

NYC Audubon Harbor Herons Shore Monitoring Program

Data and Findings



Volunteers from the 2004 monitoring season.

June – August, 2004

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Funded By:

A grant from New York City Environmental Fund, administered by the Hudson River Foundation.

Partners:

Fuji Film and Gateway National Recreation Area.

Abstract:

NYC Audubon Harbor Herons Shore Monitoring Program attempts to identify the foraging grounds of herons, egrets, and ibis nesting in New York Harbor in order to preserve these areas. As a first step, this Program identifies flight lines used by the Harbor Herons as they leave and enter their colonies. Flight lines are identified by monitoring the colonies from shore locations opposite these island-colonies. The observed flight lines are then used to track and identify the foraging areas of the Harbor Herons.

During the 2004 breeding season three island-colonies were monitored: Brother Islands (North and South Brother), Hoffman, and Canarsie Pol. Using the observed flight lines, as well as field trips to the foraging areas and other sources of information, revealed a large portion of the foraging areas to be located outside New York Harbor, in areas such as the NJ Meadowlands. Furthermore, the flight lines suggest that each colony relied on separate foraging grounds throughout the breeding season. Finally, the data suggests the existence of inter-colony differences in the birds' flight patterns, perhaps the result of differences in the relative crowdedness in each colony.

While this report focuses on the main findings from the 2004 season, it is important to note that the goal of the *NYC Audubon Harbor Herons Shore Monitoring Program* is to increase the public's awareness of and involvement in one of the most significant heronries in the eastern United States. The Program's volunteers play an important role in realizing this goal. It is through citizen science research and education that we hope to create a community of informed stewards to advocate on behalf of wading birds and their nesting and foraging sites in the New York Harbor estuary. During the 2004 season, this community of stewards was further expanded and strengthened.

Introduction:

A major expansion of wading birds into the New York City area began in the mid 1970s in western Staten Island (Buckley and Buckley 1980). Between the 1980s and 1990s, populations have varied at different colonies, sometimes increasing in number, and at other times, decreasing. In 2004, approximately 1,700 pairs of wading birds nested in seven colonies throughout greater New York Harbor area (Table 1). Nesting species include Black-crowned Night Heron (*Nycticorax nycticorax*), Great egret (*Ardea alba*), Snowy egret (*Egretta thula*), Glossy ibis (*Plegadis falcinellus*), Little blue heron (*Egretta caerulea*), Cattle egret (*Bubulcus ibis*), Yellow-crowned Night heron (*Nyctanassa violacea*), and Tricolored Heron (*Egretta tricolor*). These species (with the exception of the Yellow-crowned Night Heron) have mainly found suitable nesting habitat on partially unused or abandoned islands throughout New York City (Fig 1).

Fig 1: Location of wading bird breeding colonies in the New York City area. A red marker indicates confirmed colony activity in 2004, black indicates inactive colonies (from Bernick 2004, map modified from OasisNYC).



Table 1: Number of active wading bird nests in the New York City area colonies (from Parsons 1987, 1995; Kerlinger 2004).

Species	1987	1995	2004
Black-crowned Night Heron	379	1,147	841
Glossy Ibis	142	271	350
Great Egret	60	136	230
Snowy Egret	191	302	240
Cattle Egret	59	40	6
Little Blue Heron	2	2	11
Yellow-crowned Night Heron	5	14	7
Green-backed Heron	5	10	0
Tricolored Heron	0	0	2
Unidentified wader nests	0	129	24
Total Wading Bird Nest Count	843	2,051	1,711

The nesting of wading birds in New York Harbor has sparked the interest of many people. NYC Audubon began the *Harbor Herons Project* in the mid 1980s as a way to monitor changes in the Harbor's wading bird population. The *NYC Audubon Harbor Herons Shore Monitoring Program* is a more recent program focusing on identifying the foraging grounds of the Harbor Herons in order to conserve both the breeding sites *and* the foraging grounds of these birds. Through citizen science research and education, the *NYC Audubon Shore Monitoring Program* hopes to create a community of informed stewards who will advocate on behalf of wading birds and their nesting sites on the islands of the New York Harbor estuary.

As a first step, this Program identifies flight lines used by the Harbor Herons as they leave or return to their colonies. These flight lines are then used to track and identify the foraging areas of the Harbor Herons. During the breeding season of 2004, data relating to wading birds' flight activity was collected for three large, active island-colonies in New York Harbor – Brother Islands, Hoffman, and Canarsie Pol. Field trips were later conducted in NJ Meadowlands and Staten Island region to identify and document possible foraging sites. This Program was made possible by a generous grant from the NYC Environmental Fund, which was administered by the Hudson River Foundation.

Methods:

In the second year of the Harbor Herons Shore Monitoring Program, volunteer researchers collected data on wading bird flight activity over a period of 11 weeks, from 3 June-15 August 2004 for three colonies in New York Harbor: Brother Islands, Hoffman, and Canarsie Pol (Fig. 1). Data was collected for the following bird species: Great Egrets (*Casmerodius albus*), Black-crowned Night-Herons (*Nycticorax nycticorax*), Snowy Egrets (*Egretta thula*) and Glossy Ibis (*Plegadis falcinellus*).

