beach**

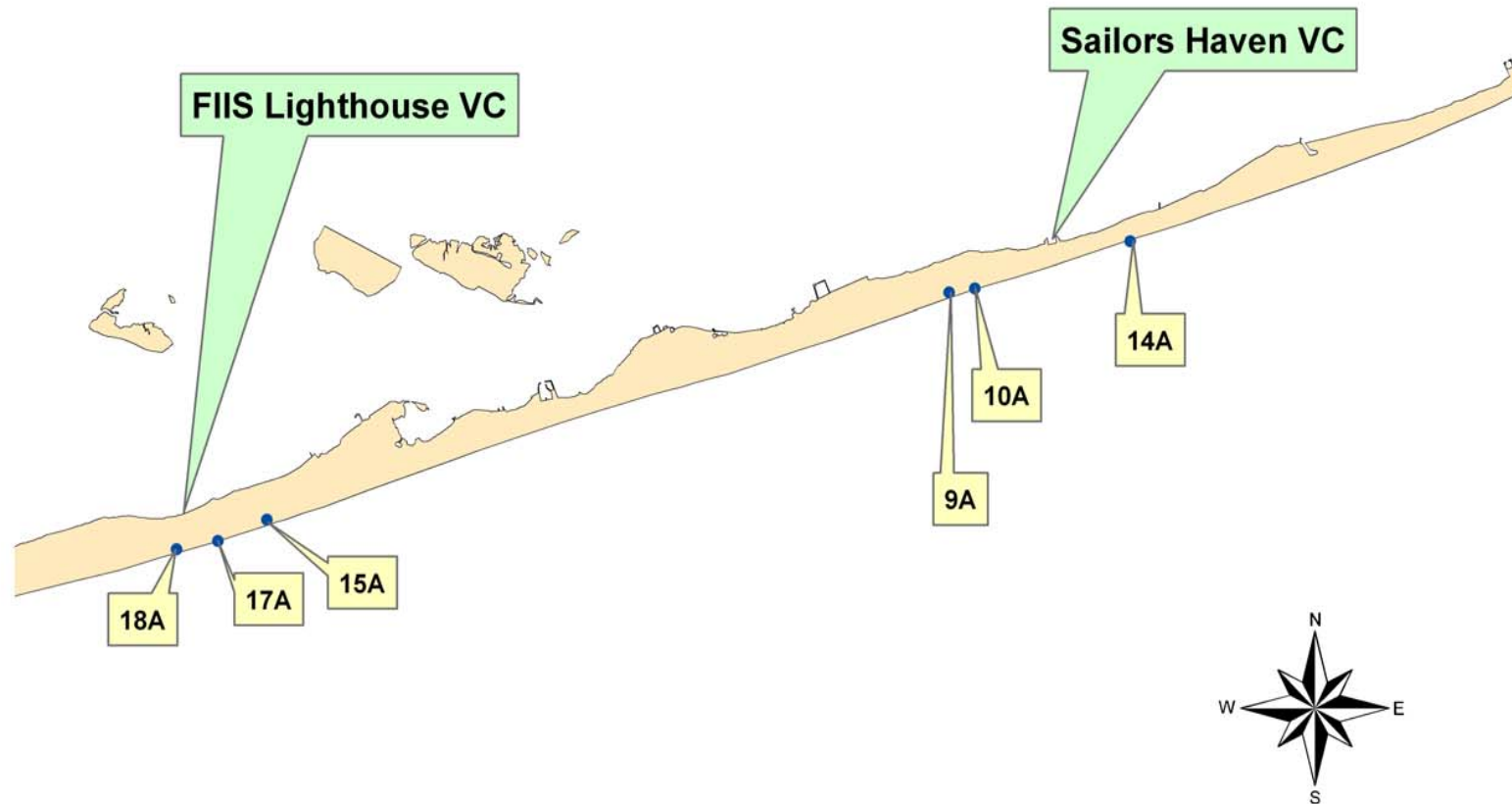


Figure 4: 2003 FHS Tern Nests
Otis Pike Wilderness Area

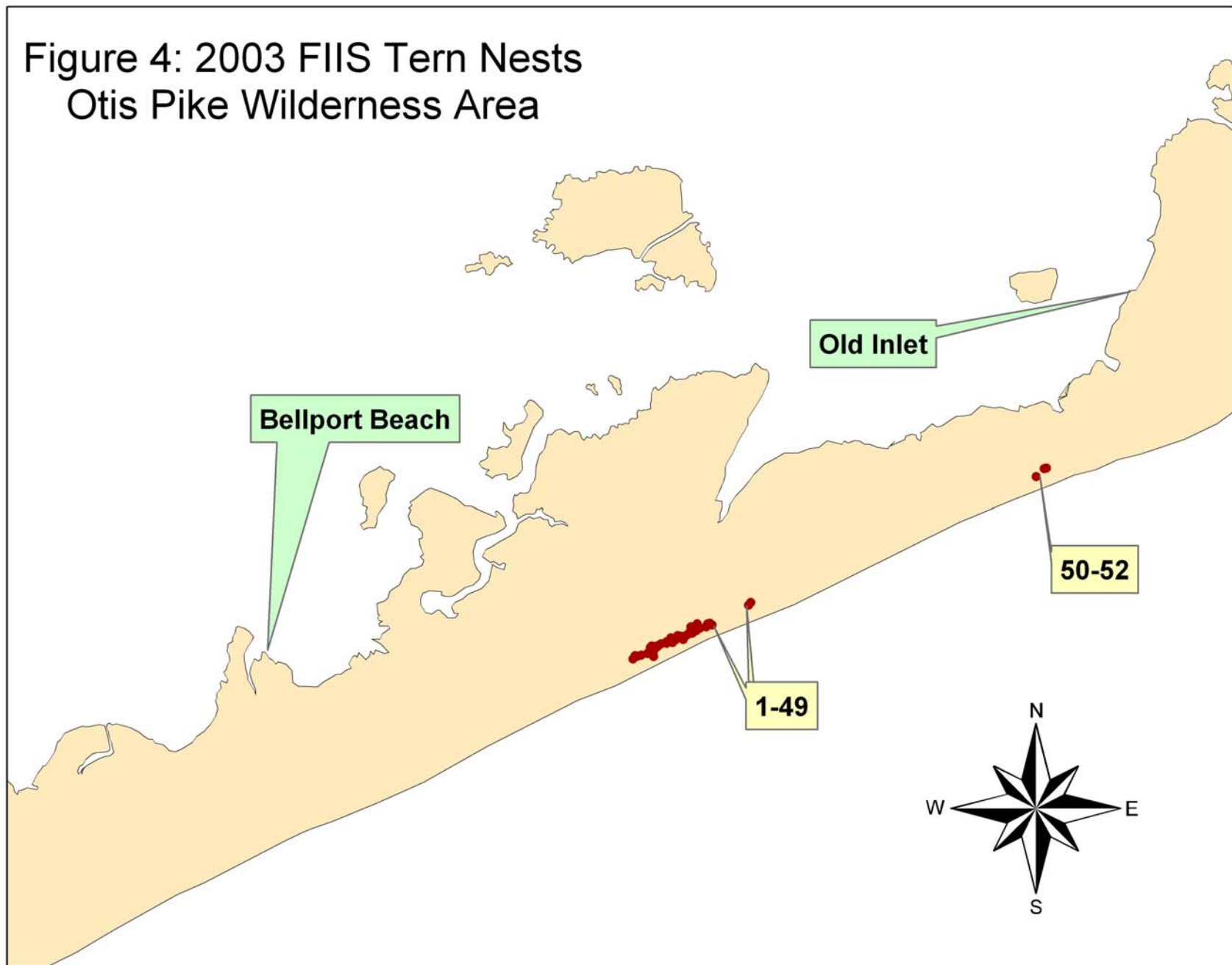


