Horseshoe Island
2023 Report

Prepared for the Tidelands Resource Council by:

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In partnership with the USFWS Edwin B. Forsythe National Wildlife Refuge

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DEPARTMENT OF THE INTERIOR

EXECUTIVE SUMMARY

Horseshoe Island is an offshore island just southeast of the Little Egg Inlet. It can be observed on aerial imagery beginning in 2017, where it likely was occupied as habitat for migrant and roosting birds. By 2020, it likely reached a sufficient elevation to support nesting but due to the Covid pandemic limiting opportunities for field work, nesting was not confirmed until 2021. It was immediately apparent that this island was critical to migratory, roosting, and nesting coastal avian species but that human disturbance could threaten to undermine its full potential. In winter 2022, the New Jersey Department of Environmental Protection Fish and Wildlife (NJFW) petitioned the Tidelands Resource Council, whose jurisdiction the island falls under, for management rights. These were granted in March 2022 for a period of five years and include a seasonal closure to human all use from March 1 - September 30 of each year.

NJFW and The Conserve Wildlife Foundation of New Jersey (CWF) (working on behalf of Edwin B. Forsythe NWR) jointly collected avian biological data, human use data, and conducted outreach for the public. Monitoring commenced on April 14 and concluded on October 3. Biological monitoring objectives were to visit the site at least 3x/week (including both weekend days), conduct American Oystercatcher surveys at least 3x/week, and a migratory shorebird survey and breeding colonial species survey at least 1x/week. Staff posted informational signs around the perimeter of the island, increasing signage over the season as the island grew in size. Public outreach was conducted on-site with boaters and off-site through information on websites.

Over 35 avian species were documented using the island (including three federally listed and seven state listed species) for migratory, breeding, or roosting purposes. Five species were documented breeding, including Black Skimmer (largest skimmer colony in the state), Least Tern (second largest Least Tern colony in the state), American Oystercatchers (notable concentration for the state), Royal Tern (northernmost colony in the Western Hemisphere), and Common Tern. Of note among the migratory species utilizing the island was Red Knot (a federally and state listed species) whose numbers peaked at 507, which represents a significant migratory flock on the New Jersey Atlantic coast for this highly imperiled species.

Signage and staff presence at the site educating the public about the closure was an effective strategy to reduce human disturbance. Breeding and migratory species continued using the western side of the island (where the majority of boat landings take place) to a high degree this year, signaling that the closure has a positive impact on increasing the amount of habitat available to the birds. In the second year of the closure, compliance was higher compared to 2022. Most people respected the closure but there were a few notable incidents where boaters landed on the island, verbally harassed staff, and refused to leave. In 2023, NJFW law enforcement personnel were able to respond to these incidents, which subsequently led to better compliance over the course of the season.

The second year of management under the agreement with the Tidelands Resource Council was deemed a success, as extremely high numbers of birds continued to utilize the entire island. Although flood events reduced the reproductive output of nesting birds, their overall use of the island signals how desirable this habitat is to them. In 2024 and beyond, partnering agencies plan to continue to engage in outreach efforts (both on and off-island), continue to engage law enforcement as needed, increase the number of site visits each week, and work towards collecting site use data in the non-breeding season. Horseshoe Island is a true gem of the New Jersey coastline, but one that is ephemeral in nature. The partners on this project are committed to ensuring its full potential for avian species of conservation concern is reached for as long as it is on the landscape.

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INTRODUCTION

Figure 1. Location of Horseshoe Island

Horseshoe Island (HOIS) is located immediately south of and adjacent to the Little Egg Inlet just offshore of Little Beach Island, New Jersey (Figure 1). A shoal/bar that was tidally overwashed on a consistent basis was present in the same location for several years, however, it transitioned to an island that regularly remains above high tide (Figure 2 – May 2023 aerial photo of the island and Appendix A for link to time-lapse .gif). Shorebird nesting was first confirmed at HOIS in 2021, including by state endangered Black Skimmer and Least Tern, among other species. High numbers of migratory and staging shorebirds were also observed on HOIS that year, including the federally threatened/state endangered Red Knot. Many of the species using the island are identified as Focal Species of Greatest Conservation Need under the state's Wildlife Action Plan (NJSWAP, March 2018). The island is absent mammalian predators, which is nearly unprecedented in New Jersey, further increasing its importance.

At the same time, regular use of the island by the public for recreational purposes was also noted in 2021; many of those activities were not compatible with bird use, potentially reducing the available area for use by the birds, limiting reproductive success of nesting birds, and disturbing other non-nesting species. Given the intersection of those factors, in the winter of 2022, NJFW and the Refuge petitioned the state's Tidelands Resource Council for management rights of the island to benefit its wildlife. The council approved a five-year Management Rights Agreement (MRA) in March 2022 that included a provision to seasonally close the island and its adjacent tidal waters to all public uses from March 1 – September 30.

2023 was the second year that the MRA was in effect at HOIS. The perimeter of the island, especially those areas on the west side where boats typically land, were marked with signs indicating the public closure. As the island grew in shape and size, additional signage was added. Regular maintenance of signage was required due to periodic storms and tidal overwash of the site. Staff from NJFW and CWF (working on behalf of the Refuge) regularly visited HOIS

from April-September to conduct biological monitoring and help deter public usage. Several outreach strategies were implemented, as per the plan, including social media posts, public presentations, and supplying information for inclusion in news articles. When staff was on-site they attempted to educate the public regarding the closure and directed them to online resources to learn more. This includes the HOIS website (https://dep.nj.gov/njfw/conservation/horseshoe-island/) as well as a video about the island that was produced by NJFW in 2022 and included contributions from the Refuge and CWF (video can be viewed at https://youtu.be/7UTVuRU_aCQ).

New in 2023 were NJFW law enforcement patrols to help reduce human disturbance. These were very successful and resulted in a dramatic decrease in the number of boat landings and people/dogs documented on the island.

This report provides a detailed account of the nesting and other avian usage at HOIS in 2023, as well as the monitoring and management effort conducted by NJFW, CWF, and the Refuge.

Figure 2. Aerial view of Horseshoe Island in May 2023, looking east. Photo credit: Sam Galick

DESCRIPTION OF MONITORING

HOIS was co-monitored by NJFW and the Refuge, which were represented by staff from the Endangered and Nongame Species Program (ENSP) and CWF, respectively. ENSP took the lead on posting signage on the island but both crews engaged in its placement and maintenance. Both crews shared weekend monitoring and public outreach responsibilities. Both utilized NestStory, an internet-based data collection tool, to record and store all relevant monitoring data. This year, monitoring on HOIS began on April 14 and ended on October 3 (three additional visits were conducted by Refuge staff in October but that effort is not reflected in this data). Over the course of the season, the field staff provided monitoring coverage on a total of 70 site visits with 37 (53%) conducted by CWF, 29 conducted by ENSP (41%), and four (6%) conducted by combined crews. In

total, staff provided monitoring coverage on 31 weekend days and three federal holidays, representing 45% of the total site visits.