Volunteer researchers monitored the island-colonies from shore locations opposite the islands. Weekly monitoring consisted of morning and evening sessions, a methodology used in other wading bird studies (Erwin *et al.* 1991). Each week monitoring alternated between morning and evening sessions, beginning with morning sessions. Morning sessions were held from 7-9:30 am and evening sessions were held from 5:30-8:00 pm. Every colony was monitored at least one time each week¹ (Table 2). Binoculars and spotting scopes were used to identify bird species. With numbers falling towards the end of the season, more attention was given to the possible location of foraging grounds in the form of field trips and field surveys of those areas.

The following information was recorded for birds observed leaving or entering the colonies: time of day, whether the bird was leaving or entering the colony, flight direction (one of eight major octants from the center of the colony), and species. The following abiotic conditions were noted during the session and updated hourly: air temperature in the shade, wind direction (one of eight major octants), cloud coverage over the colony, and whether it rained or not. Tide information was added later using NOAA tide tables; wind speeds at each colony were added from the

¹ During the last week, only one colony was monitored.

website “weather.com.” Monitoring was conducted by a group of volunteers, with Yigal Gelb supervising the data collection process throughout every session.

Table 2: Session Description, including Total Bird Count.

Date	Colony	Start	Finish	Birds Counted
3-Jun	Canarsie	7:20	10:00	37
4-Jun	Hoffman	7:10	10:03	122
5-Jun	Canarsie	7:20	10:00	20
6-Jun	Hoffman	7:25	8:45	3
10-Jun	Brothers	17:10	19:40	180
11-Jun	Hoffman	17:45	19:45	171
12-Jun	Brothers	17:45	20:00	139
13-Jun	Canarsie	17:20	19:00	27
17-Jun	Brothers	7:00	9:00	207
18-Jun	Canarsie	7:00	9:00	27
19-Jun	Hoffman	7:20	9:15	144
20-Jun	Canarsie	7:00	9:00	47
24-Jun	Canarsie	17:50	19:30	9
25-Jun	Hoffman	17:35	19:00	96
26-Jun	Brothers	17:30	19:30	67
27-Jun	Hoffman	17:40	19:33	125
1-Jul	Brothers	7:00	9:00	160
2-Jul	Hoffman	7:30	9:10	120
3-Jul	Brothers	7:00	9:00	199
4-Jul	Canarsie	7:20	9:00	27
8-Jul	Brothers	17:40	19:40	81
9-Jul	Canarsie	17:30	19:30	24
10-Jul	Hoffman	17:10	19:15	150
11-Jul	Canarsie	17:50	19:00	9
15-Jul	Brothers	7:00	9:00	118
16-Jul	Hoffman	7:15	9:15	122
18-Jul	Canarsie	7:00	9:00	19
22-Jul	Brothers	17:40	19:40	64
23-Jul	Hoffman	17:45	19:45	62
24-Jul	Brothers	17:30	19:50	52
25-Jul	Canarsie	17:50	19:30	25
29-Jul	Brothers	6:00	8:00	49
30-Jul	Hoffman	7:15	9:15	21
31-Jul	Brothers	7:00	9:00	36
1-Aug	Canarsie	7:15	8:30	2
5-Aug	Brothers	17:30	19:30	27
7-Aug	Brothers	17:30	19:30	20
8-Aug	Hoffman	17:30	19:30	3
15-Aug	Brothers	17:30	19:00	0

In order to allow for a cross-colony comparison, data was truncated to ensure that all morning sessions and all evening sessions started and ended at the same time for all colonies. Intervals with complete overlap for all colonies ranged from 7:30-9:00 (1.5 h) for morning sessions, and from 17:45-19:30 (1.75 h) for evening sessions.

Study area:

Brother Islands:

This colony was situated on two islands, North Brother and South Brother, in New York City's East River near the South Bronx (40° 47'-48'N, 73° 53'W) and included about 500 nesting pairs. The predominant species were black-crowned night-herons followed by great egrets and snowy egrets (Kerlinger 2004). There were no ibis on these islands. Most of the birds nested on the 7-acre island of South Brother with a smaller population of black-crowned night-herons nesting on the 20 acre island of North Brother. A large cormorant population was also nesting on South Brother Island. Monitoring took place from a deck located in Castle Oil in the Bronx (140th St. and Locust Ave.) which was WNW of the Islands. This location allowed for a good view of both Islands with North Brother Island 450 meters and South Brother Island 900 meters from the monitoring deck. Since monitoring took place from only this location, flight activity on the other side of the islands was obscured.

Hoffman Island:

This colony was situated on a dredge-spoil island off the east side of Staten Island in the Lower Bay area of New York Harbor (40° 34'N, 74° 3'W) and included about 500 nesting pairs. The predominant species were black-crowned night-herons followed by great egrets, snowy egrets and glossy ibis (Kerlinger 2004). All the birds nested on the 10 acre island of Hoffman with cormorants present as well. Most of the cormorants, however, nested on the nearby island of Swinburne. Monitoring took place from two locations: The main location was a gazebo on South Beach, corner of Father Capodanno Blvd. and Sand Ln. in Staten Island, located NW of the Island. The second location, also in Staten Island, was a gazebo at the end of the Pier of Seaview Av., located W of the Island. These locations allowed for a good view of both Islands and were about 1,300 meters from Hoffman Island. Since monitoring took place from only these locations, flight activity on the other side of the islands was obscured.