**Figure 5: 2003 FIIS Amaranth Plant Locations
Otis Pike Wilderness Area**

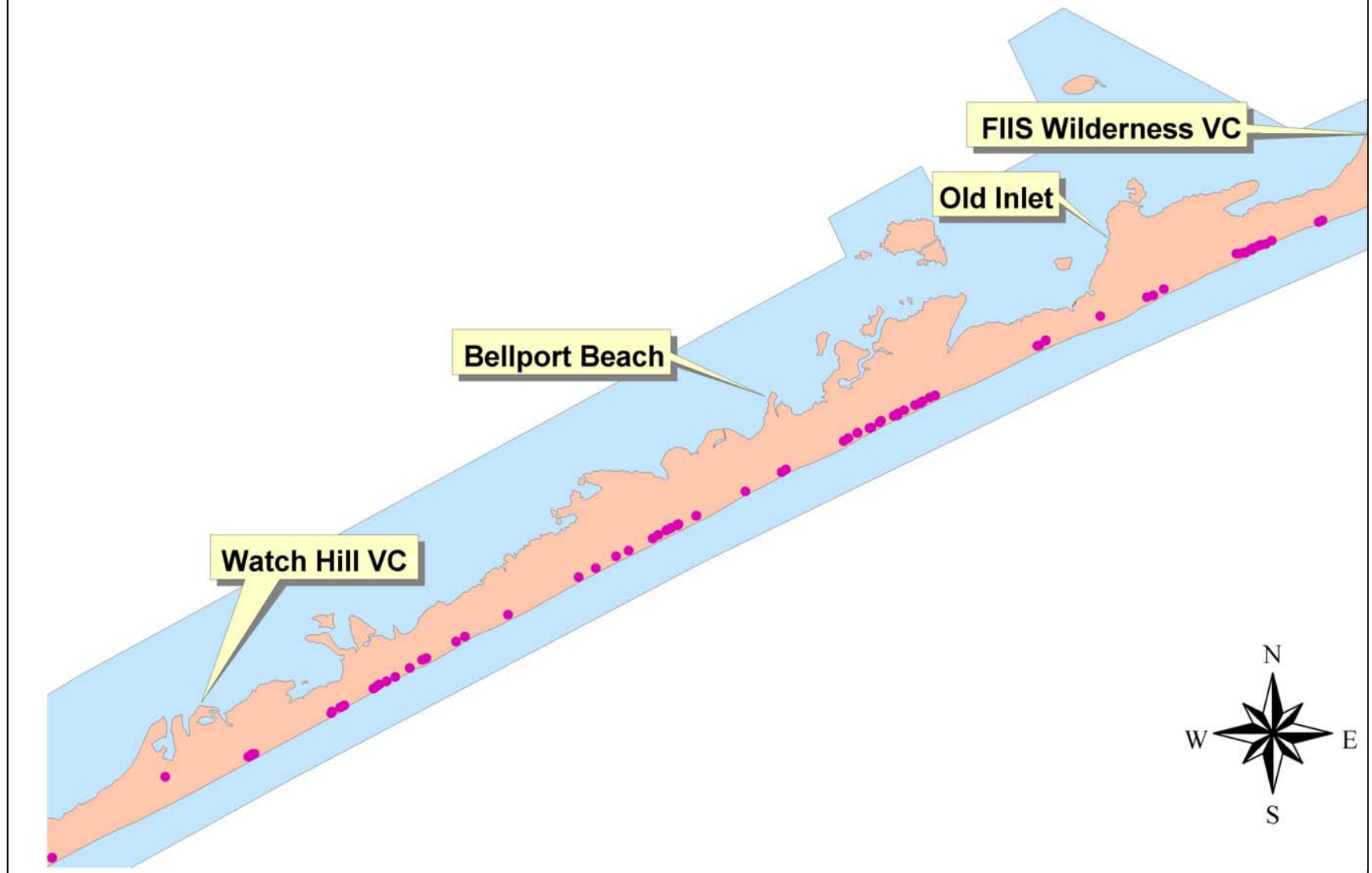