Compared to other beach-nesting bird sites in New Jersey, HOIS presented unique monitoring challenges due to its status as an offshore island that is only accessible by boat. As a result, monitoring efforts were particularly limited by tidal cycles and weather conditions. Crews were especially cognizant of high winds and swells, which can make operating small watercraft through Little Egg Inlet unsafe. Taking these logistical restrictions into account, staff from each branch collaborated to achieve the following monitoring objectives each week:

1. Minimum of two site visits per week and ideally at least one weekday and both weekend days
2. American Oystercatcher nest/brood checks for each nesting/brooding pair on every visit
3. At least one comprehensive colonial species survey once every 5 days
4. At least one comprehensive shorebird/migrant survey once every 5 days

Monitoring Frequency

In the early stages of the season (mid-April - May), staff aimed to conduct two site visits per week on HOIS. Weekend coverage began on Memorial Day Weekend and continued for the remainder of the season to maintain staff presence during the most likely periods of high human activity. ENSP and CWF crews divided monitoring responsibilities on weekends, with each crew providing coverage on one weekend day. In addition to weekend coverage, staff aimed to conduct at least one weekday site visit, for a minimum total of three monitoring days each week.

Monitoring frequency changed throughout the season as nesting activity increased and management responsibilities intensified. In June, staff conducted surveys between two and three times a week. Monitoring efforts peaked in July and August when staff conducted up to four site visits a week. After Labor Day, monitoring intensity decreased, and staff provided coverage between two and three times a week. Site visit length varied depending on the scope and purpose of each mission. For example, short visits (between 30 minutes to an hour) could include checking a colony's status after suspected flood damage or sighting an American Oystercatcher brood on its fledge date. Longer visits (up to 6 hours) included thorough surveys, colony counts, nest/brood checks, sign maintenance, and outreach.

American Oystercatcher Monitoring

American Oystercatcher monitoring occurred from April 14 through July 15. Upon determining nesting territories for breeding oystercatcher pairs, staff searched for nests within those territories using behavioral cues and tracking as aids. Once a nest was discovered, staff assigned an oystercatcher pair to the nest based on behavioral observations and band re-sights. Conditions permitting, staff aimed to perform nest checks per on each site visit with a visual confirmation of the egg count and status (e.g., laying, incubating, hatching, etc.). Estimated hatch dates were calculated by adding 28 days to the date staff determined the final egg was laid. Nests found at full clutch were given a "no later than" estimated hatch date, which was calculated by adding 28 days to the date of discovery. All egg and nest losses were recorded along with the suspected cause of loss (e.g., flooding, burial, depredation, etc.).

Once nests hatched, staff monitored the location and status of each brood. Similar to nest checks, staff aimed to conduct brood checks on every visit with visual counts of the chicks and GPS coordinates marking the broods' locations on the island. Direct brood observations for oystercatchers can be difficult as adult oystercatchers are

particularly sensitive to human disturbance and will hide their easily camouflaged chicks among piles of wrack. As a result, staff attempted to scope oystercatcher broods from a distance whenever possible. If a brood could not be directly observed, staff used behavioral cues from the adults to help determine if a pair was still brooding chicks. A brood's estimated fledge date was calculated by adding 35 days to the determined hatch date. Chicks are considered fledged upon direct observation on their fledge date. To reduce uncertainty, broods are checked at least two additional times following their fledge date (this was not applicable in 2023, however, as no chicks fledged).

Colonial Species Monitoring

Staff monitored breeding colonies of Least Terns, Black Skimmers, Common Terns, and Royal Terns at Horseshoe Island. Areas containing nesting birds were divided into four sub-colonies (HOIS 1, HOIS 2, HOIS 3, and HOIS 4 {also known as HOIS – Sandbar}) based on their location on the island (Figure 3). "HOIS 1" included birds nesting on the southern arm of the main island. "HOIS 2" included birds on the southeastern section of the main island. "HOIS 3" included birds nesting on the northwestern arm of the main island. "HOIS 4" included birds nesting on an area that was previously the eastern sandbar, but which is now attached to the main island without a deep channel separating them. It is located northeastern of HOIS 2.

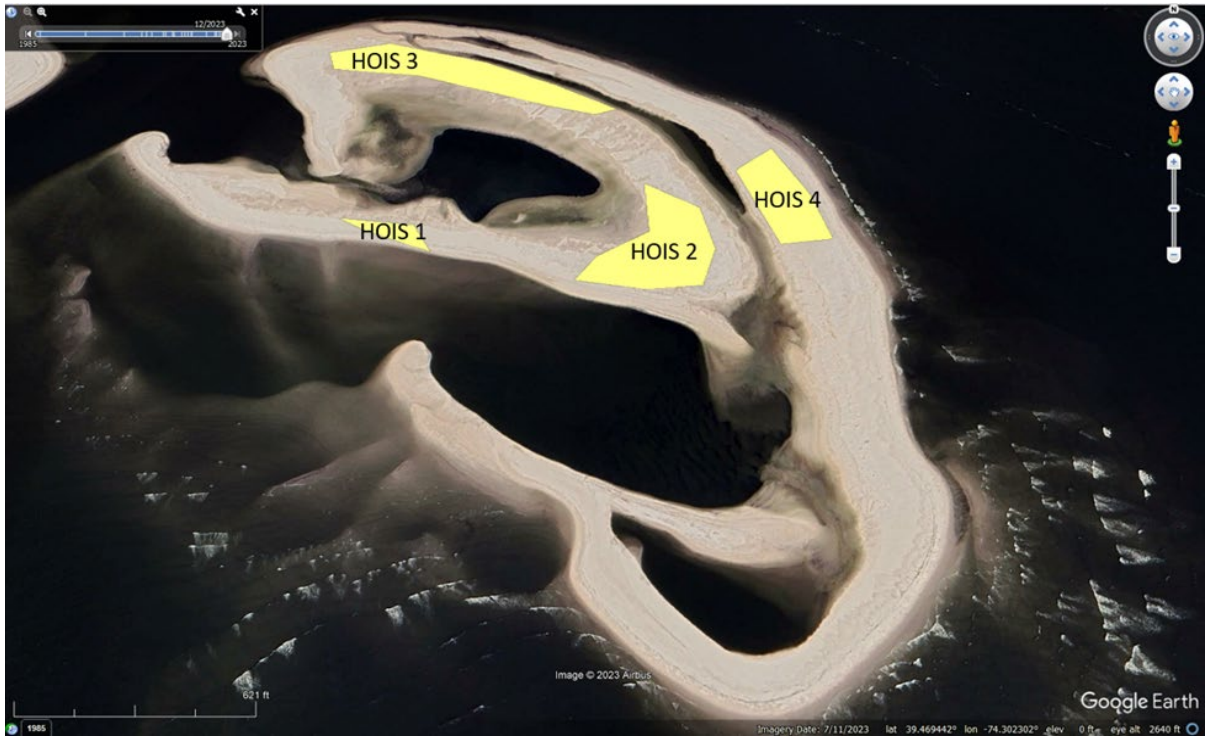

Figure 3. Approximate extent of 2023 tern and skimmer colonies with colony names.

Staff strove to conduct colony counts every five days from late May through early October, following survey protocols established by ENSP. Counts were performed for each species within the four colonies. Staff counted the total number of adults present within the colony as well as the total number of incubating adults, as indicated by sitting posture. The weekly incubating adult counts provided an estimate for the number of active nests, in lieu of a visual nest count that would require entering (and disturbing) the colonies (the only exception was one walk-through nest count for Royal Terns, who were more difficult to survey). Once hatching occurred, staff counted the number of downy chicks, feathered chicks, and fledglings present during each survey. Counts

were generally conducted from the periphery of the colony to minimize disturbance, but staff did occasionally enter the colonies to confirm the presence of eggs or chicks. Depending on the size and complexity of the colony, multiple crew members would conduct independent counts and report an average to reduce outliers. Whenever possible, staff also re-sighted any banded adults present in the Black Skimmer and Royal Tern colonies. Any significant events impacting the status of the colonies, such as depredation, flooding, or human disturbance, were noted along with the date and general proximity to the colony. GPS coordinates were also recorded around the perimeter of each colony to record its general location. Trail cameras were also placed within and near the colonies by CWF staff. Recordings from these cameras did not stand-in for or provide quantitative data but were able to offer valuable information about flood and predation events.

