

2023 New Jersey Beach-Nesting Bird Project Report



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**NJ DEP Fish and Wildlife
Endangered and Nongame Species
Program**



*Skimmers and Terns on Stone Harbor Point.
Photo courtesy of Meredith Wray*

The New Jersey DEP Fish and Wildlife – Endangered and Nongame Species Program (NJFW) is responsible for the monitoring and management of beach-nesting birds on all state, county, and municipal sites and the collation of statewide data (including federal and private properties).

This report offers a summary of nesting in 2023 for the four primary species that comprise this group in NJ – Piping Plover (federally threatened, state endangered), Black Skimmer (state endangered), Least Tern (state endangered) and American Oystercatcher (species of special concern).

Due to a constraint on resources, not all potential sites in the state were surveyed for all species. All known nesting sites for Piping Plover and Least Tern were monitored. All known beach-strand nesting sites for Black Skimmer were monitored but no marsh island sites were monitored. All known beach-strand nesting sites for American Oystercatcher were monitored but only a small percentage of marsh sites were monitored.

Each species has slightly different nesting phenology and habitat requirements. Some species are solitary nesters (plovers and oystercatchers) while others are colonial (terns and skimmers). These differences can lead to not only distinctive management strategies but also to vastly disparate reproductive outcomes (at a given site, one species may be successful while another may fail). It can therefore be difficult to formulate conclusions for the group, so results are presented by species.

However, there were some commonalities across species. As has been the case for many years, predation and flooding/storm-related loss were the major factors in poor reproductive success for many nesting birds. It should be noted that *direct* human disturbance (nests being stepped on or run over, for example) is not a primary limiting factor in reproductive success solely because of the intense management that partners across the state engage in to prevent these types of losses. Although the state did not experience a major nor'easter in May (as was the case in 2021 and 2022), there were a number of weather events starting in June that significantly impacted the season's results. The timing of storms in June (versus May) can sometimes be more impactful, as they hit closer to the end of the egg-laying period for American Oystercatcher and Piping Plover, meaning fewer adults will elect to renest. Predation by fox was especially notable this season, although all the major predators played a role to some degree.

In response to the predator challenges, NJFW, in partnership with USDA-APHIS-Wildlife Services, experimented with four novel management strategies: fladry, urine perimeters, nocturnal monitoring with thermal imager, and pigeon spikes. Results from these trials can be found as an appendix to this report.

The distribution of beach-nesting birds across the state continued to be species-specific. The pattern of Piping Plovers primarily nesting at the highly desirable habitat on federal lands in the central and northern portions of the state continued. Black Skimmers continued to distribute themselves into multiple large colonies, an important change from primarily converging on just one (now inactive) super-site (Seaview Harbor Marina). Least Terns, for the first time, showed a tendency towards converging on the most highly protected sites. It is too early to say if this is the beginning of a new pattern, or a one-season shift. American Oystercatchers continued to be distributed rather evenly throughout the state, which may be partially explained by their elasticity in nesting site selection.

Banding of beach-nesting bird species continued on a reduced scale in 2023. A modest number of plovers were banded from the Barnegat Light Restoration Area and at a few specific sites throughout the state. A modest number of American Oystercatchers and Black Skimmers were banded by NJFW and The Wetlands Institute (TWI) and a portion of those skimmers were outfitted with transmitters by TWI.

Although the productivity for Piping Plovers was at record lows in many areas, the Barnegat Light Restoration Area continued to attract new breeding adults, underscoring how important vegetation maintenance is to the longevity of a coastal restoration project. Horseshoe Island continued to attract high numbers of breeding and migratory species. The second year of the five-year management rights agreement for the island, as granted by the Tidelands Resource Council, was a success on the human disturbance front as NJFW Bureau of Law Enforcement officers were able to lend critical support to the endeavor. Details on the 2023 season at Horseshoe Island will be made available in a standalone report (including nesting results for nesting Royal and Common Terns and site use by migratory birds).

The NJFW wishes to express its deep appreciation to our seasonal staff and all the cooperators, interns, and volunteers that worked tirelessly to ensure that New Jersey's beach-nesting bird species remain part of the coastal landscape for the foreseeable future.

Special thanks to Michael Heine for his help in compiling data for this report.

Data from partners was provided by USNPS -Gateway National Recreation Area – Sandy Hook Unit, USFWS – Edwin B. Forsythe National Wildlife Refuge & Cape May National Wildlife Refuge, the Conserve Wildlife Foundation of New Jersey, The Nature Conservancy, The Wetlands Institute, and the US Coast Guard.

Two related reports are available for 2023; one is focused solely on Piping Plover (available November 2023) and a second on Horseshoe Island (available January 2024). Either can be requested through NJFW or located on the NJFW website.

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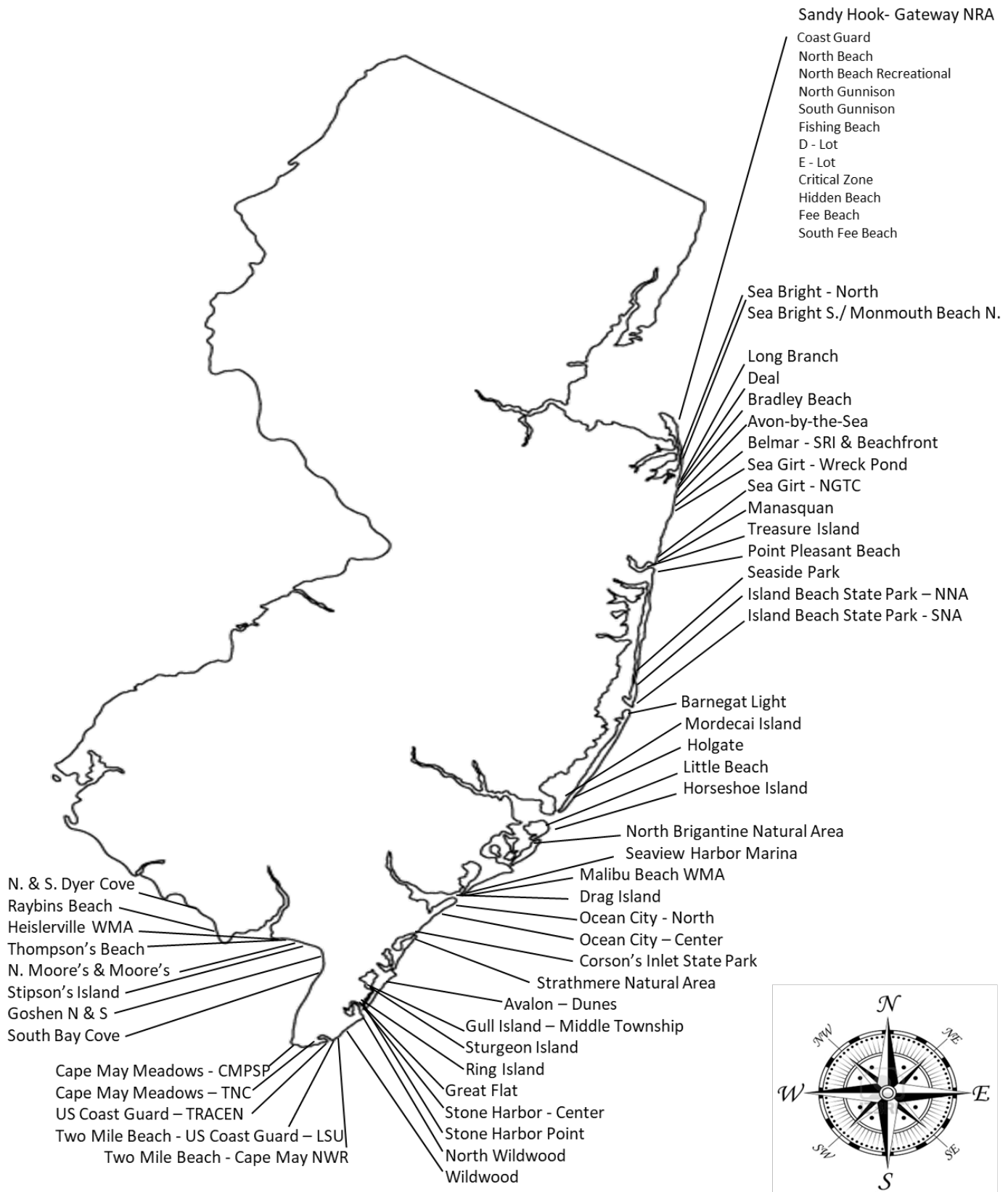
[Black Skimmer Nesting Summary](#)