Canarsie Pol:

This colony was situated on an island in Jamaica Bay and included about 500 nesting pairs. The predominant species were glossy ibis and black-crowned night-herons, followed by great egrets and snowy egrets; cormorants were also present on the Island (Kerlinger 2004). Monitoring took place from the edge of Canarsie Pier in Brooklyn, located NW of the Island. From this monitoring site the Island was about 900 meters away. Since monitoring took place from only this location, flight activity on the other side of the islands was obscured.

Analysis:

The data collected was analyzed in the following ways (due to insufficient data, Canarsie Pol was dropped from certain sections of this analysis):

1. Morning/Evening Flight Averages: These represent average number of wading birds observed flying during morning and evening sessions at the colonies.

2. In/Out Flight Averages: These represent average number of birds observed flying in and out of colonies during morning and evening sessions at the colonies. For each colony, numbers are reported by species.

3. Flight Directions at the Colonies: These represent the percentage of birds observed flying in 8 major compass directions (N, NW, W, etc.) at the colonies. Percentages are charted for all birds and by species. Compass directions are taken from the center of the colony. Numbers are aggregated across morning and evening sessions. For the concentric circle charts, all bars add up to 100% of the birds charted.

4. Flight Lines and Possible Foraging Areas: These represent wading bird flight lines to and from the colonies as well as possible foraging areas. Using the flight directions presented in section 4, as well as other data sources, an attempt was made to chart the wading birds' main flight lines in order to identify the foraging grounds of each colony. It is assumed here that flights in and out of the colonies were related to foraging (Maccarone and Brzorad 2000; Erwin et al. 1991). Solid lines rely on data from the 2003 and 2004 seasons of the Harbor Herons Shore Monitoring Program. Dashed lines rely on other data, anecdotal information, or inference.

For Brother Islands, data collected from the first year (2003) of the Harbor Herons Shore Monitoring Program by volunteers supervised by Andy Bernick (CUNY Graduate Center) was useful in charting flight lines beyond the monitoring location of 2004. Weekly survey data collected by Alison Siegel from Rutgers University's Graduate Program in Ecology and Evolution, anecdotal information from Kyle Spendiff, a wetlands specialist at NJ Meadowlands Commission, and surveys conducted by the Harbor Herons Shore Monitoring Program during 2004 were helpful in documenting the birds' foraging areas in NJ Meadowlands. For Hoffman, data collected by New York City's Dept. of Parks & Recreation's Natural Resources Group, anecdotal information from Andy Bernick and surveys conducted by the Harbor Herons Shore Monitoring Program during 2004 were helpful in documenting the birds' foraging areas in and around Staten Island.

5. Species Composition: These represent the total and relative abundance of birds for the beginning and middle periods of the monitoring season based on the counts of birds flying in and out of the colony (i.e., not nesting counts). For each colony, numbers are reported by species and are calculated by aggregating one morning and one evening session from the beginning period (week 2 and 3) and one morning and one evening session from the middle period (week 6 and 7).

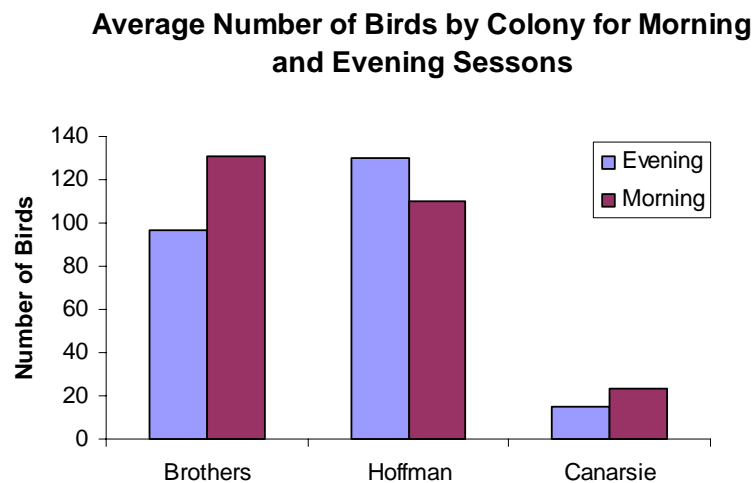
For all results, the following shorthand is used for the main wading bird species observed:

BCNH – Black-crowned Night Heron
SNEG – Snowy egret
GREG – Great egret
GLIB – Glossy ibis

Results:

Over the course of 11 weeks 2,811 wading birds were counted leaving and entering the three colonies in New York Harbor. After the data was truncated to ensure that all sessions started and ended at the same time across all colonies for both morning and evening sessions², the following numbers were recorded at each colony: Brothers 909 (8 sessions), Hoffman 721 (6 sessions), and Canarsie 154 (8 sessions).

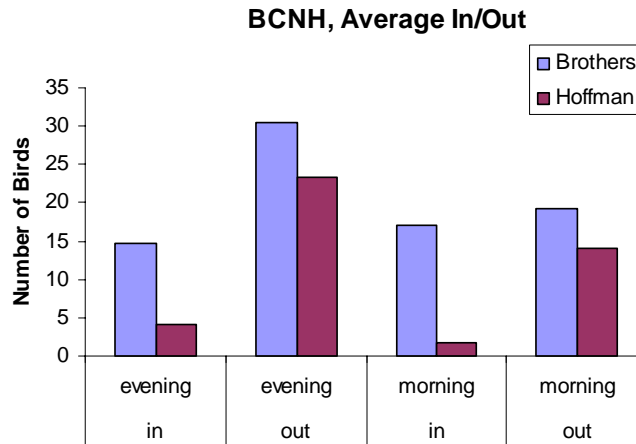
- 1. Morning/Evening Averages:** Average number of wading birds observed flying during morning and evening sessions at the colonies.