Banding of Black Skimmers was conducted on HOIS for the first time in 2023, in a joint effort between ENSP, CWF, and The Wetlands Institute. As it was the first time that banding was attempted at this site, staff chose to take a conservative approach and banded one time, on August 17. Juvenile skimmers were hand captured and banded from the HOIS 2 and HOIS 4 subcolonies. Data collected from this effort is reported below (Avian Use) and is expected to help species managers better understand demographics of this population.

Shorebird/Migrant Surveys

Staff endeavored to conduct shorebird and waterbird surveys every five days at HOIS to assess how migrants and non-breeding species utilized the island. During these surveys, staff recorded the abundance of shorebirds and waterbirds foraging and/or roosting on the island and its adjacent sandbar. Birds were identified to the lowest taxonomic level possible based on expertise and sighting conditions. Attempts were made to distinguish between individuals who utilized the site as both migrants and breeding individuals) for example, Royal Terns and Common Terns). The complete list of nonbreeding species observed on HOIS in 2023 can be found in the Avian Use section, below.

Additional Monitoring and Management Responsibilities

In addition to the four primary monitoring objectives, staff performed other tasks as needed including sign maintenance and public outreach. To provide education about the island's closure and help discourage unauthorized boat landings, staff installed the following signage on Horseshoe Island (Appendix B.2).

- Multiple large format "No Landing" signs in the most heavily used landing zones (the southwestern corner and the northwestern corner of the main island).
- One large QR code signs at the north and south ends of the island, which provided a link to the NJFW webpage about HOIS (https://dep.nj.gov/njfw/conservation/horseshoe-island/) It was designed to be large enough to scan from a passing boat, without landing.
- Small format signage along the perimeter of the island (including portions of the newer southeastern horseshoe that formed and gained elevation over the last year) with information regarding the island's closure.

Signage was originally posted around the perimeter of the island in mid-April, but staff regularly repaired and replaced signposts throughout the season in response to flooding events and suspected vandalism and theft. All signage was removed from the island on September 20 ahead of a coastal storm, although monitoring continued until October 3.

Public outreach was conducted primarily on weekend monitoring days and involved educating the public on the seasonal closure. To record human activity on HOIS, staff documented all watercraft landings on HOIS and its surrounding areas by recording the number of people, boats, jet skis, and dogs present. Whenever possible, staff recorded watercraft registration numbers, descriptions of disturbance, and notes about boater interactions, which are all maintained in a database. To supplement human use surveys taken during HOIS site visits, CWF staff conducted additional surveys during routine monitoring days at Little Beach Island when the west side of HOIS could be directly observed from Little Beach. Surveys from Little Beach were conducted during periods of low human activity (weekday mornings) and represented brief (approximately one hour) durations. In addition, NJFW and CWF staff recorded landings on Little Beach that were observed from Horseshoe Island.

AVIAN USE

Breeding and migratory bird species were observed using the entirety of HOIS throughout the seasonal closure (March 1 – September 30) (Table 1). While breeding and migratory use of the island overlaps, the species groups vary. Breeding birds at HOIS were comprised of state-listed beach-nesting bird species: Black Skimmer (endangered), Least Tern (endangered), Common Tern (species of special concern), and American Oystercatcher (species of special concern). Royal Terns (stable) also continued to nest at HOIS for the third documented year. Royal Terns typically limit breeding to the Delmarva peninsula and south. They have been observed nesting before in New Jersey prior to the existence of HOIS, at Hereford Inlet (2008, 2009, 2015, 2016). Horseshoe Island is the northernmost known colony of breeding Royal Terns in the Western Hemisphere. Piping Plovers (federally threatened, state endangered) were noted utilizing the habitat during the breeding season. Nesting Piping Plovers were not observed; however, marked breeding adults from nearby nesting sites were observed foraging. Marked migrant Piping Plovers were also noted using the island. Notable sized flocks of Red Knots (federally threatened, state endangered) were observed using HOIS to roost and forage on both their south- and north-bound migrations.

Table 1. All Avian Species Observed on HOIS

Species Common Name	Scientific Name	State Listing Status[1]	Breeding on HOIS	Species Common Name	Scientific Name	State Listing Status[1]	Breeding on HOIS
Brown Pelican	*Pelecanus occidentalis*	S	N	White-rumped Sandpiper	*Calidris fuscicollis*	S	N
Double-crested Cormorant	*Phalacrocorax brasilianus*	S	N	Semipalmated Sandpiper	*Calidris pusilla*	SC	N
Snowy Egret	*Egretta thula*	SC	N	Western Sandpiper	*Calidris mauri*	S	N
Bald Eagle	*Haliaeetus leucocephalus*	E	N	Least Sandpiper	*Calidris minutilla*	S	N
Peregrine Falcon	*Falco peregrinus*	E	N	Short-billed Dowitcher	*Limnodromus griseus*	S	N
Osprey	*Pandion haliaetus*	T	N	Laughing Gull	*Larus atricilla*	S	N
Black-bellied Plover	*Pluvialis squatarola*	S	N	Ring-billed Gull	*Larus delawarensis*	S	N
American Golden-Plover	*Pluvialis dominica*	S	N	Herring Gull	*Larus argentatus*	S	N
Semipalmated Plover	*Charadrius semipalmatus*	S	N	Great Black-backed Gull	*Larus marinus*	S	N
Piping Plover*	*Charadrius melodus*	E	N	Caspian Tern	*Sterna caspia*	SC	N
Marbled Godwit	*Limosa fedoa*	S	N	Sandwich Tern	*Thalasseus sandvicencis*	S	N
Whimbrel	*Numenius phaeopus*	SC	N	Gull-billed Tern	*Gelochelidon nilotica*	SC	N
American Oystercatcher	*Haematopus palliatus*	SC	Y	Royal Tern	*Thalasseus maximus*	S	Y
Willet	*Tringa semipalmata*	S	N	Common Tern	*Sterna hirundo*	SC	Y
Short-billed Dowitcher	*Limnodromus griseus*	S	N	Forster's Tern	*Sterna forsteri*	S	N
Ruddy Turnstone	*Arenaria interpres*	S	N	Roseate Tern*	*Sterna dougallii*	E	N
Sanderling	*Calidris alba*	SC	N	Black Tern	*Chlidonias niger*	S	N
Red Knot*	*Calidris canutus*	E	N	Least Tern	*Sternula antillarum*	E	Y
Dunlin	*Calidris alpina*	S	N	Black Skimmer	*Rhynchops niger*	E	Y

[1]Status Codes: E=Endangered, T= Threatened, SC = Special Concern, S = Stable, - = Not listed
* Federally listed species
Species Listing Source: Species Status Review of Birds – DRAFT April 2017, report for the NJ Endangered & Nongame Species Advisory Committee