[Least Tern Nesting Summary](#)

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[Appendix: Novel Approaches to Predation Management in New Jersey for the Protection of Beach-nesting Birds](#)

New Jersey Beach-Nesting Bird Sites: 2023



** This map represents all the Atlantic Coast and Delaware Bayshore sites where breeding and breeding outcomes were documented. It does not show sites that were monitored but no active nesting detected or sites that nesting did/may have occurred but where there was no monitoring, as was largely the case for the marsh islands of the Atlantic Coast.*

Piping Plover Nesting Summary

- **One hundred and eighteen (118) pairs of Piping Plovers nested in New Jersey in 2023**, a 0% change from 2022 (118) and a 14% decrease from 2021 (137). The same number of breeding pairs, despite poor productivity in 2022, is at least partly attributed to immigration from neighboring states (confirmed via banded birds).
- **Pairs nested at 24 sites statewide**, a decrease from 26 in 2022 and 28 in 2021. The distribution continues to heavily favor the federal properties (46% at EB Forsythe NWR, 29% at Gateway NRA – Sandy Hook Unit, 1% at Cape May NWR/USCG for a total of 76% of the state's population).
- **The 118 pairs laid 200 nests. Of those nests, 57 hatched (28.5%), 137 failed (68.5%) and six had an unknown outcome (3%).** Of the 137 that failed, 58 were lost to predators (42% of failures), 31 to flooding (23% of failures), 25 to abandonment (18% of failures), and 23 had undetermined cause of failure (17% of failures).
- Statewide pair-nest success (the percentage of pairs that successfully hatch at least one nest) decreased in 2023 compared to 2022 (47% vs. 59%, respectively) and was lower than the period since federal listing (69%).
- **The statewide productivity rate was 0.53 fledglings/pair**, a drop from 2022 and 2021 where it was 0.85 for both years. Prior to 2021, the last time it dipped below 1.20 fledglings/pair was in 2013 (also 0.85 fledglings/pair). The rate was so low this year that it represented the second lowest state-wide productivity since 1987, when it was 0.39 in 1997. The productivity goal is 1.50 fledglings/pair and rates below 1.00 fledglings/pair in NJ may lead to a population decrease.
- **Thirty-five (35) nests were exclosed**, or 18% of nesting attempts. The exclosed hatch rate was 31%. **The abandonment rate for exclosed nests was 51%** (abandonments can suggest an adult mortality event). In two cases, adults were killed at an exclosed nest that later hatched (these situations are not included in the 51% metric, as the nests were not abandoned). Exclosures (predator cages) are known to increase the likelihood of plover nests hatching but also increase the likelihood of adult mortality. Abandonments were higher than historic data and the hatch and fledge rates did not suggest a marked improvement by exclosing (in 2023, the unexclosed hatch rate was 28%). This pattern has been noticeable in the last two years and is why the number of nests exclosed is much lower than it used to be, as species managers weigh the difficult decision of whether to exclose a nest. For example, from 2008-2021, the abandonment rate of exclosed nests ranged from 3%-16%. In 2022 it was 23% and in 2023 it was 51%. The dramatic increases are not well understood but are giving managers pause as they determine whether to continue to decrease exclosure use, to make modifications to their design, a combination of both, or consider other options so as to curb mortality events and increase hatch rate to previous levels.
- **The majority of plovers (76%) are still nesting on federal properties.** The continued funneling of birds to these areas is not a sustainable path to recovery.
- The plateau in pairs was unexpected, as the 2022 productivity suggested a decrease for 2023. This might be related to the number of bachelors in the 2022 population (10) who potentially returned and found mates in 2023 and/or immigration from Delaware and New York (banded birds from each state were confirmed nesting in New Jersey). However, it does highlight the continued unpredictability of the NJ population. To wit, in 2021 the productivity was 0.85 and there was a pair decrease in 2022 (137 to 118 pairs). Productivity was again 0.85 in 2022 but there was no subsequent decrease in pairs (it should be noted there were only 3 bachelors in 2021 so perhaps this does play a role in the following year's pair number). This volatility continues to concern species managers in terms of the stability and future of the population.

Please see the standalone 2023 Piping Plover Nesting Results in NJ report for additional details.