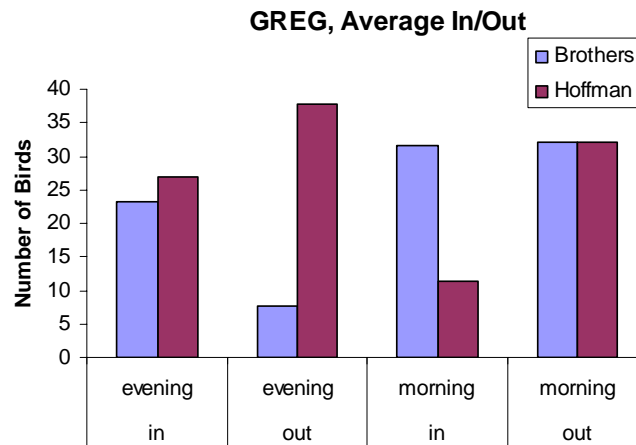
- 2. In/Out Flight Averages:** Average number of birds observed flying in and out of colonies during morning and evening sessions at Brother Islands and Hoffman colonies.

During evening sessions at Brother Islands, more black-crowned night-herons were observed leaving the colony than entering it; the same was true for Hoffman colony. During morning sessions at Brother Islands, about equal numbers of birds were observed entering and leaving the colony, while at Hoffman more birds were leaving the colony than entering it. These numbers differ significantly between the two colonies (Chi 2 = 8.8, P = 0.031).

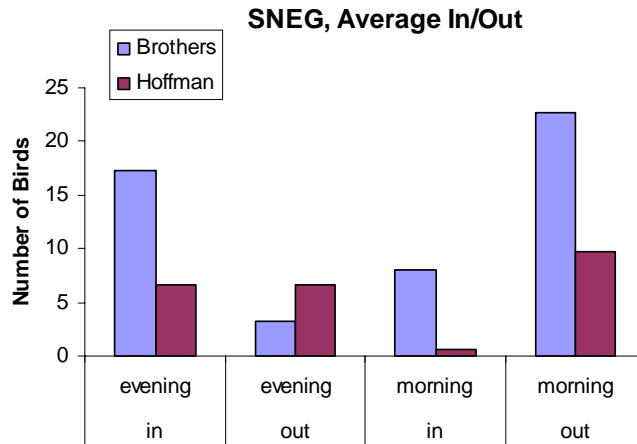
² 7:30-9:00 (1.5 h) for morning sessions, and from 17:45-19:30 (1.75 h) for evening sessions.



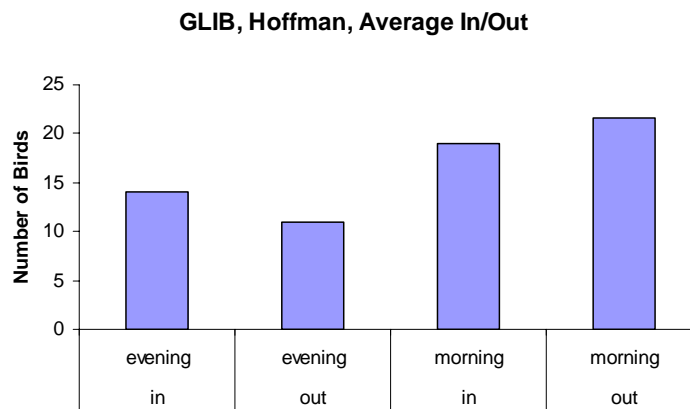
During evening sessions at Brother Islands, more great egrets were observed entering the colony than leaving it, while at Hoffman the *opposite* was true with more birds observed leaving the colony than entering it. During morning sessions at Brother Islands, about equal numbers of birds were entering and leaving the colony, while at Hoffman more birds were leaving the colony than entering it. These numbers differ significantly between the two colonies (Chi 2 = 29.4, P < 0.001).



During evening sessions at Brother Islands, more snowy egrets were observed entering the colony than leaving it, while at Hoffman equal numbers of birds were observed leaving and entering the colony. During morning sessions at Brother Islands, more birds were observed leaving the colony than entering it; the same was true for Hoffman colony. These numbers differ significantly between the two colonies (Chi 2 = 8.4, P = 0.038).



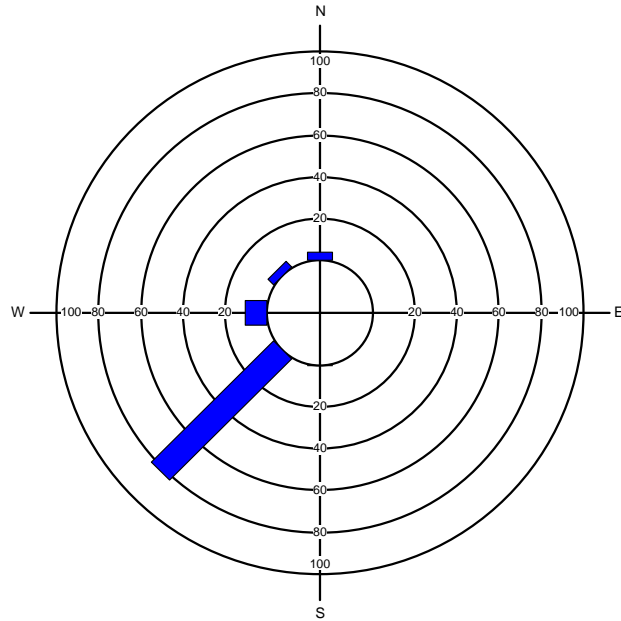
At Hoffman, about equal numbers of glossy ibis were observed leaving and entering the colony during morning and evening sessions. Higher numbers of ibis were observed during morning sessions.



