New Jersey Field Office Recommendations for Statewide Piping Plover Habitat Improvement

Introduction

The U.S. Fish and Wildlife Service's (Service) New Jersey Field Office (NJFO) has worked closely with the New Jersey Department of Environmental Protection's Endangered and Nongame Species Program (ENSP), beach managers, and many other partners to conserve the piping plover (*Charadrius melodus*) (plover) since the species was federally listed in 1986. These partnerships have spurred many advances and achievements in plover conservation, but recovery in New Jersey remains elusive. This document is provided as technical assistance pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) (ESA) to articulate NJFO recommendations for the next phase in plover recovery in New Jersey—one focused on habitat improvement, which we define to include restoration, enhancement, creation, and maintenance. As discussed below, plover populations and habitat conditions in the State have declined to alarmingly low levels that could preclude recovery over the long term—not just in New Jersey but rangewide. This document lays out a vision and a challenge for all recovery partners to work together on innovative, adaptive, and collaborative habitat solutions at a speed and scale adequate to halt the declines and begin reversing the plover's currently dire situation in New Jersey.

Background and Need for Action

Population Trends

The Atlantic Coast plover population in 2023 (2,593 breeding pairs) was more than triple its size at the time of listing (790 pairs). However, steady population growth in New England since the 1990s has obscured downward trends in other portions of the range. In Atlantic Canada, New Jersey, and the southern states from Maryland to North Carolina, plover populations remain below recovery targets and are declining in many places (Service 2025). The security of the Atlantic Coast piping plover is fundamentally dependent on even distribution of population growth across the breeding range in order to maintain a sparsely-distributed species with strict biological requirements in the face of environmental variation, buffer it against catastrophes, and conserve adaptive capacity (Service 2025). Accordingly, the recovery plan (Service 1996) delineates four recovery units: Atlantic Canada, New England, New York-New Jersey, and Southern (Delaware, Maryland, Virginia, and North Carolina). Recovery criteria established in the recovery plan define population and productivity goals for each recovery unit, as well as for the population as a whole. Attainment of these goals for each recovery unit is an integral part of a piping plover recovery strategy (Service 1996). The New York-New Jersey recovery unit is a key link providing connectivity between units to the north and south.

Through decades of hard work by many partners, New Jersey's plover population saw uneven growth from an early low of 93 pairs in 1987 to a high of 144 pairs in 2003 (Service 2024); see Figure 1. However, productivity has only exceeded the recovery target (1.5 fledged chicks per pair) in one year (2018) since listing, and pair numbers have declined sharply in recent years despite intensive ongoing management. After averaging about 120 pairs per year through 2005, the statewide population has averaged only 109 pairs per year since 2006, with record lows in 2014 (92 pairs), 2024 (89 pairs), and 2025 (76 pairs) (Service 2024, Heiser and Davis 2025).

In addition, pair distribution has become highly concentrated in just two sites—the Sandy Hook Unit of Gateway National Recreation Area (Sandy Hook) and Edwin B. Forsythe National Wildlife Refuge (EBFNWR); see Figure 1. The annual proportion of statewide pairs nesting in these two sites averaged about 43 percent through 2008, but climbed to an average of nearly 71 percent from 2009 through 2025, with peaks of 79 percent and 84 percent in 2014 and 2015, respectively (Jenkins *et al*. 1996, 2005; Pover and Kisiel 2007; Heiser and Davis 2025). This highly clumped distribution left smaller sites vulnerable to extirpation. Indeed, New Jersey dropped to 18 active nesting sites in 2025, down from 24 sites in 1995 and a record 30 sites in 2004 and 2005 (Jenkins *et al*. 1996, 2005; Heiser and Davis 2025). This extreme concentration also left the statewide population vulnerable to stochastic factors impacting Sandy Hook or EBFNWR. These risks have now been born out with: (1) a sharp decline at Sandy Hook to 14 pairs in 2024 and 9 pairs in 2025 (versus the long-term average of 31 pairs per year, with the 2025 count the lowest since 1986) (Jenkins *et al*. 1996, 2005; Pover and Kisiel 2007; Heiser and Davis 2025); (2) a sharp decline in productivity at EBFNWR (0.35 and 0.28 fledge per pair in 2024 and 2025, respectively, the lowest since before 2012 (Kopec *et al.* 2024, Heiser and Davis 2025)); and (3) declining habitat suitability at both sites (Heiser and Davis 2025).