New Jersey Piping Plover Nesting Summary by Site: 2023

Site	Pairs	Hatched	Chicks Fledged	Pair Success	Fledge Rate	SP Fledge Rate
Sandy Hook NRA	34	6	11	0.18	0.32	1.83
Coast Guard	2	0	0	0.00	0.00	0.00
North Beach	13	2	4	0.15	0.31	2.00
North Beach Recreational	4	1	2	0.25	0.50	2.00
North Gunnison	6	0	0	0.00	0.00	0.00
South Gunnison	3	2	3	0.67	1.00	1.50
E-Lot	1	0	0	0.00	0.00	0.00
Critical Zone	4	0	0	0.00	0.00	0.00
South Fee Beach	1	1	2	1.00	2.00	2.00
Sea Bright – North	2	0	0	0.00	0.00	0.00
Monmouth Beach – North ¹	2	0	0	0.00	0.00	0.00
Region 2 Subtotal	38	6	11	0.16	0.29	1.83
Seaside Park	1	0	0	0.00	0.00	0.00
Island Beach SP NNA	1	1	1	1.00	1.00	1.00
Island Beach SP SNA	1	0	0	0.00	0.00	0.00
Barnegat Light ²	8	5	7	0.63	0.88	1.40
Region 3 Subtotal	11	6	8	0.55	0.73	1.33
EB Forsythe NWR	54	35	42	0.65	0.78	1.20
Holgate	53	35	42	0.66	0.79	1.20
Little Beach	1	0	0	0.00	0.00	0.00
North Brigantine NA	1	1	0	1.00	0.00	0.00
Region 4 Subtotal	55	36	42	0.65	0.76	1.17
Malibu Beach WMA	1	1	0	1.00	0.00	0.00
Ocean City – North	3	0	0	0.00	0.00	0.00
Ocean City – Center	2	1	0	0.50	0.00	0.00
Region 5 Subtotal	6	2	0	0.33	0.00	0.00
Corson's Inlet SP	3	3	2	1.00	0.67	0.67
Region 6 Subtotal	3	3	2	1.00	0.67	0.67
Stone Harbor Point	3	0	0	0.00	0.00	0.00
Two Mile Beach	2	2	0	1.00	0.00	0.00
Cape May NWR	1	1	0	1.00	0.00	0.00
Coast Guard (LSU)	1	1	0	1.00	0.00	0.00
Region 7 Subtotal	5	2	0	0.40	0.00	0.00
NJFW sites TOTAL	28	12	10	0.43	0.36	0.83
All NJ sites TOTAL	118	55	63	0.47	0.53	1.15

Active Sites **24**

¹This site includes Sea Bright – South and Monmouth Beach – North

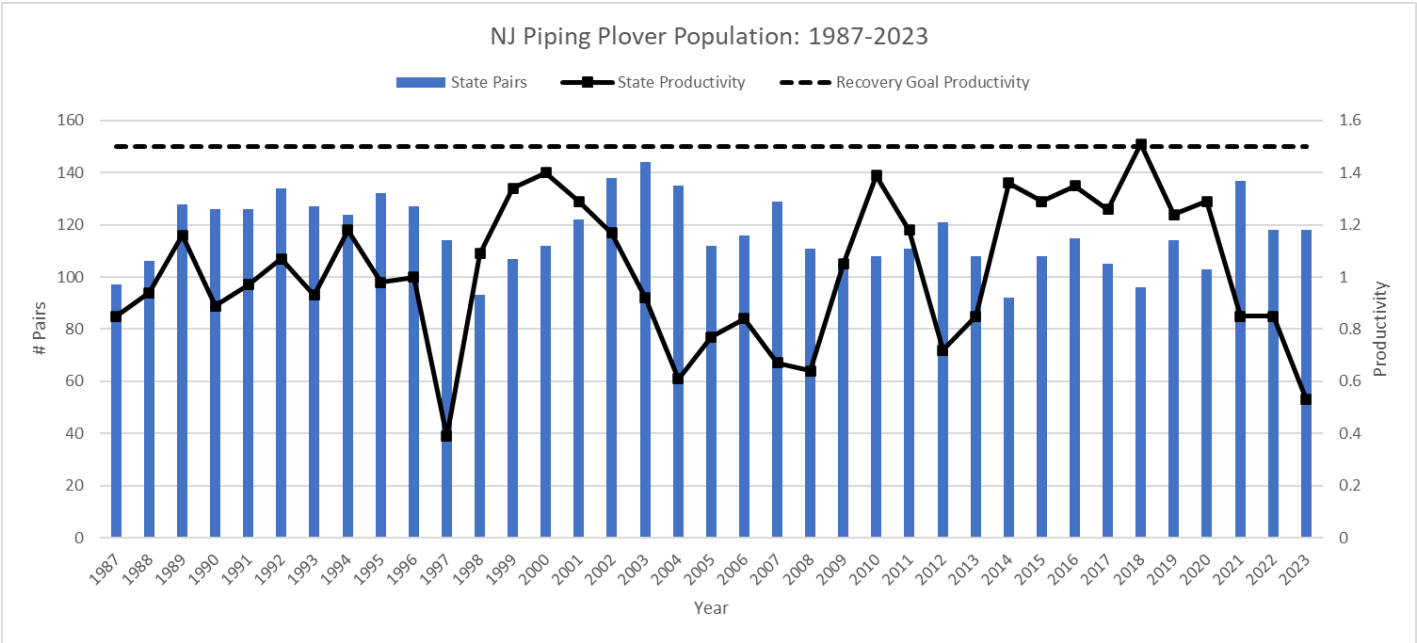
² This site includes Borough of Barnegat Light and Barnegat Light Restoration Area (BLRA). BLRA fledge rate was 0.50 fledglings/pair

Pair Success equals the percentage of pairs that hatched young (at least one chick observed).

Fledge Rate equals the number of chicks fledged per pair.

Successful Pair (SP) Fledge Rate equals the number of chicks fledged per pair that successfully hatched young.

New Jersey Piping Plover Population: 1987-2023



Black Skimmer Nesting Summary

- Black Skimmer breeding bird counts were conducted approximately every week at active sites from arrival on breeding grounds (mid-May) until nesting ceased (September) on beaches along the entire Atlantic coast. Marsh islands were not ground surveyed this year, but aerial surveys in May and June did not reveal any active colonies. Active nesting (at least one nest with eggs) was observed at four sites. All sites were visited 3-7x/week for management and outreach for the duration of the nesting season.
- **A total of 2,685 adults were present at active sites.** This figure is the cumulative total of site counts that occurred in the peak survey period, which took place 31 July – 6 August. The sum of the peak adult number from each site was 3,074. The larger the difference between these two numbers, the more likely it is there was failure at any given colony and then relocation/renesting to another colony; that was the case this year.
- **A peak count of 880 incubating adult Black Skimmers were tallied** in the 17-23 July survey period. The incubation number was lower than might be expected given the number of adults present and was almost certainly lower than how many nested. As is generally the case, vegetation at Stone Harbor Point blocked observers from garnering the most accurate count of these ground nesters but walk-through colony counts are not safe or effective at these highly vegetated sites.
- Black skimmer statewide **productivity appeared to be moderate with 802 fledglings produced statewide.** This translates to 0.91 fledglings/pair if calculated on the peak incubating adult count (880). If we simply halve the peak period total adult number (1,342) and use that as pair count, the productivity is 0.60 fledglings/pair. The true rate is likely somewhere in the middle.
- Black Skimmers were more evenly distributed in the state than they have been in recent years, continuing the pattern observed in 2021-2022. For about a ten-year period, the majority of NJ skimmers nested at Seaview Harbor Marina. 2023 was the first year since 2008 that there was no nesting at this site. It was encouraging to see the birds able to disperse to other sites and still find success.
- TWI and NJFW partnered together to band 65 adult and juvenile skimmers in 2023, including the very first banding to take place at Horseshoe Island. TWI was also able to outfit 11 of those birds (all adults) with GPS PinPoint tags, bringing the total number of adults tracked with transmitters in 2021-2023 to 29. Preliminary results reveal interesting patterns that will help guide future management, but that data is not yet available as data collection is on-going.
- Over the course 2023, 117 individuals banded in NJ from 2016-2023 were observed, with 85 of those either on migration or wintering grounds. In 2023, skimmers banded in NJ were observed in NY, VA, NC, SC, GA, FL, and Cuba. A total of 377 skimmers have been banded in NJ since 2016 and the resight database contains nearly 3,000 records.
- Please note that the data in the following table is presented both in terms of peak tallies of each site *and* the peak counts statewide in the week-long survey windows. It is presented by site so that the peak use of any given location can be understood. However, simply tallying these peaks can lead to double counting individuals since this species is known to use multiple sites in one year (e.g., a colony fails at one site and they re-nest at another site.) so the statewide peak window count is an effort to account for that issue and add context to the site total figures.