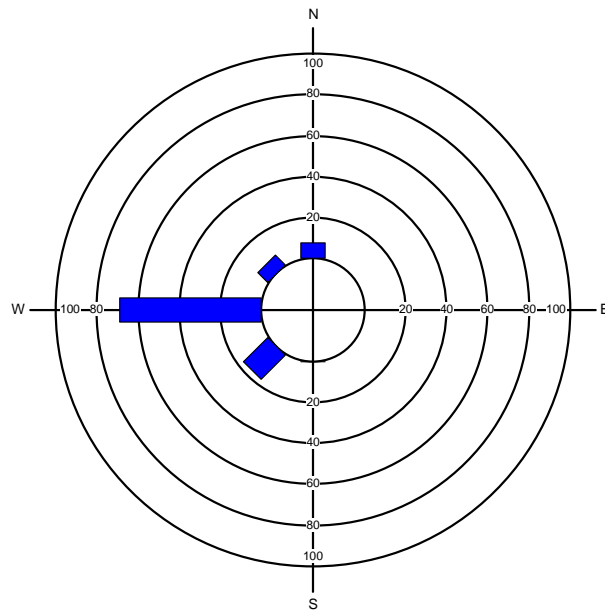
3. Flight Directions at the Colonies: Percentage of birds observed flying in 8 major compass directions at Brother Islands and Hoffman colonies. Percentages are charted for all birds and for black-crowned night-herons and great egrets separately.

Brother Islands: 82% of all birds were observed flying southwest. **Hoffman:** 69% (including ibis) were observed flying west. Hoffman seems to have somewhat more dispersion in its flight lines. But when ibis are not included, Hoffman seems to have noticeably more dispersion compared with Brother Islands.

Brother Islands, Flight Directions for All Birds (all birds = 100%)

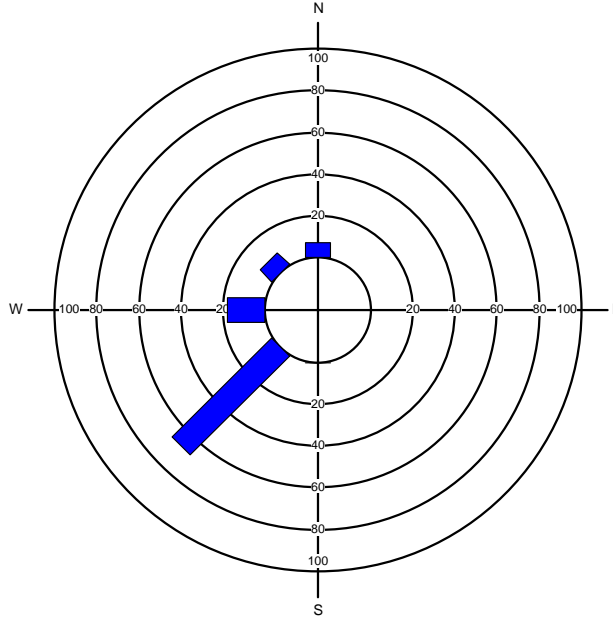


Hoffman Island, Flight Directions for All Birds (all birds = 100%)

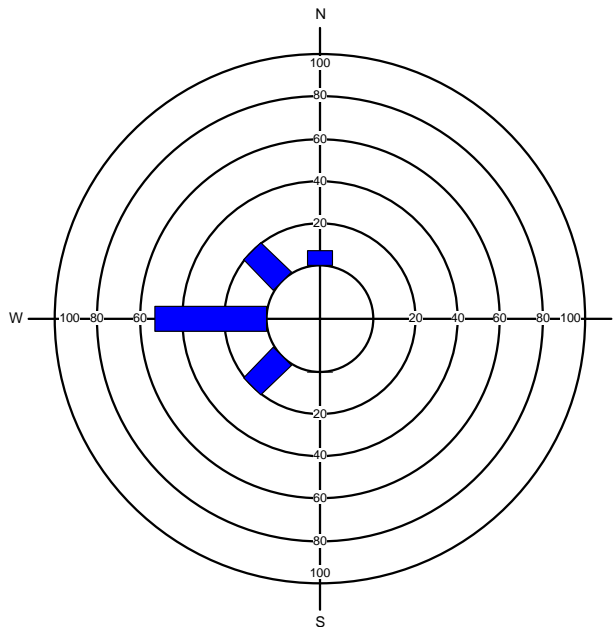


Black-crowned Night Herons: At Brother Islands, 67% of black-crowned night-herons were observed flying southwest. At Hoffman, 53% were observed flying west. Hoffman seems to have more dispersion in its flight lines.