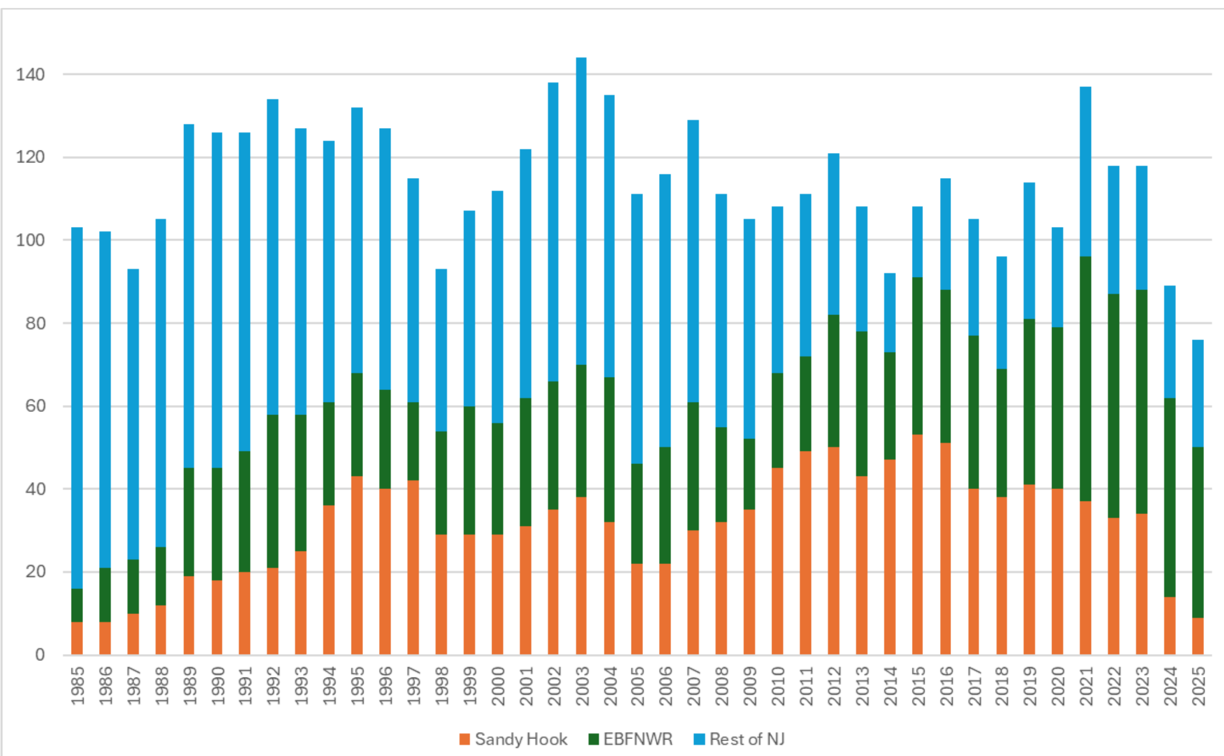

Figure 1. Numbers and Distribution of Piping Plover Breeding Pairs in New Jersey, 1985-2025

Habitat Conditions

The wide, flat, sparsely vegetated barrier beaches, spits, sandbars, and bayside flats preferred by plovers are formed and maintained by natural forces and thus are susceptible to degradation caused by development and shoreline stabilization activities (Service 2025). Inlet dredging and jetties can affect the formation of spits, as well as ebb and flood tidal shoals. Jetties stabilize inlets and cause island widening and subsequent vegetation growth on the updrift inlet shores; while causing island narrowing and/or erosion on the downdrift inlet shores. Seawalls and revetments restrict natural shoreline movement and exacerbate erosion. Although beach nourishment projects may restore lost or degraded habitat (*e.g.*, in instances where the beach has been reduced or eliminated by hard structures and/or limited sediment supplies), the practices of sediment placement, installation of sand fences, and beach scraping can also degrade piping plover habitat by altering natural topography and sediment composition; depressing the invertebrate prey base; and hindering habitat formation and maintenance that would otherwise occur during storms. Habitat loss and degradation, including functional habitat loss due to insufficient protection from human disturbance, are major widespread continuing threats to breeding Atlantic Coast plovers that reduce carrying capacity and productivity (Service 2025). Detailed reviews of scientific literature describing the effects of modifications to tidal inlets and sandy ocean beaches are provided by Nordstrom (2000), Rice (2016, 2017), Guilfoyle *et al.* (2019), and Miselis *et al.* (2021). Previous Service documents (1996, 2009, 2020, 2025) summarize a robust body of scientific literature showing the central role of habitat quality in supporting successful plover breeding.