New Jersey Black Skimmer Nesting Summary by Site: 2023

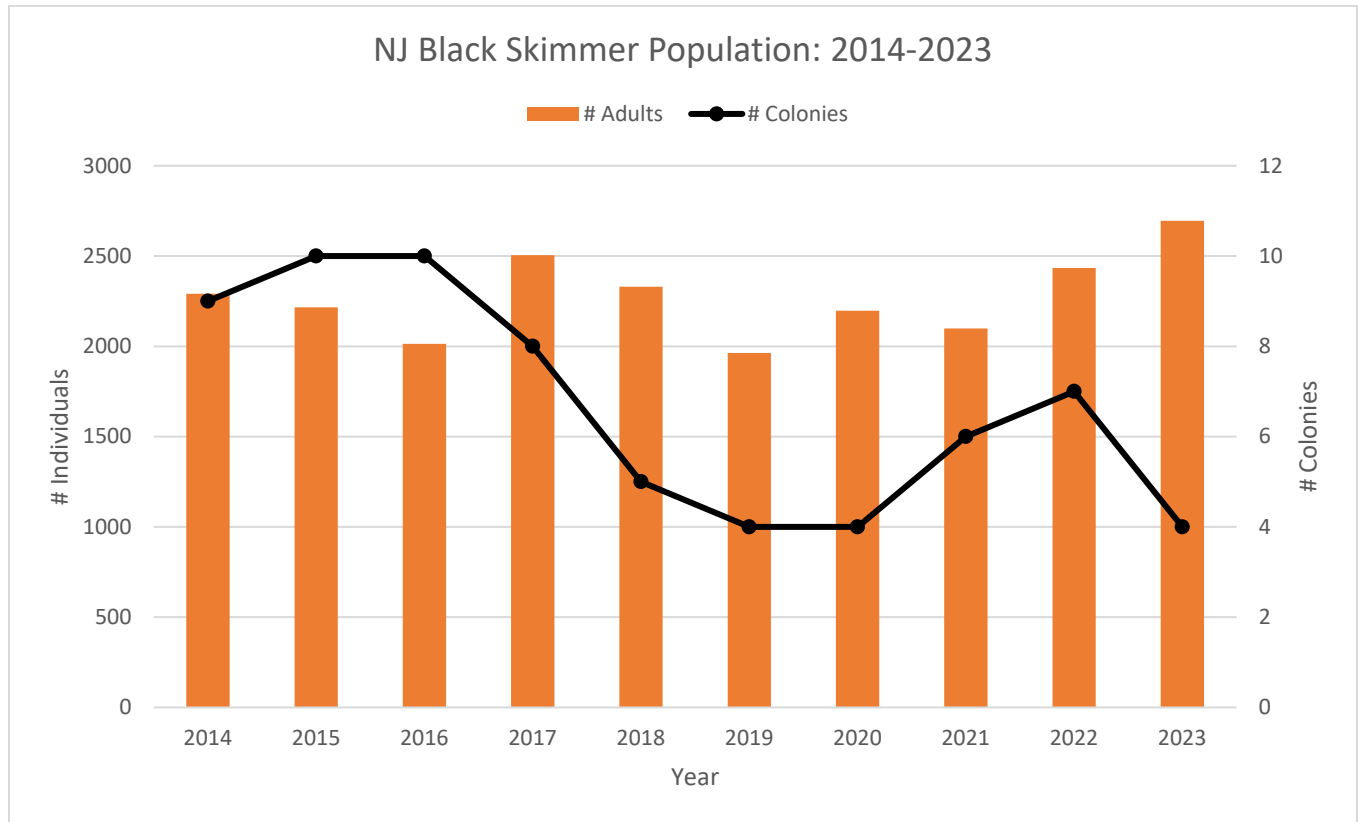
SITE	Peak Total Adult Count	Peak Incubating Adult Count	Chicks Fledged	Fledge Rate
Holgate – EB Forsythe NWR	930	250	155	0.62
Horseshoe Island ¹	1435	690	225	0.40
Stone Harbor Point	687	252	422	1.67
Cape May Point State Park	22	2	0	0.00
NJFW sites TOTAL	2,144	944	647	--
All NJ sites TOTAL	3,074	1,194	802	--
Statewide Peak Window Count	2,685	880	--	--
	(7/31-8/6)	(7/17-7/23)		
# Active Sites	4			

“**Fledge Rate**” equals the number of chicks fledged per incubating adult. This number should be considered an estimate as there is not a high degree of confidence in the incubating adult and fledged number as these data points are very difficult to collect. Because of this difficulty, there is no statewide fledged rate tallied here.

“**Peak Total Adult Count**” & “**Peak Incubating Adult Count**” are the highest adult counts observed at any point during the breeding season. “**Statewide Peak Window Count**” represents the highest tally for one one-week survey window. This species can exhibit a high degree of intra-year movements so both numbers are important to understand the distribution of adults and habitat use (on site and state levels) in NJ.

¹ This site is jointly managed by NJFW and EB Forsythe NWR/Conserve Wildlife Foundation of NJ

New Jersey Black Skimmer Population: 2014-2023



Note: The number of colonies only includes sites where active nesting was documented.