Brother Islands, Flight Directions, BCNH (BCNH = 100%)

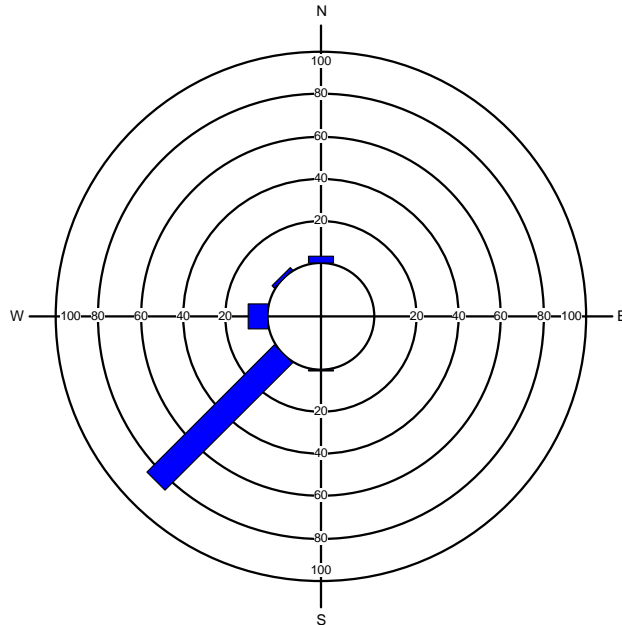


Hoffman Island, Flight Directions, BCNH (BCNH = 100%)

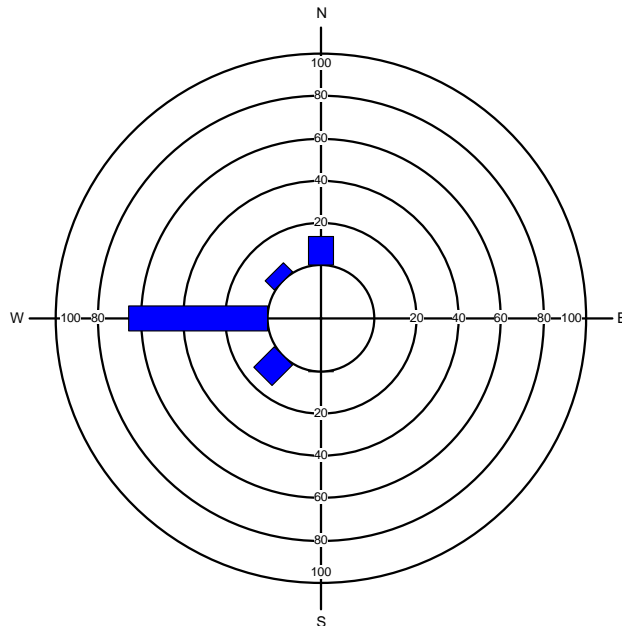


Great Egrets: At Brother Islands, 85% of great egrets were observed flying southwest. At Hoffman, 66% were observed flying west. Hoffman seems to have noticeably more dispersion in great egrets' flight lines. This finding is more pronounced for snowy egrets.

Brother Islands, Flight Directions, GREG (GREG = 100%)



Hoffman Island, Flight Directions, GREG (GREG = 100%)