Periodic declines and lack of population growth following some years with productivity well-above the estimated rate deemed necessary to maintain a stationary population in this part of the range, and the species response to habitat-creating events, suggest that habitat may be limiting plover breeding abundance in New Jersey (Service 2021). This is further supported by several landscape-scale assessments (Kisiel 2009, Maslo *et al.* 2016, 2018, Zeigler *et al*. 2019, 2021, Stantial *et al.* 2021). As discussed below, the highly stabilized, human-modified condition of the New Jersey shoreline is the key factor limiting the state's piping plover habitat quality and quantity, which has been linked to chick growth and survival (Stantial *et al*. 2021).

Within the plover's Atlantic Coast breeding range, New Jersey stands out as a state particularly impacted by a long history of extensive coastal development and associated engineering practices aimed at stabilizing shorelines and inlets (Rice 2016, 2017) and fixing them in place (Tenebruso *et al.* 2022). Rice (2017) summarized several historical reviews of the New Jersey shoreline condition, paraphrased here. McCormick *et al.* (1984) (as cited by Rice 2017) coined the term "New Jerseyization" of beaches, where shoreline armoring leads to more and larger armoring until eventually the shoreline is lined with armored structures with no beaches or only small pockets of beaches on the updrift sides of groins. Hall and Pilkey (1991) reported that, "The New Jersey shoreline, in many places stabilized for longer than a century, provides evidence of the degradational effect of hard stabilization on recreational beaches." Mitteager *et al.* (2006) described how private oceanfront property owners in developed areas of New Jersey have modified the natural dune system and its vegetation, including how structures such as bulkheads, boardwalks and walls "interrupt the natural environmental gradient. … Dunes that are now seaward of buildings are truncated portions of natural dunes or, more commonly, new dunes created artificially using sand fences, vegetation plantings, or earth-moving equipment."

Although few new hard structures have been built in New Jersey in recent decades, a vast network of existing hard structures is being maintained (Rice 2016, 2017), and the coastline is further stabilized by the country's most extensive beach nourishment program (Elko *et al*. 2021) that includes engineered dunes, dense vegetation planting, and sand fencing (*e.g.*, Corps 1999). Looking at Atlantic Coast states from Maine to North Carolina as of 2015, Rice (2016) reported that New Jersey had the highest proportion of modified inlets (91 percent, 10 of 11 inlets), including alterations via hard structures and/or dredging. New Jersey's last remaining unmodified inlet was dredged in 2018 and is slated to become a recurrent borrow area (Service 2026). Looking at Atlantic Coast states from Maine to North Carolina as of 2015, Rice (2017) found that New Jersey was tied for the second highest proportion of developed sandy shoreline (65 percent). New Jersey also had the second highest proportion of shoreline modified with armor (62 percent), with 455 groins and 161 seawalls, bulkheads or revetments. As of 2015, New Jersey had the second highest proportion of shoreline modified with beach nourishment (63 percent) and the highest proportion with recent nourishment (63 percent), with 47 percent of the coast featuring sand fencing (Rice 2017).

New Jersey's long history of coastal engineering across a large geographic extent has indirectly affected many undeveloped portions of the shoreline, even those that have not been directly modified. Virtually no portions of the coast are beyond the range of influence from nearby stabilization structures or projects. Groins and jetties cause updrift accretion and downdrift erosion. Beach nourishment causes downdrift accretion that can alter beach widths, elevations, slopes, and grain sizes, and can result in inlet shoaling or spit elongation that can, in turn, lead to increases in dredging activity. Seawalls and other structures that prevent shoreline migration cause discontinuities with adjacent unstabilized beaches, which can alter wave environments and sediment transport patterns. Inlet dredging can exert profound influences on nearby shorelines (Nordstrom 2000, Corps 2002, Miselis *et al.* 2021). In addition to changing geophysical habitat parameters, these combined effects can also influence prey availability and vegetation patterns.