Figure 6: 2003 FIIS Amaranth Plant Locations
Watch Hill to Cherry Grove

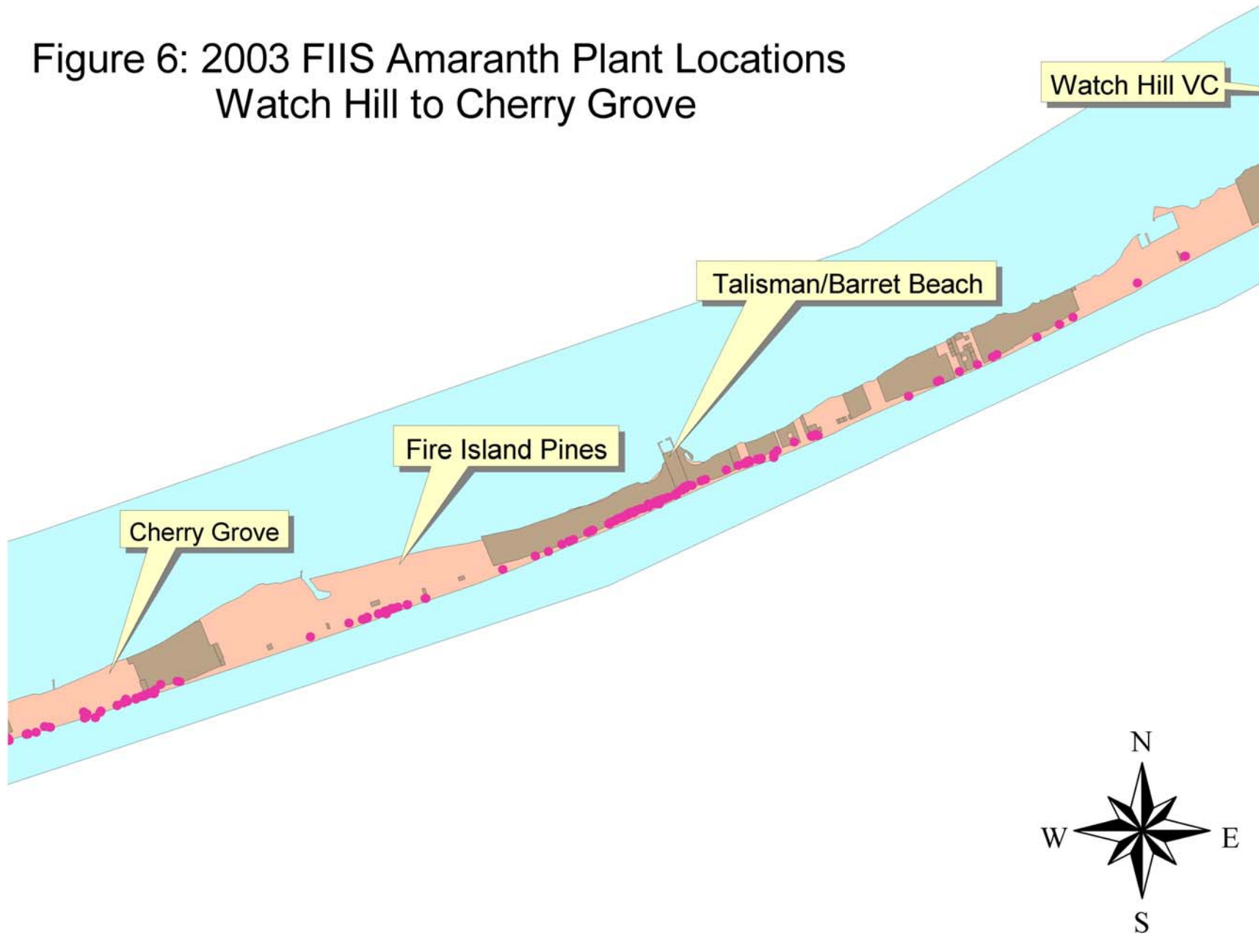