4. Flight Lines and Possible Foraging Areas:

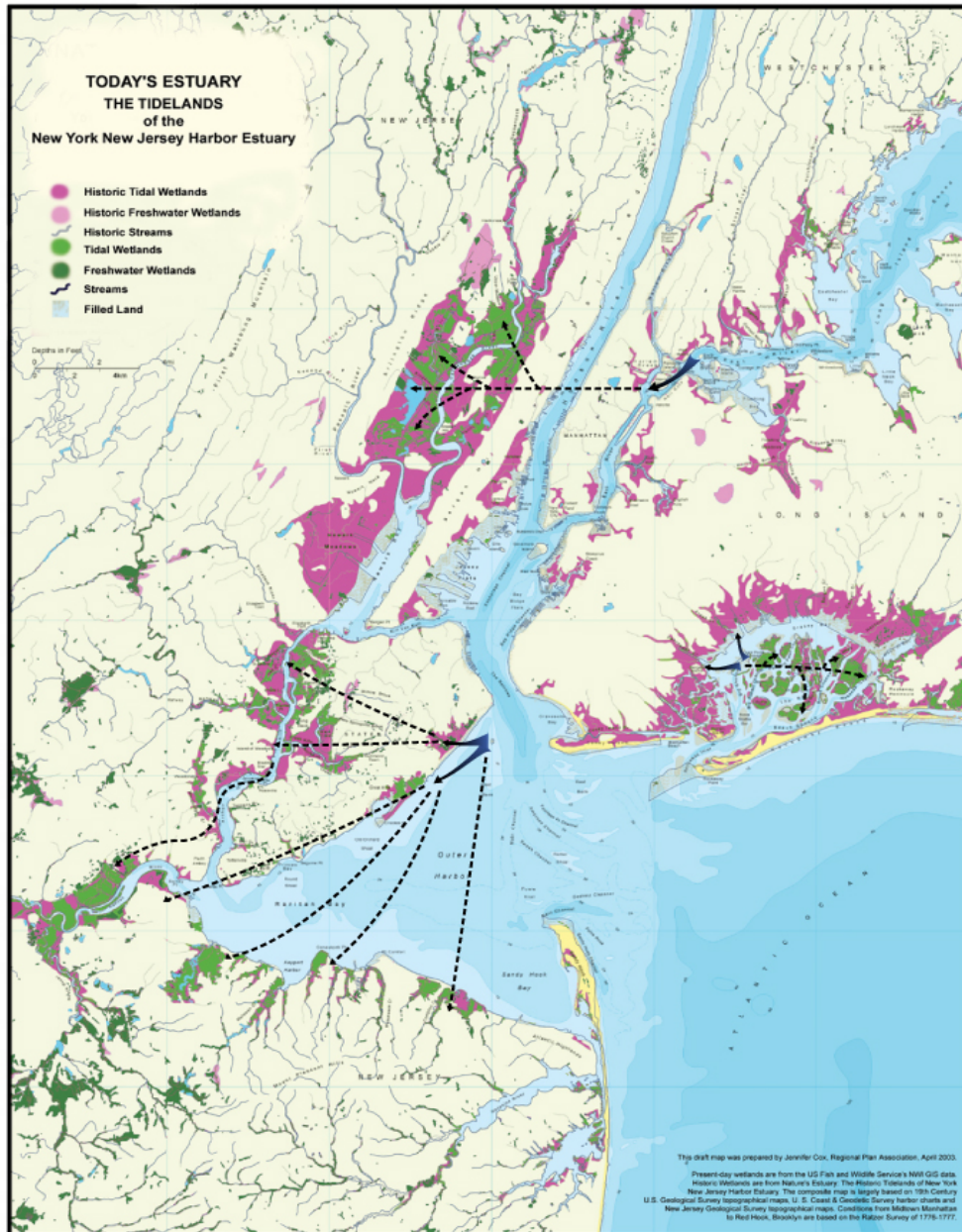


Image: http://www.rpa.org/projects/openspace/maps/draft_todaysestuary.jpg
Special thanks to Jeff Frezoco for drawing in the flight lines.

Flight lines are superimposed here on a map showing the current and historic wetlands of the New York Harbor region (current wetlands in green, historic – in purple). Solid lines represent the major flight lines observed during the course of the first and second year of Harbor Herons Shore Monitoring (summer of 2004 and 2003). Dashed lines represent *projected* flight lines. All

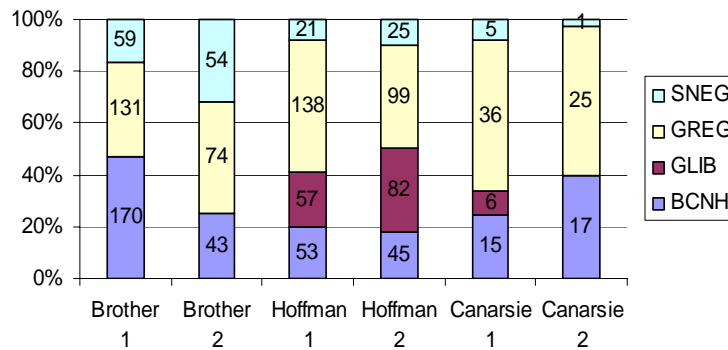
three major wading bird colonies in New York Harbor are represented in this map with Brother Islands at the top, Hoffman in the bottom left and Canarsie Pol in the bottom right.

Specifically for Brother Islands colony, data gathered during the 2003 Shore Monitoring Program showed birds flying over Mill Rock Island on an East West path, which is why the black line (which turns red) bends sharply at that point.

The map above seems to suggest that birds from each colony mostly forage in locations unique to their colony: Flight lines for Brothers colony show most birds flying south west and then west towards NJ Meadowlands (opposite directions on the return flight). Flight lines for Hoffman colony show most birds flying west and southwest towards Staten Island and surrounding areas. Flight lines for Canarsie Pol suggest that most birds fly east into Jamaica Bay.³ The data from the foraging grounds also suggests that birds from other colonies do not forage outside their unique areas, for instance, no ibis have been observed in the NJ Meadowlands, suggesting that ibis from Hoffman Island do not fly up to the foraging areas of Brother Islands (glossy ibis were breeding at Hoffman Island but not at Brother Islands during 2004).

5. Species Composition: Total and relative bird abundance at beginning (1) and midpoint (2) periods for each colony (based on the counts of birds flying in and out of the colony and not nesting counts).

Bird Counts, Mid June (1) and Mid July (2), and Relative Abundance, by Island



Glossy ibis were only present at the Hoffman and Canarsie Pol colonies. Excluding Canarsie Pol, this species significantly increased in numbers from Period 1 to Period 2, while all other species decreased in numbers or increased only slightly.

³ Anecdotal data as well as the following inference process were used to arrive at this conclusion: given that the numbers seen during monitoring (from the location to the West of the colony) were very small, it is very likely that most of the birds flew in the opposite direction, into the Bay.

Discussion:

The image of *flight lines and possible foraging areas* (p.14) – an image which summarizes the shore monitoring data gathered over the past two seasons as well as data from field trips and anecdotal information – reveals two important findings: First, it suggests that a large segment of the foraging grounds are located outside of the immediate area of New York Harbor. Second, this image suggests that each of the three island-colonies studied during the past season rely on separate foraging areas over the course of the breeding season. More research is necessary to confirm this conclusion, though, since the eastern flanks of all three colonies were not adequately monitored.

Regarding inter-colony differences in flight patterns:

As presented in the results section, Morning/Evening averages, In/Out flight averages, and flight directions at the colonies all point to significant differences in wading bird flight activity among Brother Islands and Hoffman colonies.