Breeding Use

The first ***American Oystercatcher*** nest on the island was recorded April 20. By the end of the breeding season, a total of twelve pairs nested on HOIS. This was a 20% increase in pair number over 2022 (ten pairs). Pair dispersal was widespread across the island utilizing the entire habitat for breeding and brood rearing. The seasonal closure continued to deter human use of the western edge, and six Oystercatcher pairs utilized those areas for nesting, a 200% increase over 2022 (two pairs). Pair-nest success (the percentage of pairs that successfully hatch at least one nest) was considerably high compared to the state-wide total (75% pair-nest success on Horseshoe, 34% pair-nest success for the state) (Davis & Heiser 2023). This is not surprising considering the lack of mammalian predators on the island. Sites elsewhere in the state were plagued with predation issues (accounting for 36% of nest losses statewide). There were 19 nest attempts on the island by American Oystercatchers: nine nests hatched, nine failed, and it was unknown if one nest hatched or failed (Figure 4). Of the failed nests, seven were lost to flooding, one was lost to avian predation, and one nest abandoned. A total of 19 chicks hatched from eight pairs. An unfortunately timed early June storm accounted for the loss of 18 chicks; the majority of those were within two weeks of their fledge dates. The loss of older chicks at a late stage in the nesting season for this species (when many pairs may choose to not renest) was devastating for the island's productivity. Just four pairs renested and those nests later flooded so no fledge success was achieved on site for American Oystercatchers in 2023. The island remains integral from a habitat perspective, as the lack of mammalian predators continued to provide exceptional rates of hatch success.

Figure 4. Location and fate of 2023 American Oystercatcher nests

Colonial nesting waterbirds are comprised of interspecific species groups that prefer nesting in large numbers with nests as close as one to two yards from each other. Nest specific data is not collected in the same manner

for colonial nesting waterbirds as compared to territorial nesting shorebirds (American Oystercatchers) due to lower levels of disturbance tolerance. Colonial nesters were first noted on the island on May 18 (Black Skimmer, Royal Tern, Common Tern). The colonial waterbird colonies were spread out across the entire island, first appearing on the southern berm. As more birds arrived and the colonies shifted due to occasional flooding, the colonies expanded into four subcolonies but were most densely concentrated on the northern and eastern berms. The subcolonies are labeled in Figure 3 and are referred to as HOIS 1, 2, 3, and 4. The locations of the colonies are marked by boundaries in the figure that contained eggs and incubating adults, but the entire island was used by breeding adults, non-breeding subadults, chicks, and fledglings. The numbers of breeding birds on the island is summarized week by week in Figure 5.

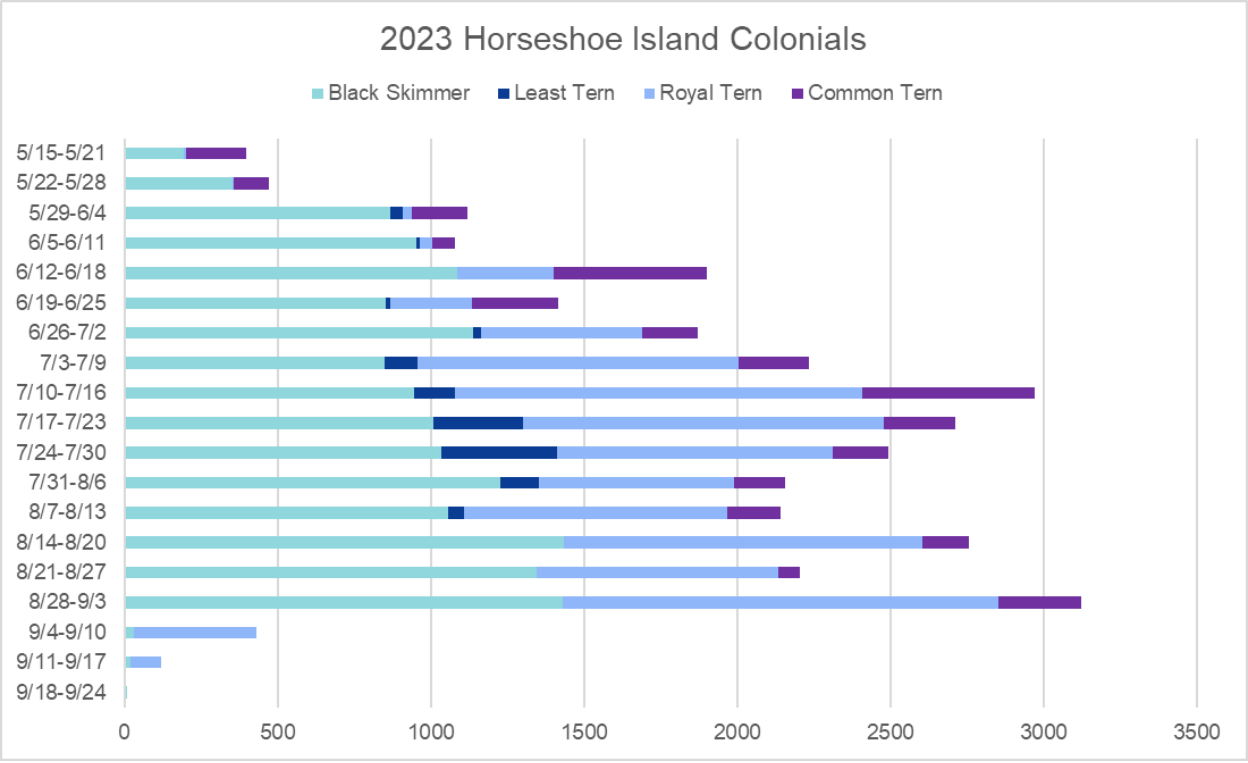

Figure 5. Total breeding adults, all colonial species, by week.

Black Skimmers nested at four (known) colonies statewide with the largest colony located on HOIS. The habitat provided refuge to adults that failed at other colonies, particularly at Holgate due to persistent predation. Black Skimmers were first observed scouting the habitat on May 12. The colony grew to a peak count of 1,435 breeding adults with 690 incubating throughout the season (May – September) (Figure 6). The Black Skimmer colony suffered from multiple flooding events throughout the season which impacted their use of the island and ultimately, their breeding success. A sub-adult Peregrine Falcon was also observed hunting the colonies in late August. Black Skimmers settled into all four subcolonies across the island, first colonizing HOIS 1 and HOIS 2. After multiple flooding events, the colony shifted to primarily use HOIS 2, HOIS 3 and HOIS 4. Flooding caused HOIS 1 and HOIS 4 to completely fail. The Black Skimmer colony fledged a total of 225 chicks and accounted for approximately 30% of the statewide fledgling total.

For the first time, Black Skimmers were banded at HOIS in 2023 as part of an on-going (since 2016) banding project in the state. This was a joint effort between ENSP, CWF, and The Wetlands Institute. Twenty-nine juvenile skimmers were hand captured and banded with metal USGS and blue field readable bands (save one, who only received a metal band) on August 14. As of this report, eight individuals were already resighted away from HOIS. Locations of resights were migratory stopover locales in New Jersey and at sites in North Carolina and South Carolina. The Wetlands Institute also regularly scanned the island for skimmers that were outfitted with GPS transmitters in Stone Harbor Point. That data is not yet available for inclusion in this report.