Least Tern Nesting Summary

- Least Tern breeding bird surveys were conducted every week from mid-May until the end of August at beaches along the entire Atlantic coast. Active colonies (those where \geq one pair was observed with eggs) were located at 13 sites and observations were made at these locations for the duration of the season. Sites were visited 3-7x/week for management and outreach for the duration of the nesting season.
- **A total of 1,059 adults were present at active sites.** This figure is the cumulative total of site counts that occurred in the peak survey period, which took place 12-18 June. The summed peak adult number from each site was 1,612. The difference between these two numbers can suggest failure at a given site and then relocation/renesting to another site; this appeared to be the case in 2023.
- **A peak count of 646 incubating adult Least Terns were observed** in the 12-18 June survey period. **Productivity was low for Least Terns with 152 fledglings produced** statewide at 0.24 fledglings/pair, based on the peak number of incubating adults. Primary causes for colony losses were predators and flooding. (Unlike skimmers, Least Terns do not tend to nest in deep vegetation and there is a greater confidence in the incubating adult number).
- **The number of active Least Tern colonies (13) decreased again** compared to 2022 (18) and 2021 (26) and was the lowest ever recorded since 1976. This is the first time that a funneling to federal sites/highly protected sites was observed in this species (during the peak survey window count, 77% of the population was at federally managed Holgate and when that site flooded, it is hypothesized that some renested at Horseshoe Island, a highly protected site). The loss of many municipal and private sites was apparent this year. It is not yet known whether this is the beginning of a trend that mimics Piping Plovers or a temporary shift, but the multi-year downward trend in number of sites suggests species managers should monitor this closely.
- Flooding was the primary limiting factor for this species this year, but it is also likely that predators would have greatly impacted them had flooding not first. Nearly every colony sustained catastrophic or near catastrophic losses by one of these two factors, causing the birds to re-nest multiple times. Due to their colonial and garrulous nature, they are easily located by predators. As with all terns, they will dive-bomb intruders, but their diminutive size often makes their defenses unsuccessful against predators, who are generally much larger. Species managers continue to work on addressing the issues, but they seem especially intractable for this species. TNC has demonstrated that wire fencing to exclude mammalian predators can be effective. The addition of fladry (see Appendix) as a management tool may also help mitigate predator losses in the future.
- The continued relative stability of this population over the last decade continues to be somewhat perplexing, given years of what appears to be poor productivity. Least Terns live a long time, which is beneficial for the individuals who nest in NJ and rarely find widespread success. This species is not banded, so biologists cannot track them to determine if the population is being sustained by immigrants from other states. If immigration is not occurring, there is a sense that a decline should be expected in coming years. Future banding studies and/or research on Least Tern population dynamics would be beneficial to monitoring and management.
- Please note that the data in the following table is presented both in terms of peak tallies of each site *and* the peak counts statewide in the week-long survey windows. It is presented by site so that the use of any given location can be understood. However, simply tallying these peaks can lead to double counting individuals since this species is known to use multiple sites in one year (e.g. a colony fails at one site and they re-nest at another site.) so the statewide peak window count is an effort to reduce that issue and add context to the site total figures.

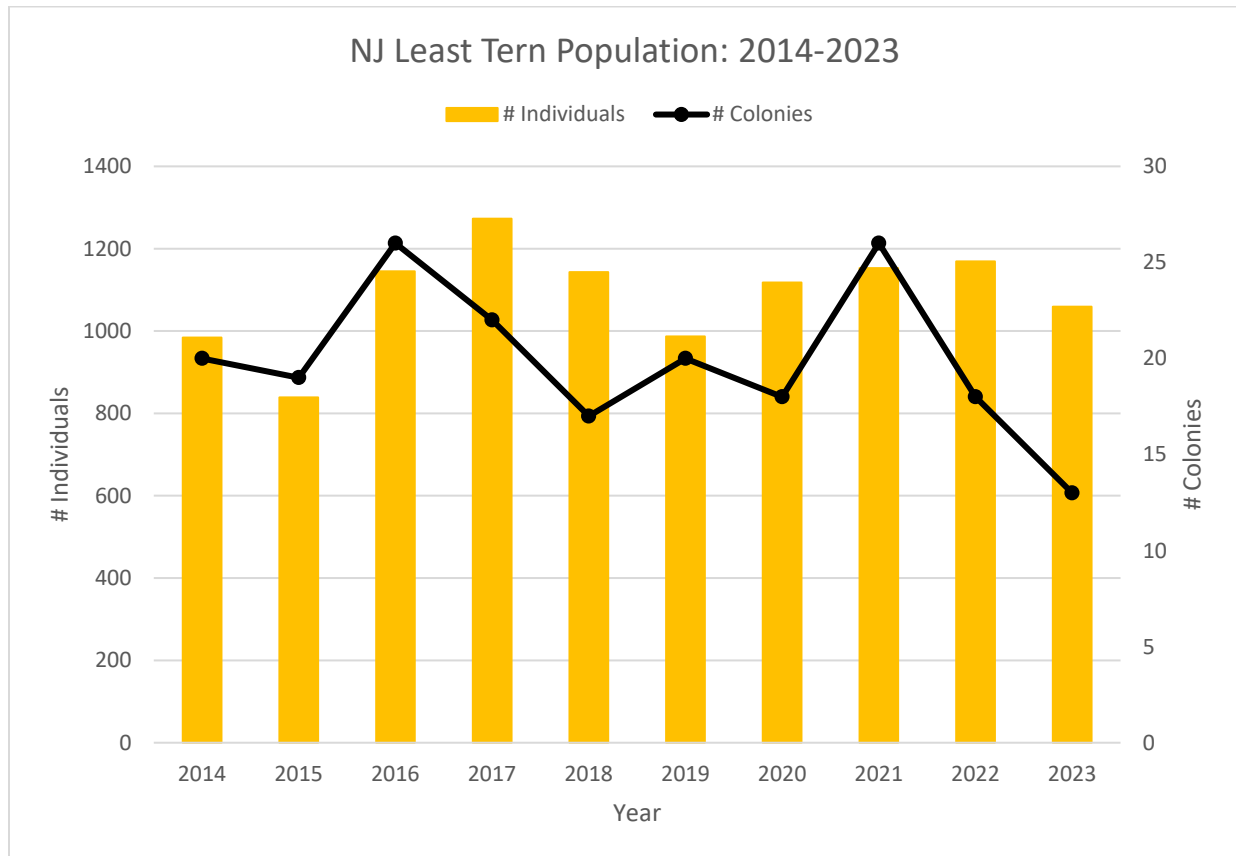
New Jersey Least Tern Nesting Summary by Site: 2023

SITE	Site Peak Total Adult Count	Site Peak Incubating Adult Count	Chicks Fledged	Fledge Rate
<i>Sandy Hook – GNRA</i>				
North Beach	15	2	0	0.00
North Beach Recreational	31	19	0	0.00
Long Branch	35	10	0	0.00
Belmar – Shark River Inlet	2	1	0	0.00
Barnegat Light (Restoration Area)	23	4	0	0.00
<i>EB Forsythe NWR</i>				
Holgate – Northern Overwash	50	15	0	0.00
Holgate – Inlet	760	470	70	0.15
Horseshoe Island ¹	293	147	0	0.00
Corson’s Inlet State Park	6	2	0	0.00
Stone Harbor Point	8	3	0	0.00
North Wildwood – Hereford Inlet	10	2	0	0.00
South Cape May Meadows – TNC	191	89	79	0.89
Cape May Point State Park	188	138	3	0.02
NJFW sites TOTAL	565	307	3	--
All NJ sites TOTAL	1,612	902	152	--
Statewide Peak Window Count	1,059	646	--	--
	(6/12-6/18)	(6/12-6/18)		
# Active Sites	13			

- “**Fledge Rate**” equals the number of chicks fledged per incubating adult. This number should be considered an estimate as there is not a high degree of confidence in the incubating adult and fledge numbers. As these data points are very difficult to collect.
- “**Peak Total Adult Count**” & “**Peak Incubating Adult Count**” are the highest adult counts observed at any point during the breeding season. “**Statewide Peak Window Count**” represents the highest tally for one two-week survey window. This species can exhibit a high degree of intra-year movements so both numbers are important to understand the distribution of adults and habitat use (on site and state levels) in NJ.