Why such differences should exist in wading bird flight activity among colonies located in the same harbor is not obvious. Some possible hypotheses are considered below:

1. Asynchronous breeding phases among colonies: It is possible that the breeding cycle started earlier on one colony compared with the other. The data doesn't seem to support this theory, though. First, the differences in In/Out flight patterns were noticed on both islands already in the first week when both were monitored (week 2). Second, the breeding season seemed to come to an end at about the same time at both colonies.
2. Differences in abiotic conditions at colonies: Since both colonies were monitored a day apart during the same time of day each week (during either morning or evening sessions), general abiotic conditions, such as cloud coverage, precipitation, wind speeds and wind directions, air temperature, and tide patterns, would have been somewhat similar for both colonies. However, as shown in the regression section, cloudiness was found to be a condition associated more with Brother Islands. Despite this, the data clearly suggests that differences identified earlier cannot be explained by this abiotic condition alone.
3. Tides were analyzed more in depth, with tide patterns at both colonies and possible foraging grounds examined. In both cases, tides were not found to be an important factor in explaining inter-colony differences.
4. The location of foraging areas is useful in explaining some of the differences among the colonies, mainly those relating to the relative dispersion of flight directions across species in each colony. The reason that Hoffman seems to have a relatively higher dispersion in flight directions is probably due to the fact that the foraging grounds associated with Hoffman are more dispersed relative to those of Brother Islands (image in section 4). However, the distance from these foraging grounds to each colony are roughly the same, and given the speed in which the birds fly, any differences in distance don't seem to be sufficient to explain the other differences among the colonies.

An additional hypothesis has to do with the colonies' species composition and geography, including the cormorant presence in these colonies:

Perhaps relatively crowded conditions on an island-colony cause more wading birds to stay off the island. Since the number of nesting pairs of cormorants on an island influence the degree of crowdedness, referred to here as overall bird-density, their numbers should also be included in any measure of crowdedness. One way to calculate an island-colony's overall bird-density is by dividing the island's total bird population (including cormorants) by the land area of that island. Such a method shows South Brother Island to be more crowded than Hoffman Island. In fact, South Brother Island appears to be twice as crowded, with 100 birds/acre, compared with Hoffman Island's 50 birds/acre (Kerlinger 2004, and author's calculation).⁴

How would differing degrees of bird crowdedness explain some of the differences in flight patterns observed in each colony? If relatively crowded conditions on South Brother Island forced wading birds such as great egrets and snowy egrets to remain off the Island in larger numbers compared to Hoffman Island, then it is likely that many of the wading birds would not return to the colony until later in the morning of the following day. This could explain, for instance, why morning In/Out flight averages at Brother Islands were about equal, while at Hoffman they were mostly outward-bound.

Conclusions:

During the 2004 breeding season three island-colonies were monitored: Brother Islands (North and South Brother), Hoffman, and Canarsie Pol. Using the observed flight lines, as well as field trips to the foraging areas and other sources of information, revealed a large portion of the foraging areas to be located outside New York Harbor, in areas such as the NJ Meadowlands. Furthermore, the flight lines suggest that each colony relied on separate foraging grounds throughout the breeding season. Finally, the data suggests the existence of inter-colony differences in the birds' flight patterns, perhaps the result of differences in the relative crowdedness in each colony.

Regarding flight lines, the research carried out during 2004 showed the following trends for each island-colony: Birds from Brother Islands were flying mostly in the direction of the NJ Meadowlands; Hoffman Island birds were flying in the direction of Staten Island and surrounding areas; and Canarsie Pol birds were flying mostly to Jamaica Bay. It is important to note that data relating to flight lines is incomplete since the colonies were not observed from all sides.

Regarding foraging grounds, the research carried out during 2004 showed that significant portions of the foraging grounds were located outside of New York Harbor, such as in NJ Meadowlands. This reinforces the notion that conservation should focus on the New York Harbor region as a whole rather than on breeding grounds or foraging grounds separately.

⁴ In Brother Islands, cormorants nested entirely on South Brother Island and numbered 350 nesting pairs. The 7-acre South Brother Island also included 381 nesting pairs of wading birds. At the 10-acre Hoffman colony, a much lower number of cormorants were nesting on the Island – only 35 pairs, with most of the cormorants nesting on the nearby island of Swinburne. Hoffman also included 500 nesting pairs of wading birds (Kerlinger 2004).

Regarding bird behavior, the data collected this season points to the existence of inter-colony differences among Hoffman and Brother Islands colonies with respect to the birds' flight patterns. A NYC Audubon researcher, Yigal Gelb, is in the process of writing a paper to be published in a peer reviewed journal titled: *Inter-Colony Differences in Wading Bird Flight Patterns in New York Harbor*.

Acknowledgements:

I am deeply grateful to all the wonderful volunteers who helped make this season a success: Donna Anderson, Catherine Barron, Andy Bernick, Kate Brash, Roberto Cavalieros, Elaine Chachkin, Gay Gelb, Yehuda Gelb, Peter Greenberg, Joan Haber, Robert Haber, Douglas Kopsco, Michelle Latimer, Regina McCarthy, Maria Olivera, Sandra Paci, Cecelia Rogers, Walter Sargeant, Layla Thomas, Revathy Uthaiyah, Bill Valentine, and Neil Walsh. Special thanks goes to Catherine Barron, Andy Bernick, Robert Haber, Peter Greenberg, Regina McCarthy, Sandra Paci, Bill Valentine, and Neil Walsh.

I would like to thank the NYC Environmental Fund for funding this Program as well as the Hudson River Foundation for administering the grant. I would like to thank Fuji Film for making their blimp available for this Program as well as Kim Tripp from Gateway National Recreation Area for making this possible.

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