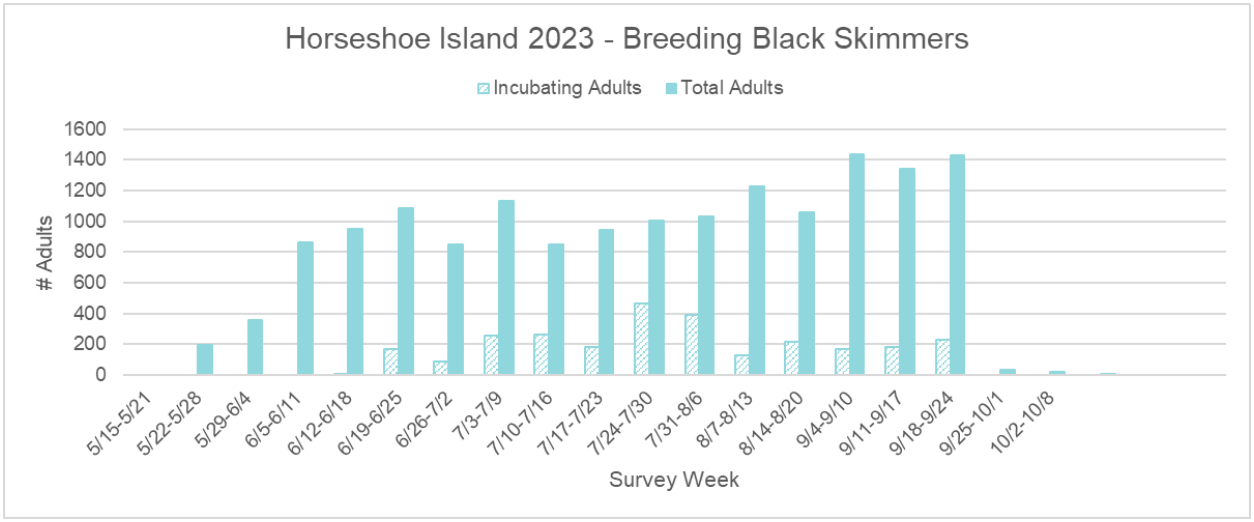

Figure 6. Total breeding Black Skimmer adults and proportion incubating, by week.

Least Terns had a peak count of 293 total breeding adults with 147 incubating adults during the July 7 – July 23 census week (Figure 7). In terms of habitat utilization, Least Terns were noted foraging and roosting across the entire island. Breeding Least Terns were congregated on HOIS 2 and HOIS 4. It appears adults from nearby Holgate failed and relocated to HOIS. Recurring flooding events limited nest success and no fledglings were produced. Compared to previous seasons (2021 and 2022) when Least Terns were able to produce limited fledgling numbers, they were unable to find any success at HOIS in 2023. It should be noted that with the continued increase of other colonial nesting species to the island, it is possible that Least Terns, with their diminutive size, are unable to compete for prime habitat and are being pushed to less desirable (i.e. lower elevation) locations on the island. Their late arrival after failures elsewhere in the state also impacted habitat selection (in that much of the island was already occupied by others species that they do not tend to nest in close proximity to).

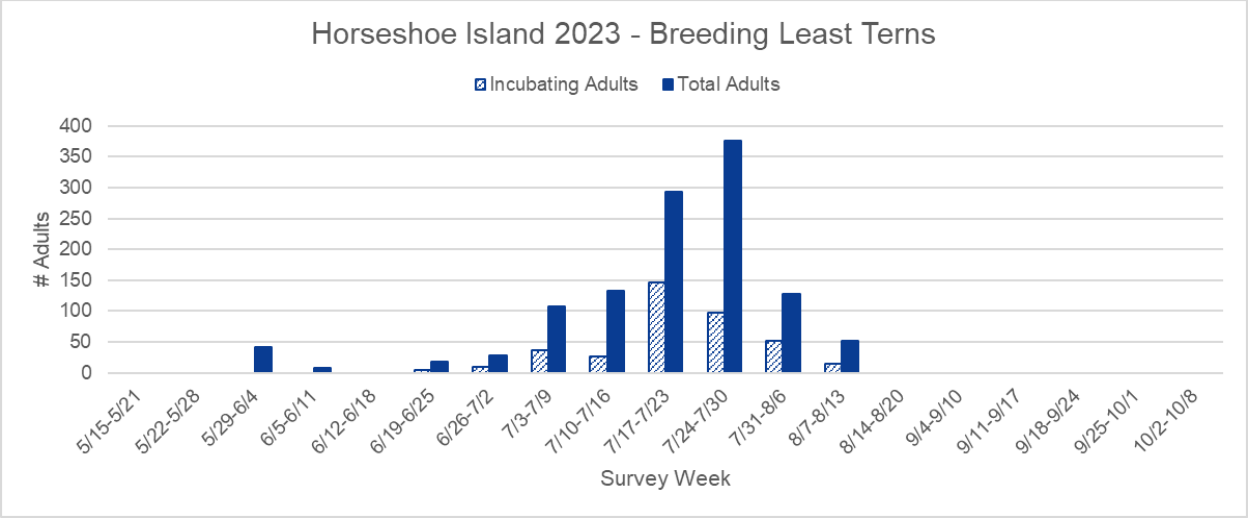

Figure 7. Total breeding Least Tern adults and proportion incubating, by week.

Royal Terns nested successfully on HOIS for the third consecutive breeding season. Northeastern Royal Terns breed along coastal Virginia south to Florida, with an irregular colony forming in southeastern Maryland (Buckley et al. 2021). Although they have been recorded previously nesting in smaller numbers in New Jersey (2008, 2009, 2015, 2016, 2021), this large, unusual colony highlights the ecological importance of HOIS. Royal Tern habitat, as described in Birds of The World, "is barren sandy barrier beaches…typified by inaccessibility, high visibility, the absence of mammalian predators, and surrounded by shallow waters near the mouth of bays" (Buckley et al. 2021). The island offers all requirements of ideal Royal Tern habitat. The first occurrence of Royal Terns was noted on May 24 (Figure 8). Two weeks later (June 13), the first nests were confirmed within the Black Skimmer and Common Tern colony in HOIS 2. A peak count of 1,178 breeding adults was recorded on the island with 404 incubating nests during the July 10 – July 16 census week. This is a nearly 350% increase in breeding adults colonizing HOIS compared to 2022 (90 incubating adults) and is the largest breeding colony for this species ever recorded in New Jersey. Royal Terns utilized HOIS 2 and 3 and expanded their territory to the edges of the island to rear chicks. The northwestern edge of the island has been particularly susceptible to human disturbance in the past. The decrease in disturbance and human use in 2023 appears to have allowed full use of the island for breeding and rearing chicks. A total of 65 Royal Tern fledglings were produced. Persistent flooding impacted fledgling success. HOIS also offered refuge to many migrant and staging flocks of Royal Terns from mid-July through September. A high count of 1,915 Royal Terns (all age classes) was recorded on August 28. Several migrant and breeding Royal Terns were marked adults banded in Virginia between 2018 and 2019.

Figure 8. Total breeding Royal Tern adults and proportion incubating, by week.

Common Terns were first noted on the island on May 24 (Figure 9). There was a high count of 563 total breeding adults with 236 incubating adults during the July 10 – July 16 census week. The birds were spread across three of the four subcolonies that formed but were most densely concentrated on HOIS 2 and HOIS 3. Common Terns are not monitored statewide (they nest on beaches and in the marsh) so it is difficult to put into perspective the site's overall contribution to regional productivity and success. However, the ~250% increase in adult abundance was notable in 2023 and offers further evidence of the premiere habitat that HOIS provides to these species. Flooding was the primary threat to Common Terns at HOIS although some success was achieved. Approximately 32 chicks fledged from the island. Considering the number of adults on the island, greater productivity was expected but flooding was a persistent issue in 2023.