¹This site is jointly managed by NJFW and EB Forsythe NWR/Conserve Wildlife Foundation of NJ

New Jersey Least Tern population: 2014-2023



Note: The number of colonies only includes sites where active nesting was documented.

American Oystercatcher Nesting Summary

- Although American Oystercatchers are a management priority in areas of high human disturbance, resource limitations dictate that the data collected on this non-listed species is not comprehensive to the state; it is well known that many individuals nest in the marsh, but the vast majority are not tracked. The locations listed in the table are all monitored sites with reproductive information available and were visited between 1x/week (or less) to 7x/week.
- For the first time since monitoring of this species began, pairs nesting on Delaware Bay beaches were monitored. The Conserve Wildlife Foundation of New Jersey and The Wetlands Institute worked together to track 19 pairs and this data is partially responsible for the statewide pair increase observed in 2023.
- **There was another increase in the number of pairs that were monitored by NJFW and partners compared to 2022 (199 vs. 174 pairs).** However, since there is not yet an ability to monitor all of the pairs in the state, it is difficult to put this into context. A better index may be to look at just Atlantic coast beach-strand pairs, where a longer and more comprehensive dataset exists. In 2023, **there was a slight increase in beach-strand pairs to 146** (138 in 2022). The nesting sites with the highest pair numbers on the beach-strand in 2023 were Holgate (50), Stone Harbor Point (19), Sandy Hook (17), and Horseshoe Island (12). Of the known 199 pairs, just 68 pairs (34%) hatched at least one egg.
- **There were 314 nesting attempts. Sixty-eight (68) nests hatched (22%), 235 (75%) nests failed, and 11 (3%) nests had an unknown outcome.** Of the 235 failed nests, 85 (36%) were lost to predators, 66 (28%) to flooding, 77 (33%) to an undetermined cause (many of these are likely predators, but there was not enough evidence to confirm), and 7 (3%) to abandonment.
- The American Oystercatcher Working Group recommends a reproductive goal of 0.50 fledglings/pair but **the reproductive output of monitored pairs in 2023 was only 0.32 fledglings/pair.** Some of this rate is explained by the effect of the low hatch rate and hence the lost reproductive potential (only 138 chicks hatched from those 314 nesting attempts). For the chicks that did hatch, it was difficult to pinpoint the cause of chick loss, but it was almost certainly driven by predators. Just one site (Holgate) fledged 61% of the state's fledglings.
- NJFW and The Wetlands Institute banded 33 (13 and 20, respectively) American Oystercatchers this year, a respectable number given the low reproductive success that resulted in fewer opportunities to trap incubating adults and band their young. Of note, NJFW experimented and found great success with trapping pre-fledge juveniles with a corral, which provides a much lower stress environment for both birds and biologists. NJFW wishes to express their gratitude to Ted Nichols, a NJFW Supervising Biologist who specializes in waterfowl, for his suggestion and training on this technique.
- Of the four species, American Oystercatchers continue to show the greatest elasticity in their nesting, utilizing natural areas of marsh islands and beaches. They also use a greater variety of atypical areas – highly groomed beaches, rooftops, and grassy strips in parking lots among them. The number of pairs that are monitored by NJFW and partners continues to increase each year but the reasons for the increase are not fully understood. Reproductive success at monitored sites does not suggest that the population is increasing. Some of the increase could be due to pairs shifting to the beach-strand, where focused monitoring is occurring, and they are now being captured in datasets (when they may have been absent from it when in marsh). It could be due to a continuing effort among partners to increase monitoring of marsh and bayside pairs. As is observed with other species, there could be some immigration from other states. It is also possible that the reproductive output needed to increase this population is lower than previously presumed, and management strategies (especially on the beach-strand where most work is focused) are working. More work is needed to understand the factors at play.

New Jersey American Oystercatcher Nesting Summary by Site: 2023

All Monitored Sites

SITE	Pairs	Pairs Hatched	Chicks Fledged	Pair Success	Fledge Rate
Sandy Hook NRA	17	0	0	0.00	0.00
North Beach	7	0	0	0.00	0.00
North Beach Recreational	2	0	0	0.00	0.00
North Gunnison	1	0	0	0.00	0.00
Fishing Beach	1	0	0	0.00	0.00
D-Lot	1	0	0	0.00	0.00
Critical Zone	1	0	0	0.00	0.00
Hidden Beach	2	0	0	0.00	0.00
Fee Beach	1	0	0	0.00	0.00
South Fee Beach	1	0	0	0.00	0.00
Sea Bright - North	1	0	0	0.00	0.00
Region 2 Subtotal	18	0	0	0.00	0.00
Long Branch	2	1	1	0.50	0.50
Deal	2	0	0	0.00	0.00
Bradley Beach	2	0	0	0.00	0.00
Avon	1	0	0	0.00	0.00
Belmar-Shark River Inlet	1	0	0	0.00	0.00
Belmar – Beachfront	1	0	0	0.00	0.00
Sea Girt – Wreck Pond	1	0	0	0.00	0.00
National Guard Training Center	1	0	0	0.00	0.00
Treasure Island	1	1	2	1.00	2.00
Point Pleasant	1	0	0	0.00	0.00
Barnegat Light	3	0	0	0.00	0.00
Region 3 Subtotal	16	2	3	0.12	0.18
Mordecai Island	1	0	0	0.00	0.00
Holgate	50	27	36	0.54	0.72
Little Beach	1	0	0	0.00	0.00
Horseshoe Island	12	9	0	0.75	0.00
North Brigantine Natural Area	2	0	0	0.00	0.00
Region 4 Subtotal	66	36	36	0.55	0.55
Malibu WMA	1	0	0	0.00	0.00
Region 5 Subtotal	1	0	0	0.00	0.00
Ocean City – North	1	0	0	0.00	0.00
Drag Island	2	0	0	0.00	0.00
Corson’s Inlet State Park	2	1	0	0.50	0.00
Strathmere NA	1	0	0	0.00	0.00
Avalon – Dunes	3	2	3	0.67	1.00
Region 6 Subtotal	9	3	3	0.33	0.33
Gull Island – Middle Township	16	5	1	0.31	0.06
Sturgeon Island	3	2	2	0.67	0.67
Ring Island	9	2	2	0.22	0.22
Great Flat	3	2	2	0.67	0.67
Stone Harbor - Center	1	1	0	1.00	0.00
Stone Harbor Point	19	1	0	0.05	0.00
North Wildwood	2	1	2	0.50	1.00
Wildwood	1	0	0	0.00	0.00
Two-Mile Beach	7	0	0	0.00	0.00
Cape May NWR	3	0	0	0.00	0.00
USCG LSU	4	0	0	0.00	0.00
Coast Guard-TRACEN	2	0	0	0.00	0.00
Cape May Meadows	7	4	4	0.57	0.57
The Nature Conservancy	4	2	3	0.50	0.75
Cape May Point State Park	3	2	1	0.67	0.33
Region 7 Subtotal	70	18	13	0.23	0.19
North Dyer Cove	1	0	0	0.00	0.00
South Dyer Cove	2	1	0	0.50	0.00
Raybins Beach	1	0	0	0.00	0.00
Heislerville WMA	1	1	0	1.00	0.00
Thompson’s Beach	1	1	1	1.00	1.00
North Moore’s Beach	3	2	1	0.67	0.33
Moore’s Beach	3	2	1	0.67	0.33
Stipson’s Island	3	1	1	0.33	0.33
Goshen - North	2	1	0	0.50	0.00
Goshen - South	1	0	0	0.00	0.00
South Bay Cove	1	0	0	0.00	0.00
Region 8 Subtotal	19	9	4	0.47	0.21
All NJ sites TOTAL	199	68	59	0.37	0.32
# Active Sites	56				