**Figure 7: 2003 FIIS Amaranth Plant Locations
Sailors Haven to Lighthouse**

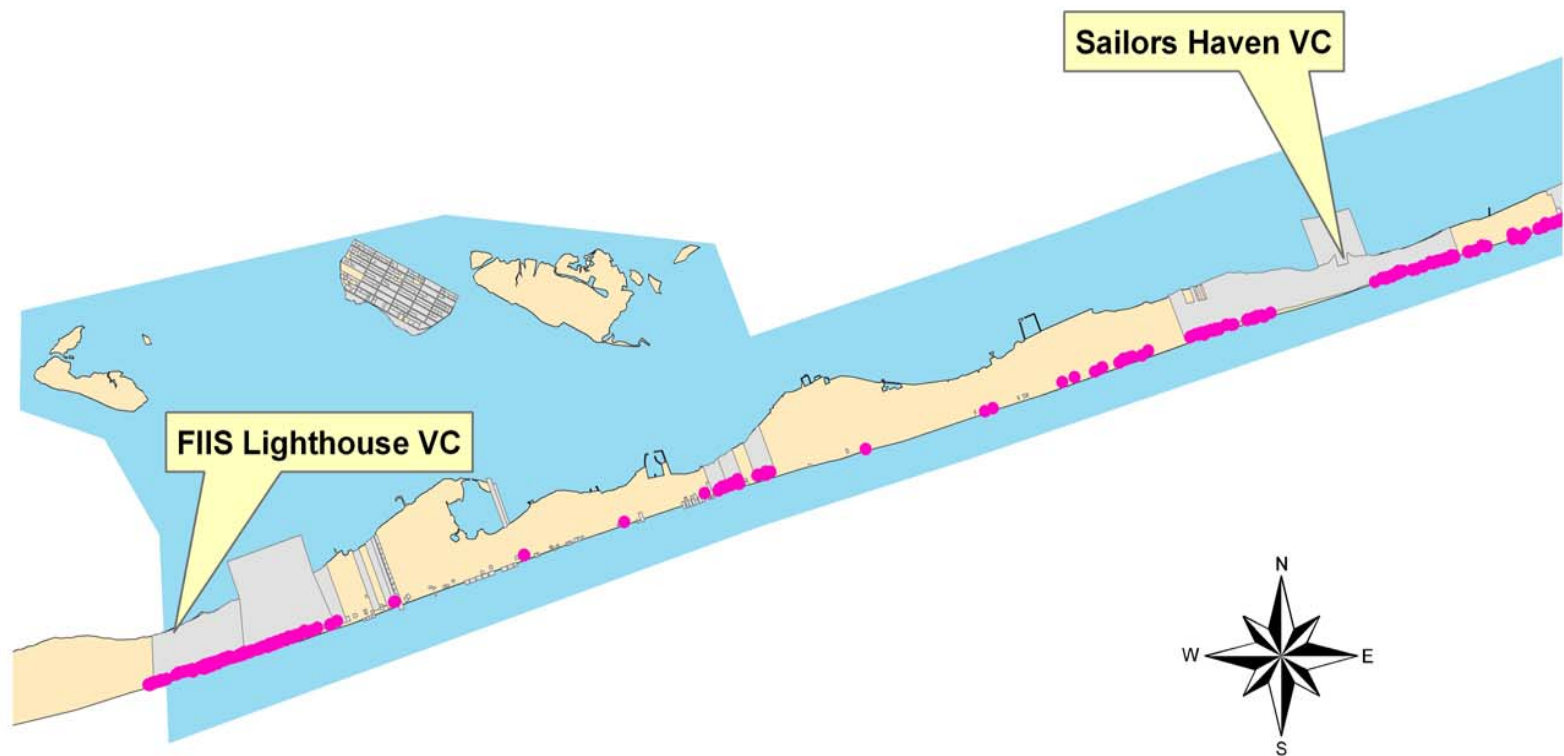