Early plover habitat improvement efforts were often ineffective or short-lived (Hecht 2016; Service 2020, 2025). However, these efforts enhanced scientific understanding and experience, leading to more recent habitat improvements that proved highly effective. Projects like Prime Hook (Delaware), Barnegat Light Restoration Area (New Jersey), and Fire Island (New York) have demonstrated the ability of habitat improvement projects to attract and support robust nesting plover populations (Service 2025). Commitments to adaptive management and frequent maintenance, which were lacking for some earlier projects, have also been key to increased success. Since 2017, a reliable funding source has become available to support habitat improvement in New Jersey (Service 2017). However, the pace of identifying, planning, and implementing projects has lagged behind the funding stream, and there remains a pressing need for more and better plover habitat.

Recovery Framework for New Jersey

The Service approaches species recovery using the conservation biology principles of resiliency, redundancy, and representation (collectively known as the "3Rs") (Service 2016).

Resiliency is the ability of populations to withstand stochastic events. Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. Generally speaking, populations need abundant individuals within habitat patches of adequate area and quality in order to withstand or bounce back from environmental or demographic stochastic events (Service 2016). Specific to New Jersey plovers, a resilient nesting area is one where carrying capacity is as high as it can be given local constraints, pair numbers are at or growing toward carrying capacity, productivity is at or growing toward the recovery target of 1.5 fledged chicks per pair, and occupancy is consistent and long term (ideally, at least 10 years).

Redundancy is the ability of a species to withstand or bounce back from catastrophic events (*e.g.*, rescue effect); it's about spreading risk among multiple populations to minimize the potential loss of the species from catastrophic events. Redundancy is characterized by having multiple, resilient populations distributed within the species' ecological settings and across the species' range. It can be measured by population number, resiliency, spatial extent, and degree of connectivity (Service 2016). Specific to New Jersey plovers, redundancy consists of highly resilient populations at all of the primary sites listed below, as well as occupancy of at least half of the secondary sites each year without any acting as population sinks.[1]

Representation is the ability of a species to adapt to changing environmental conditions over time. It is characterized by the breadth of genetic and environmental diversity within and among populations (Service 2016). Specific to New Jersey plovers, redundancy involves roughly even distribution of nesting pairs across the state's four Atlantic Coast counties (adjusted for shoreline length), and no more than 30 percent of statewide pairs at any one site.

Habitat Improvement Strategy

Based on the above considerations and our ongoing experiences and partnerships, NJFO concludes the following.

1. With the State's entire coastline directly or indirectly affected by coastal engineering, natural processes are constrained and unable to create and maintain sufficient quality and quantity of habitat to support a resilient, redundant, and representative plover population in New Jersey. Habitat is: (a) currently insufficient to support plover recovery in New Jersey (Service 2021); (b) unlikely to rebound absent human intervention; and (c) likely to further decline due to "coastal squeeze," with beaches bounded by extensive infrastructure on one side and accelerating sea level rise on the other side (Defeo *et al*. 2021).
2. Although habitat challenges are not new, a more robust network of "primary" and "secondary" plover nesting sites existed in New Jersey during a 20-year period (1987-2007)

[1] We give a preliminary definition of a sink as a site with annual productivity ≤1 fledged chick per pair. This definition may be updated as new demographic information becomes available.

(Kisel 2009) that saw some promising growth in the size of New Jersey's plover population (Service 2025) (Figure 1).

3. Scientific understanding and practical experience have advanced to the point of allowing effective habitat improvement, and a reliable funding source is available to support the work.
4. Habitat improvement offers the best path toward plover recovery, and provides incidental benefits to other beach-dependent species.

Therefore, NJFO recommends a thoughtful, robust, coordinated, long-term, coastwide initiative to restore, enhance, create, and maintain plover habitat as needed to establish the following.

<u>Optimal habitat and highly resilient nesting populations at a distributed network of primary sites (from north to south)</u>:

1. Sandy Hook
2. Island Beach State Park
3. Barnegat Light Restoration Area
4. Holgate (EBFNWR)
5. Little Beach (EBFNWR)
6. North Brigantine Natural Area
7. Corson's Inlet State Park
8. Stone Harbor Point
9. Cape May National Wildlife Refuge
10. Cape May Meadows / Cape May Point State Park

<u>Suitable habitat and at least 50 percent annual occupancy at a distributed network of secondary nesting sites, including but not limited to the following (from north to south)</u>:

1. Sea Bright
2. Monmouth Beach
3. Seven Presidents Oceanfront Park
4. Long Branch
5. Deal
6. Belmar Shark River Inlet
7. Wreck Pond
8. Sea Girt National Guard Training Center
9. Barnegat Peninsula municipal beaches
10. Barnegat Light front beach
11. Long Beach Island municipal beaches
12. Horseshoe Island
13. Brigantine City
14. Malibu Beach Wildlife Management Area / Seaview Harbor Marina
15. Ocean City
16. Strathmere Natural Area / Upper Township / Whale Beach
17. Sea Isle City
18. Avalon
19. North Wildwood
20. U.S. Coast Guard Training Center Cape May