Appendix to the 2023 New Jersey Beach-Nesting Bird Project Report: *Novel Approaches to Predation Management in New Jersey for the Protection of Beach-nesting Birds*

Christina “Kashi” Davis and Emily Heiser, NJ Fish and Wildlife

Predation of nests is a primary driving factor of low productivity for all beach-nesting bird species with a conservation status in New Jersey. A number of techniques are already used to mitigate this threat, with varying degrees of success. As predation remains a limiting factor for the recovery of these species despite those approaches, in 2023 NJFW biologists experimented with four novel approaches to mitigate this risk. For two of them (fladry and urine perimeters), they partnered with US Department of Agriculture - Animal and Plant Health Inspection Service - Wildlife Services (APHIS-WS) and US Fish and Wildlife Service - NJ Field Office (who provided funding) on the use of fladry and urine perimeters. NJFW also experimented with two other techniques - nocturnal monitoring with a thermal imager and pigeon spikes. Outcomes are reported below.

Note: Estimated costs are only for equipment; they do not include labor costs for installation, or in-person and/or remote (trail cams) monitoring.

Approach I: Fladry



L to R: Installation of fladry by APHIS-WS, completed fladry line, mammal tracks leading to fladry and then changing course.

Description: Fladry is a line of brightly colored nylon flags that are attached to a line of polywire. This line is attached to posts and creates a perimeter around a sensitive area, such as a tern colony. The flagging hangs low to the ground and its constant motion (due to wind) makes it unattractive to some mammalian predators, who are wary of crossing through it. It is most commonly used on western pasturelands, to prevent wolf and coyote predation of livestock. The polywire can also be electrified as an additional layer of protection (although that step was not taken in 2023).

Sites Deployed: Stone Harbor Point

Target Species: Mammalian predators, especially red fox and coyote

Cost: \$660 for ~.17 miles of fladry line, \$100/0.17 miles of posts (this cost can be avoided if use same fencing as delineates a colony for protection from human disturbance. In this effort, it was a separate line). Equipment can be reused so the cost is reduced with each deployment.

Pros: Provides an option to protect colonies; installation is straight-forward; showed promise as a deterrent; provided additional visual cues to humans that the area was roped off.

Cons: Only able to test at one site so cannot more fully comment on effectiveness; mammals can get desensitized to it and it loses effectiveness; only targets mammalian predators (not avian predators); needs regular maintenance (streamers wrap around polywire); effectiveness can be impacted by storms,

flooding, and sand accretion; may not be appropriate for solitary nesters (who walk in and out of their nest areas) due to concerns of reducing their perceived ability to access the nest.

Additional Comments: APHIS-WS purchased and deployed the fladry, with assistance from NJFW (particularly with maintenance). The pre-season plan was to experiment at multiple sites on small areas (i.e. a Least Tern colony of ~25-50 pairs). Unfortunately, 2023 featured a reduction in the number of colonies in the state and early colony failures at the ones that were active, limiting options for experimentation. The Stone Harbor Point Black Skimmer/Common Tern colony was the only site available in the correct timeframe for APHIS-WS staff and equipment deployment. This site is large, and it was not practical to fully enclose it so in this application, a line was run across the tip (running east west on the north side of colony) and to determine if it might deter animals from crossing it. APHIS-WS later came back to install additional fladry on the east side of the colony. As the site is at the tip, it is surrounded by water on three sides, which may have offered some protection (although in the past, coyotes have entered the site on the bay side via water). Nonetheless, unlike all the solitary nesting birds at the site (three pairs of Piping Plovers and 19 pairs of American Oystercatchers), the colonial nesters found great success in hatching and fledging young. This species-based pattern of lopsided productivity has occurred in the past, so it is not clear that the fladry was the determining factor. However, there was evidence that the fladry did influence the mammalian predators (reluctance to cross the fladry line as captured via trail cam still pictures and video and very few mammal tracks inside the colony, unlike the rest of the site). Terns and skimmers (including juveniles) were observed roosting the fladry line and it did not appear to impact them.

Rating: Results promising (despite small sample size), additional experimentation warranted.

Further Experimentation: Utilize to fully enclose additional smaller colonial nesting sites. Consider testing on solitary nesters. Consider electrifying polywire as an additional layer of protection.

Based on:

Windell R. M, Bailey L. L, Young J. K., Livieri T. M., Eads D. A., and Breck S. W. 2022. Improving evaluation of nonlethal tools for carnivore management and conservation: evaluating fladry to protect an endangered species from a generalist mesocarnivore. *Animal Conservation*: 25 (2022) p. 125-136

Young J.K., Draper, J., Breck, S.W., 2019, Mind the Gap: Experimental Tests to Improve Efficacy of Fladry for Nonlethal Management of Coyotes. *Wildlife Society Bulletin* 43(2):265–271; 2019

Approach II: Urine Perimeter



L to R: APHIS-WS staff filling a urine dispenser; square urine perimeter around an oystercatcher nest (orange and red digital graphics included to show corners of perimeter and location of nest).

Description: Based on work done with sea turtles in the southeastern US (Wauson, M. & W. Rogers 2021), the goal of a urine perimeter is to outline a sensitive area with the urine from a predator that will outcompete and be territorial of areas shared by the one being targeted (coyote for red fox and wolf for coyote and red fox). The perimeter is meant to convince the targeted predator of the presence of this theoretical predator, thus shifting its activity away from the area and protecting the nest from being depredated. The perimeter consists of wooden posts with vials of urine secured in a manner that the scent will dissipate into the air and be detected by the targeted predator. Urine was refilled on a regular or as-needed basis (for example, if high temperatures evaporated the urine prior to the next scheduled refilling). Distance between vials varied by site and situation.

Sites Deployed: Bradley Beach, Island Beach State Park, Barnegat Light, Avalon – Dunes, Cape May Point State Park.

Target Species: Coyote and red fox

Cost: \$360/200 dispensers, \$625 for 5x64 oz wolf urine, \$33.11/25 pack wooden stakes (not all materials used this season).