Figure 8: FIIS Knotweed Plant Locations 2003
Otis Pike Wilderness Area

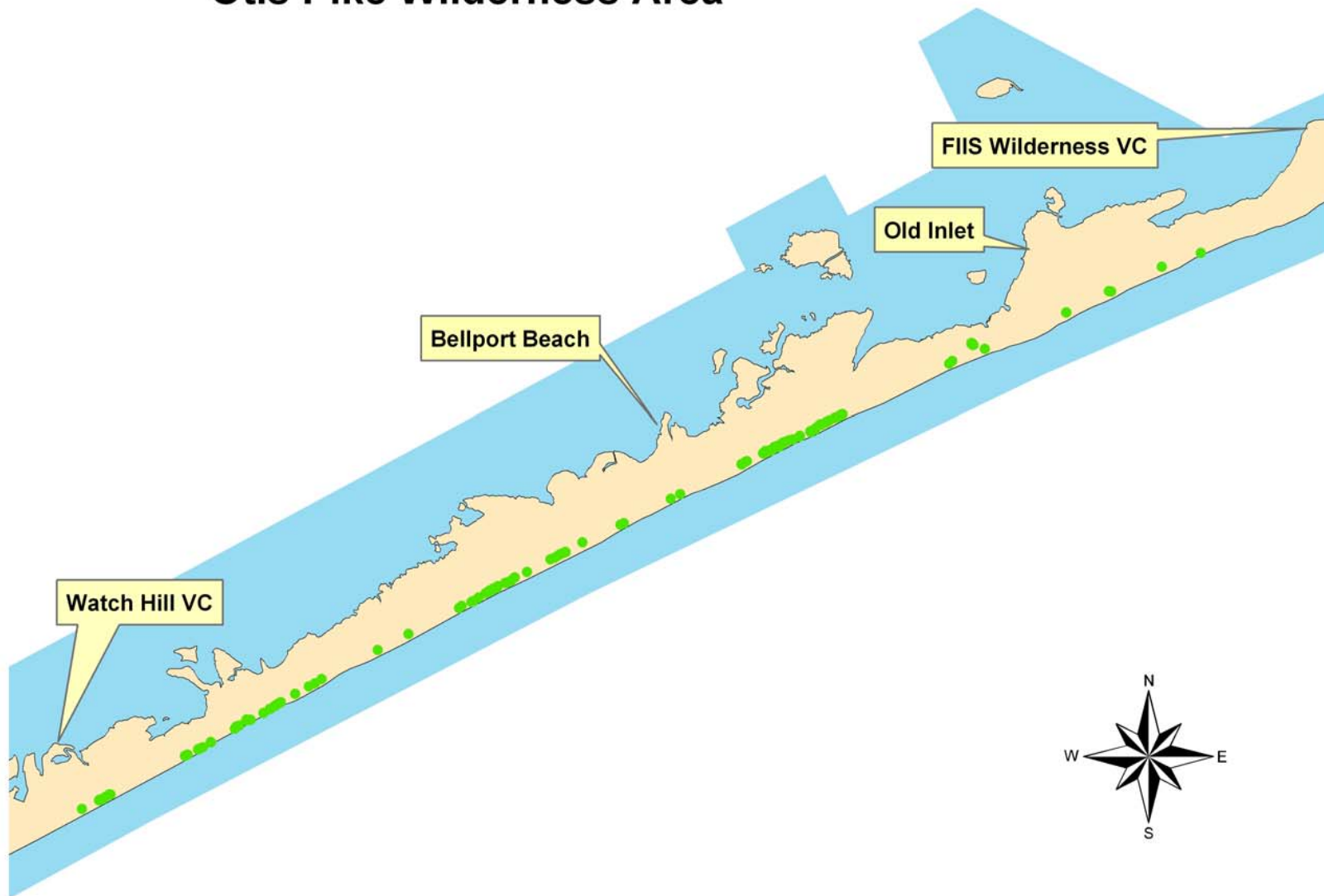


**Figure 9: 2003 FIIS Knotweed Plant Locations
Watch Hill to Cherry Grove**



**Figure 10: 2003 FIIS Knotweed Plant Locations
Sailors Haven to Lighthouse**