Guiding Principles for Habitat Improvement

1. Site-specific habitat improvement projects should be planned and carried out in the context of this statewide recovery strategy. Plover recovery partners should work to develop a project pipeline, such that at least one project is in planning and one in initial construction at all times until the above-listed goals are achieved, or until habitat is no longer an important factor limiting statewide plover recovery.

2. Improvement projects should aim to provide high-quality habitat not just for nesting but also for foraging, which is linked to chick growth and survival (Maslo *et al.* 2012, Hecht 2016, Stantial *et al.* 2021).

3. Natural coastal processes are the most effective method of creating and maintaining plover habitat (Service 1996, 2009, 2020, 2025; Robinson *et al*. 2019; Zeigler *et al*. 2019). Improvement projects should seek to restore and/or mimic these processes to the maximum extent possible. Where habitat formation via natural processes has been curtailed (*e.g.*, within or adjacent to groins, jetties, sea walls, artificial dunes, beach nourishment areas), projects should seek to counteract or compensate for the adverse effects of coastal engineering on habitat conditions.

4. Each habitat improvement plan should include a strategy for funding and implementing long-term maintenance, including but not limited to vegetation management and, to the extent practicable, adaptive management (Hecht 2016).

5. Projects should be focused on designated conservation lands in order to: (a) offer the most potential to work with or mimic natural coastal processes (Zeigler *et al.* 2019); (b) minimize conflict with human beach users; (c) provide low-disturbance environments that support robust plover population growth (DeRose Wilson *et al.* 2018, Stantial *et al.* 2021); and (d) afford the most flexibility in predation management techniques.

6. Projects must be planned in close coordination with local beach managers and regulators to ensure compliance with relevant laws, regulations, and policies (*e.g.*, National Park Service, National Wildlife Refuge, and Federal Wilderness Area regulations; State Coastal Zone, Tidelands, and Natural Area rules; local Beach Management Plans[2]) and to address legitimate stakeholder concerns such as coastal resilience and compatible beach uses. Institutional barriers at each site should be identified and worked through with appropriate representation from key stakeholders.

7. Projects should assess and offset, to the extent practicable and/or required by regulation or policy, unavoidable impacts to back dune and maritime shrub/forest habitats. A proactive and holistic series of back dune offset projects distributed across the state would address these concerns in advance of individual project proposals and may speed the approval process for beach habitat work. Examples of back dune offset projects may include controlling invasive vegetation and planting native coastal species.

[2] https://www.fws.gov/project/beach-management-planning-new-jersey

8. Habitat improvement practitioners should follow best practices (*e.g.*, Rice 2009, Guilfoyle 2019), be informed by best available science (*e.g.*, Maslo *et al.* 2011, Maslo *et al.* 2012, Hecht 2016), and regularly and candidly report on lessons learned—both successes and failures.

9. To the extent practicable, habitat improvement projects should occur in areas with an approved Beach Management Plan that addresses human recreation, predation management, and other key issues to maximize the productivity of the improved habitat.

10. Wherever possible, projects should pursue beneficial use of dredged or otherwise surplus clean sand while ensuring suitable grain size for breeding plovers.

Other Recommendations

1. To the extent practicable and allowed under the ESA, plover marking and tracking studies should be carried out to document population sources, sinks, and connectivity in relation to habitat improvement projects. Study designs that collect data on covariates and provide annual analysis and reporting are essential to maximizing the scientific value and conservation benefit of these efforts.

2. The Service and ENSP should work cooperatively with the U.S. Army Corps of Engineers (Corps) to develop and carry out a statewide prey study, which can form the basis of routine future prey monitoring relevant to both beach nourishment and habitat improvement.

3. The Service and the Conserve Wildlife Foundation of New Jersey should finalize dune recommendations specifically for use on beaches that support listed species.

4. The Service and ENSP should work with the Corps, the Federal Emergency Management Agency, and the New Jersey Office of Coastal Engineering to adopt and implement a cooperative post-storm response strategy that balances recovery of human infrastructure with the conservation of storm-created plover habitats (Maslo *et al*. 2018, Zeigler *et al.* 2019).

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