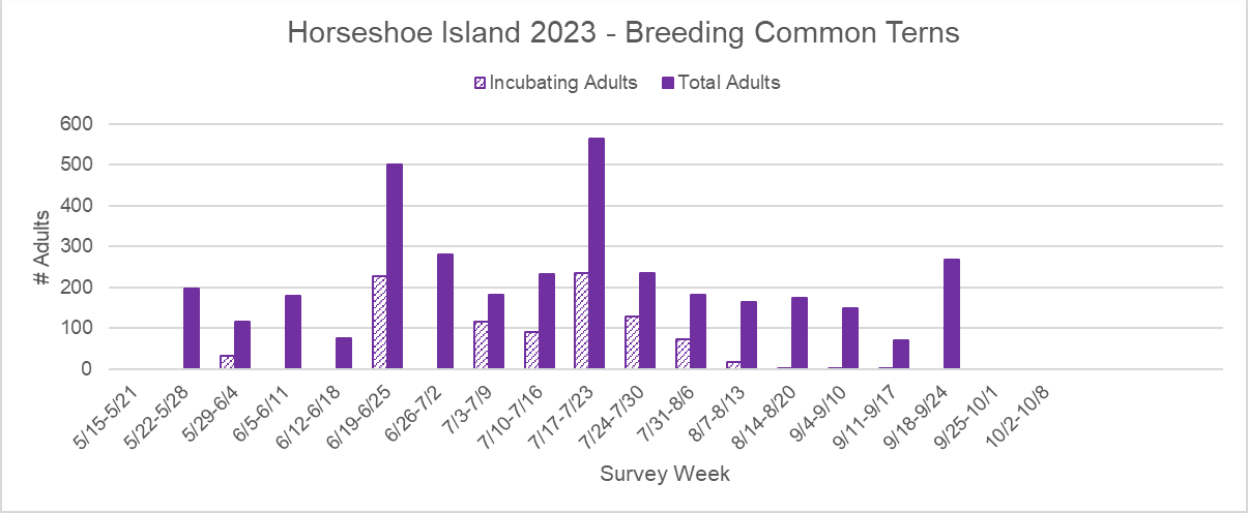

Figure 9. Total breeding Common Tern adults and proportion incubating, by week.

Migratory Use

HOIS was used as a migratory stopover site by a variety of shorebirds and other avian species along coastal New Jersey (see Table 1 for full species list). Several shorebird and waterbird species were noted on the island throughout the season which further highlights the island's importance as a disturbance-free refuge for otherwise constantly disturbed bird species. Migrants regularly used the entirety of the island (once again illustrating the effect of lower human disturbance) but were particularly attracted to the lagoon area and the intertidal waters surrounding the island for foraging (Figure 10). Roosting migrant flocks were widespread across the island. While the island was used by a diverse group of bird species, this report section will focus on species with priority listing status and/or notable use of the island: Red Knot (federally threatened, state endangered), Piping Plover (federally threatened, state endangered), Roseate Tern (federally endangered, state endangered) and Brown Pelican (stable). In 2023, the Refuge conducted additional surveys during southbound migration and completed a thorough report chronicling the island's importance for migratory birds. To obtain additional information on this effort or a copy of the report, please contact Refuge Biologist Joseph Smith at Joseph_Smith@fws.gov.

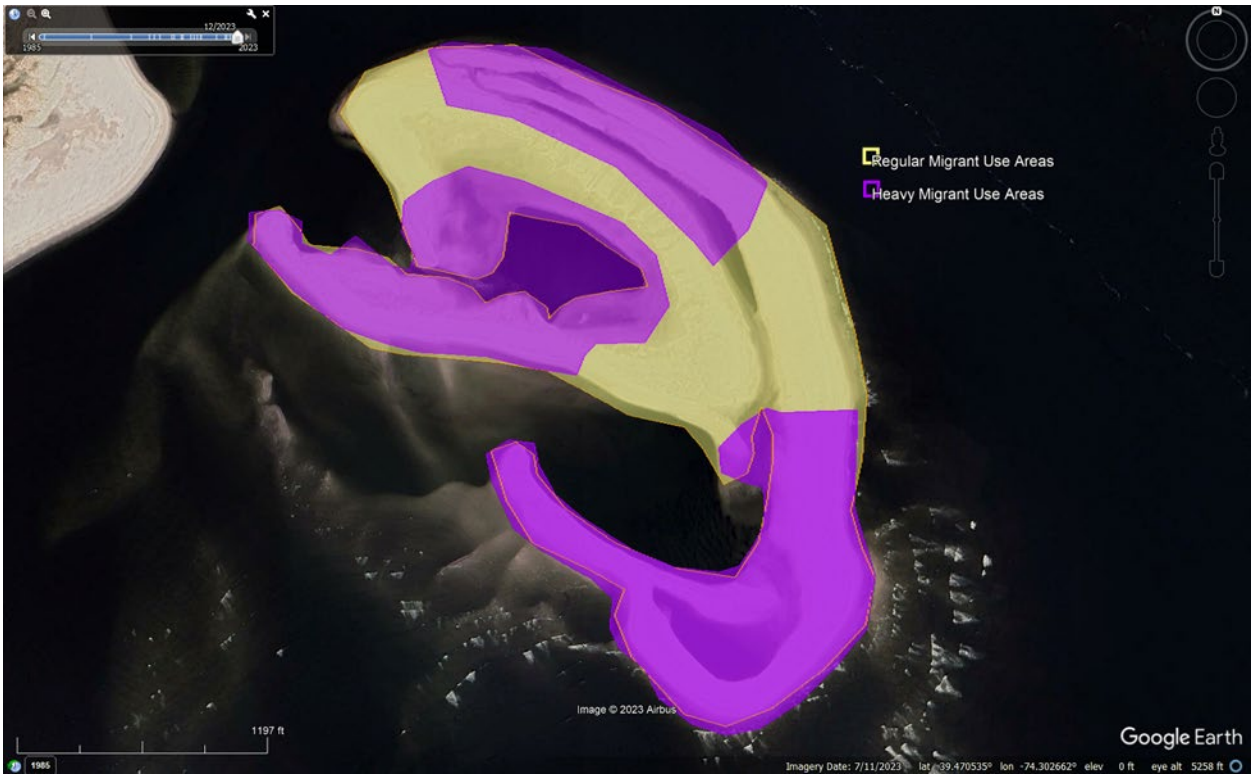

Figure 10. Use of HOIS by migratory species

Red Knot occurrence was prioritized during shorebird surveys. Sixteen surveys included Red Knot sightings, a notably high consistency of use. The site hosted a large flock of knots (507) on July 28, the peak count for the 2023 season. Previously collected geo-locator data from Red Knots indicate that many Northeastern birds depart the US on long migratory flights over the ocean during their southbound migration (USFWS*)*. Some make additional stops along the way while others complete their migration uninterrupted to wintering grounds in South America. Data from satellite-tagged Red Knots showed use of the island in 2020 and played a role in expanding the USFWS proposed Critical Habitat designation for Horseshoe and the surrounding shoals (W.