Pros: Simple method that is relatively inexpensive to deploy; no noticeable impact on nesting birds (in all cases, they immediately returned to incubating their nests and seemed unaffected by the posts).

Cons: The urine is extremely pungent and difficult to transport without an open-air truck bed and to handle without contaminating skin (gloves are a necessity).

Additional Comments: This work was completed in conjunction with APHIS-WS. They provided the materials and deployed them at most of the sites, with NJFW adding a handful of other sites. Of the seven plover/oystercatcher nests that were treated, four hatched (one was also exclosed), one was infertile (but eggs not predated for over a week after estimated hatch date), and three were predated. NJFW suggested a “line” perimeter to protect one whole site with multiple solitary and colonial nesters but that did not seem to dissuade predators from crossing “over” it. Finally, NJFW tried a perimeter around an entire Least Tern colony, which was beginning to show signs of being predated, but it still collapsed. Evidence such as tracks within the perimeter did not lend confidence to this strategy. The highest degree of success was with individual nests, so that may be the best use of this option.

Rating: Results mixed.

Further Experimentation: Additional experimentation recommended with modifications or within the constraints of a larger study to increase sample size and a make statistical determination of effectiveness. Modifications could include timing perimeter deployment to coincide with late-stage incubation (because effectiveness will be limited) and investigating whether pairing them with audio calls of coyote/wolf improves efficacy.

Wauson, M., W. Rogers. 2021. A test of the use of gray wolf (*Canis lupus*) urine to reduce coyote (*Canis latrans*) depredation rates on loggerhead sea turtles (*Caretta caretta*) nests).

Approach III: Nocturnal Monitoring with Thermal Imager



L to R: Pulsar Helion 2 XP50 Pro Monocular, example of a screenshot image from the thermal imager (please note in-person image quality higher than this image suggests). There are no mammalian predators in this image, but the red circle denotes the location of the incubating plover.

Description: Some studies suggest that the presence of humans suppresses mammalian activity (Suraci J.P. et al 2019). Thermal imagers provide humans excellent night vision of any objects radiating heat (in this case predators) which can help those monitoring nests in the dark to have a better understanding of what is happening on a site beyond what can be seen with limited nocturnal human vision. The experiment was to determine if being present on a beach at a time of day (8pm-8am) where mammalian predators typically do not encounter humans would prevent them from depredating a plover nest and its incubating adults.

Sites Deployed: Corson's Inlet State Park

Target Species: Any nocturnal predators, but especially fox and coyote

Cost: \$4,000/ Pulsar Helion 2XP 50 thermal imager (borrowed, in this instance)

Pros: Ability to see in real time what is happening at sites prior to a predator event (versus reviewing trail camera footage retroactively) and intervene.

Cons: Thermal imagers are extremely expensive; may suffer staffing shortages and/or burnout when trying to cover sites diurnally and nocturnally; not practical to institute on any large scale.

Additional Comments: This strategy was employed as hatch date was nearing for a later season plover nest and fox activity was picking up at the exclosure (tracks, dig marks), despite it being protected with electric fence. At exclosed nests elsewhere in the state where an adult was killed in 2023, there was often sign of fox presence/attempts to get into the exclosure on the nights prior to the actual depredation. This strategy relies on two prongs – the physical presence of humans to help deter predators and the ability to actively chase away any animals that are not deterred by that presence. The (borrowed) thermal imager was critical to this strategy, as it meant observers had detailed information about what predators were present on site at any given time. After three nights of nocturnal monitoring the nest hatched and, more importantly, the adults were not depredated during incubation of an exclosed nest. Anecdotally, monitors noted less activity from fox when they were positioned closer to the nest (but far enough so birds continued to incubate) and increased predator activity that required intervention when positioned further away (approximately 150' versus 250').

Rating: Results ambiguous due to small sample size but may show some promise.

Further Experimentation: Consider recruiting volunteers to help fill the gaps in either nocturnal or diurnal monitoring at nest sites where this strategy may be employed. Only implement as a last resort, due to high resource/staffing use.

Suraci J.P., Clinchy, M., Zanette L.Y., Wilmers, C.C. 2019. Fear of humans as apex predators has landscape-scale impacts from mountain lions to mice. Ecology Letters, vol. 22:10, p 1578-1586.
<https://doi.org/10.1111/ele.13344>

Approach IV: Pigeon Spikes



L to R: Commercially available pigeon spikes utilized by NJFW, image of an enclosure at night to better see the spikes mounted along the top (can also see a fox undeterred by electric line along the bottom, a previously used strategy that was not novel in 2023).

Description: Although the full mechanics of adult mortality associated with exclosures by avian predators (most commonly Great-horned Owls and Peregrine Falcons in NJ) is not well understood, numerous trail cam still pictures and videos have shown both species perching on exclosures so reducing their ability to perch on exclosures may help reduce avian predation of adults. Pigeon spikes are metal spikes that can be deployed on any surface where one wishes to deter avian species from perching. They were deployed by securing them with cable ties along the top of every exclosure deployed on NJFW Piping Plover nests at the time of exclosure construction.

Sites Deployed: Every exclosed NJFW nest (15 nests), which were located in Sea Bright, Monmouth Beach, Island Beach State Park, Barnegat Light, North Brigantine Natural Area, Ocean City, Corson's Inlet State Park, and Stone Harbor Point.

Target Species: Peregrine Falcon, Great-horned Owl

Cost: \$120/exclosure for initial investment, but can be used repeatedly so cost is reduced with each reuse

Pros: Over multiple uses/years it is relatively simple and inexpensive way to protect valuable adults

Cons: Adds significant time to exclosure deployment (i.e., birds off their nest longer)

Additional Comments: This technique was first tried in 2022 at a site where the electric topper was not deterring a Great-horned Owl (determined via trail cam footage). As a last-ditch attempt to prevent an adult loss, pigeon spikes were put on the exclosure and the nest hatched without an adult loss or any other visits by the owl. In 2023, the decision was made to put them on all NJFW exclosures.

There were several adult mortality events for pairs associated with a NJFW exclosed nest so there were a fair number of losses to assess (15 nests exclosed, five that were or strongly suspected to have been associated with adult mortalities). All exclosed nests were also monitored with trail cams, and in no cases was there evidence of avian perching on exclosures, nor was there evidence of avian predation post-abandonment (such as wings or heads located nearby). All adult mortality appeared to be related to red fox and none were observed climbing up the exclosure and accessing it through the top (as has happened

in the past). Although this technique did not improve overall abandonment/adult mortality rates, it did appear to have reduced the number adults killed by avian predators. However, there was one abandonment that was the result of adult refusal of the exclosure and although this has happened in the past without pigeon spikes, it is possible the longer deployment time played a role so that will be a consideration for future deployment protocols.

Rating: Results promising, additional experimentation warranted.

Further Experimentation: Recommend continue using on every NJFW exclosure to continue gathering data on its effectiveness. Given the additional time added to the exclosure deployment, consider adding pigeon spikes at a separate time (even if later the same day, after adults have accepted the exclosure).