Walsh, personal communication, December 12 and 21, 2022). The satellite data showed that knots used the island as part of a habitat complex that also includes the Refuge and adjacent state lands. The proximity of HOIS to these other protected areas increases the island's value for migrating knots by allowing birds to shift among habitats based on food, predators, disturbance, weather, tides, and other conditions.

Piping Plovers were regularly observed on the island throughout the breeding and migratory season. Directly adjacent to HOIS is the Refuge's Holgate and Little Beach units. The Refuge hosts the largest percentage of breeding Piping Plovers in New Jersey (Davis & Heiser 2023). Marked breeding adults from the Refuge were observed foraging on the island in May, with a high count of six on May 3. At least six marked adults from other nesting sites were observed foraging on the island throughout the breeding season. Many unmarked adults were also noted using the island, particularly in spring and fall, indicating that this site is of relative importance to migrating Piping Plovers.

Roseate Terns were observed throughout the season as migrants using HOIS as a stopover site. They were observed seven times, which (as per eBird records) is a higher degree of occurrence than elsewhere in the state. A maximum of 11 adults were recorded on August 28 roosting with flocks of Common Terns. A high count of 16 adults was recorded in September 2003 in Cape May following a storm event but otherwise, 11 adults in the post-breeding season with no known weather events impacting their migratory route is a notable occurrence in the state. The high numbers of terns recorded on HOIS across multiple species demonstrate the importance of the island as a stopover for migratory species that are threatened and endangered. The North Atlantic population of Roseate Tern is listed as federally endangered, largely due to habitat loss. Roseate Terns nested on New Jersey beaches prior to 1980, so it is possible that HOIS could serve as a new breeding site for this endangered tern species.

Brown Pelicans were regularly observed roosting on HOIS in 2023. Brown Pelicans are a regular occurrence during the summer months in New Jersey, but large roosting flocks are uncommon. The high count of Brown Pelicans on HOIS in 2023 was 150 adults and juveniles on August 14. Few records of 150 or more birds exist in eBird records for New Jersey, further highlighting the importance of HOIS for Brown Pelicans. Use of the island by pelicans was mostly spread across the eastern berm. The intertidal waters surrounding the island, which provided excellent foraging opportunities, were heavily used by pelicans.

HUMAN DISTURBANCE

Compared to many beach-nesting bird sites in the state, human disturbance at HOIS is relatively low as access is only by boat. Nevertheless, there is a high degree of risk associated with any human disturbance because of the large concentration of breeding birds present on the island (see Avian Use, above). A seasonal closure to all types of human disturbance is the primary means by which this threat was reduced at HOIS. ENSP and CWF staff work to help the public understand the purpose of the closure through site signage (including the QR sign that links to the NJFW HOIS webpage) and direct outreach. They informed the public about the stipulations of the MRA. However, they were not able to take any enforcement actions in a scenario where a member of the public refuses to leave the site during the time periods of the closure (and thus their presence disturbs birds and/or results in habitat avoidance). This was an on-going issue in 2022 and an area that was recommended for improvement in the 2022 HOIS report.

In winter 2023, ENSP worked with their colleagues in the NJ DEP Fish and Wildlife Bureau of Law Enforcement to make plans for routine patrols and response patrols by Conservation Police Officers (CPOs) for

the 2023 field season. Protocol for response patrols was that the field crew would make initial contact with the boater, informing them of the closure and MRA. If the boater refused to leave after outreach attempts were made, the field crew would call the CPOs via the 1-877-WARN-DEP hotline. While most boaters complied after the outreach attempts, a small but significant portion deliberately disregarded the island's closure by landing and refusing to leave. CPOs were contacted five times by staff (notable incidents occurred on 6/18, 7/15, and 7/22) during the monitoring period and officers responded on all five occasions. Response times were quick, with CPOs on site between 10 and 45 minutes after the initial call, and in all cases resulted in boaters leaving the island. Over the course of the 2023 season, CPOs conducted numerous boat patrols and made multiple vessel stops, which resulted in more than 100 public contacts to educate the public and enforce the closure. The addition of the CPOs to the management of the island resulted in a dramatic decrease in the amount of human disturbance in 2023 compared to 2022 (Figure 11).

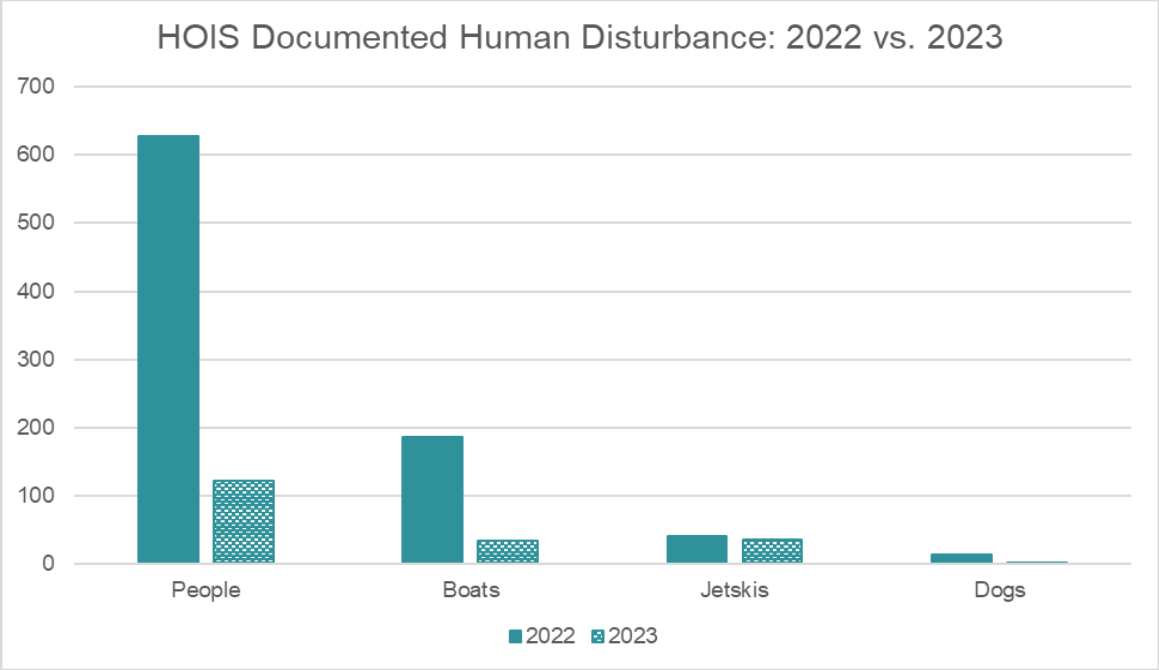

Figure 11. Documented human disturbance on HOIS: 2022 vs. 2023

Watercraft landings on HOIS were recorded on 24, or 35%, of site visits. This is a decrease from 2022, when watercraft landings were recorded on 33, or 46%, of site visits. As expected, human activity increased as the spring gave way to summer and was higher on weekends/holidays, which represented 17 (71%) of days with recorded landings. Supplemental reports taken on weekdays from Little Beach/Holgate only captured landings on one weekday survey, which further highlights the popularity of weekend landings.

Although monitoring began in April, the first recorded public boat landing did not occur until May 27, during Memorial Day Weekend. The number of landings steadily increased in the following months and peaked in July. Most landings consisted of fewer than five boats and jet skis, which is a change from 2022 when double digit numbers were often recorded between (what was) the sandbar and the main island. The frequency of public landings decreased throughout August and September.

The western side of HOIS is typically more susceptible to boat landings since it is more sheltered from wave activity. As a result, human activity was particularly disturbing to brooding oystercatchers and colonial birds located near these areas. For example, trespassers directly disturbed a Black Skimmer colony located on the southwestern corner of the island and refused to move when staff informed them of the disturbance. Staff also recorded multiple instances in which roosting flocks of Black Skimmers and terns flushed in response to boat landings. Beginning in 2023, the channel between the main island and the eastern sandbar began to fill in and was no longer accessible to boats. As a result, many boats redirected to Little Beach (part of the Refuge), which is closed year-round to the public. ENSP and CWF staff documented 111 watercraft landings on Little Beach in 2023, up from only 27 in 2022. Staff often observed boat passengers walking through dunes on Little Beach after disembarking. Additional signage, as well as outreach and enforcement will likely be necessary to deter watercraft landings on Little Beach.

Overall, the signage was successful in influencing many boaters' behavior. Staff recorded at least 23 instances of watercraft approaching HOIS (presumably intending to land) but turning around immediately after noticing the "No Landing" signage or interacting with staff. The most common argument from uncooperative boaters was that they were exempt from restrictions while below the mean high tide line. However, HOIS's intertidal zone is specifically included under the MRA and is permitted to be closed to reduce disturbance to nesting and foraging birds. Members of the public either did not understand the unique stipulations of the closure, or they based their argument on other closures in which the land below the mean high tide line is not eligible to be regulated by the landowner.

When signage and outreach did not work, the ability to call CPOs provided a number of benefits. First, their uniformed appearance led to the public better respecting the legitimacy of the closure and allowed them to achieve the desired outcome (boater leaving the site). Second, their presence very likely helped to drive the reduction in overall site use by people (2022 vs. 2023, as enumerated above), as it was now evident to the public that patrols were occurring and that landing at the site would not be permitted (another factor is that it was the second year of the closure and compliance can also naturally improve in restricted areas as the public becomes more aware). Finally, it provided an important support system for field staff, who now had a protocol in place for when public interactions turned abusive. Their aid this season was invaluable and should be replicated in future years, as resources allow.

RECOMMENDATIONS

- Continue to conduct outreach on the island to educate members of the public about the use of the site by nesting and migrating birds and to convey details of the seasonal closure.
- Continue to conduct outreach off-island through traditional media (newspapers, magazines) and social media. This could include targeted posts with nesting updates and creating additional videos to share with the public.
- Continue presence on the site by law enforcement to reinforce the seasonal closure.
- Conduct biological monitoring a minimum of 4x/week. This includes both breeding and non-breeding/migratory species, which both rely on the island.
- Maintain signage on site to ensure there is island-wide coverage to inform the public of the closure, especially as the perimeter changes throughout the course of the season (due to natural processes exerted on a dynamic island).

- Investigate the feasibility of monitoring the island year-round to provide data on the importance of the site to wintering birds. This could include in-person visits as well as mining spatial data that is collected via GPS tags on a myriad of species.
- Continue to band Black Skimmers and begin banding other species that utilize the island, such as Royal and Common Terns, to better understand population demographics of each species. Increase resighting efforts of all banded birds.

CONCLUSION

The second year of management under the MRA built on the successes of the first year and made strides towards additional improvements. The island once again attracted a wide variety of species, including many listed species, who used the site for migrating, roosting, and/or nesting. The island continued to change in shape and grow in size, which increased challenges for its protection, but also increased the amount of space available to avian species. An increase in highly suitable habitat for coastal species is extremely rare in New Jersey and one that species managers worked hard to take advantage of, by increasing signage, site visits, and outreach to the public. Staff presence on the island greatly contributed to the effectiveness of the closure and that was only made stronger by the ability to call in CPOs as needed.

The quality of the biological data collected in 2023 continued to meet a high standard. This allowed biologists to document the avian use of the island in a comprehensive manner and to highlight its immense value to these coastal species. HOIS solidified its position as one of the most significant sites for avian species in the state, particularly in this landscape. Species managers continue to manage the site with the knowledge that while its lifespan is unknown, every year it is present and suitable will be highly beneficial for the species that have now come to rely on it for foraging, migratory stopovers, and breeding. Continued and improved protections are critical for as many years as the island persists.

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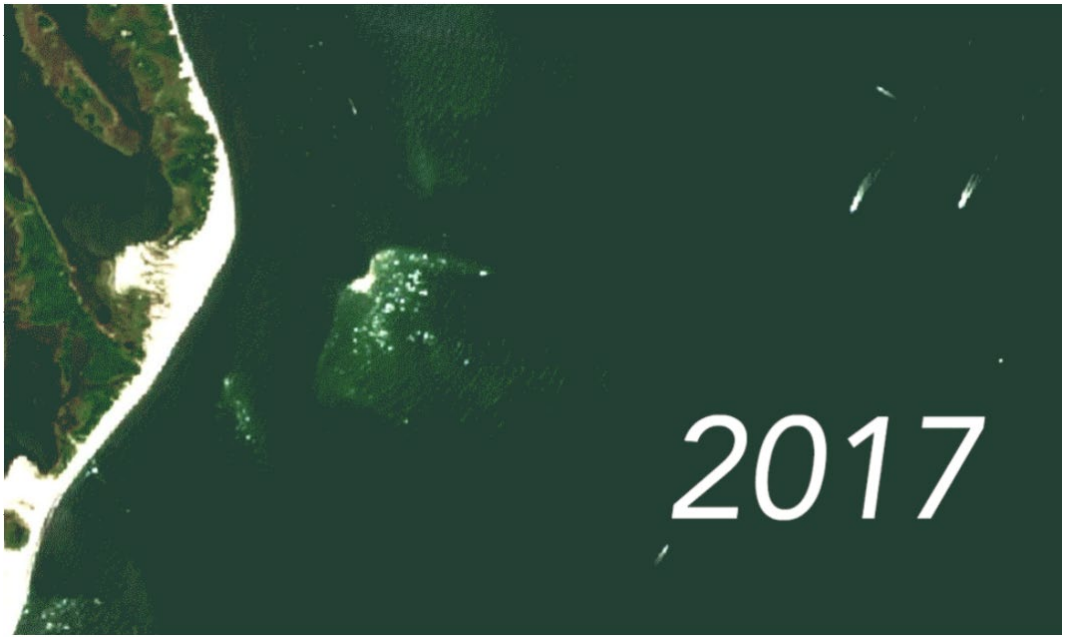
Appendix A. Links to time lapse GIFs of Horseshoe Island from 2017-2023

1. 2017-2023 zoomed out

2. 2017-2023 zoomed in



Appendix B. Photographs from 2023

B.1. Examples of bird activity

Top to bottom: Royal Terns with Black Skimmers in background, variety of birds using HOIS, roosting Black Skimmers using undisturbed intertidal area. Photo credit: Teri Bowers

Inaugural Black Skimmer banding effort on HOIS, August 2023. Photo credit: Christina Davis

Examples of the way eggs are laid directly on the sand, making them very susceptible to human disturbance. Third picture shows a nest that was laid in the area where people often land. Photo credits (L to R): Amy Kopec, Dakota Bell, Audrey Randazzo.

B.2. Examples of signage

Photo credits: NJFW