

Monomoy Refuge Banding Station (MRBS) 2011-2014 - Final Report



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Executive Summary

Monomoy Refuge Banding Station (MRBS) was founded in 2011 as a migration monitoring study around the lighthouse on South Monomoy, Monomoy National Wildlife Refuge (NWR) in Chatham, Massachusetts. A trial season was undertaken in 2011 and following its success a plan for a standardized approach was developed and implemented in 2012. The primary goal of MRBS is to collect data that can contribute to the understanding of fall migrant bird use on Monomoy NWR across a wide variety of groups. MRBS also raises awareness of Monomoy NWR and Cape Cod's avian life, attracting visitors and increasing conservation activism.

Our program covered a twelve-week period from August 15 to early November (weather dependent). The number of species observed generally increased annually with corresponding to our effort, from 120 species in 2011 to 162 in 2012 plateauing at 182 in 2013 and ending with 174 in 2014, for a 4-year cumulative total of 229 species observed. Diversity of observations varied from 12 to 69 species observed daily, usually totaling around 40 species in August and September and 30 species in October and November. Over four years of operation, 7898 individuals of 107 species were banded. Individuals banded increased each year as banding effort increased, from 872 in 2011 to 1770 in 2012, to 2481 in 2013 up to 2775 in 2014. The top species banded in the fall are Yellow-rumped Warbler, Tree Swallow, Savannah Sparrow, Song Sparrow, Slate-colored Junco and Golden-crowned Kinglet Banding diversity increased from August to September, peaking late in the month and decreasing through October and into November. Banding abundance also increases from August into September and continues to increase into October, then begins to decline in early November.

Owl migration was monitored at MRBS in 2012-2014 in a limited capacity. 11 nights of effort (2 nights/12 net hours in 2014, 6 nights/62 hours in 2013 and 3 nights/25 hours in 2012) have only led to two captures on a single night (4-Nov 2012).

The summary provided in this report should serve as a jumping point to further explore the data. In only four years of operation, inter-annual patterns in the data collected regarding rare birds, weather, and diversity have emerged. In fact, the extreme environment of Monomoy provides an opportunity to study rare, unusual, and off-course migrants in sufficient numbers without the overwhelming static of common birds encountered at most banding stations. In just four years, MRBS captured more unusual, rare and vagrant species (Townsends Solitaire, Black-throated Gray Warbler, Lark Sparrow (4), Vesper Sparrow and 'Western'' Flycatcher, to name a few) than most banding stations will catch in 50 years. The station offered a unique opportunity to encounter enough vagrants to begin asking relevant questions about where and why they occur.

We have further questions regarding dispersal of common year-round residents and shortdistance migrants and their striking absence (Black-capped Chickadee, Tufted Titmouse and Blue Jay) or expected presence (Northern Cardinal, American Goldfinch and Red-breasted Nuthatch) at MRBS. Why do some of these abundant local breeders never appear at MRBS, while others do? What does this say about the differences in their dispersal behavior and the underlying pressures driving them? Songbirds breeding in sandy, salty and sunny habitats like Monomoy NWR experience extreme feather degradation. Have they evolved any response to this pressure (Peele et al. 2009) or other adaptations to the extreme climate (Aldrich 1984)? Finally, MRBS's remote coastal location is in fact near three banding stations on Cape Cod: Manomet Wellfleet Bay and Wing Island. The proximity of these stations, and stark differences in habitat and geography, allow us to compare weather and habitat effects on waves of migrants arriving on Cape Cod throughout the fall.

Introduction

This report summarizes the first three years of operation of Monomoy Bird Observatory (MBO). Established in 2011 and operated through 2014, MRBS is located in Chatham, Massachusetts, on South Monomoy Island on Monomoy National Wildlife Refuge. It is comprised of a number of ponds and marshy areas mixed with small stands of pines and surrounded and interspersed with typical dune habitat. This area represents the largest stands of trees and reedy marsh surrounding the only fresh water in eight miles, the rest of the islands being sand, dune, and salt water.

History

MRBS was established in August 2011 under the onus studying of passerine use of South Monomoy Island during fall migration through constant effort passerine banding. The idea was motivated by knowledge of the area and its known propensity for attracting rare birds and high potential of the area to act as a migration hotspot. In 2011, we banded on a total of eighteen days between August 18 and October 11. No organized census was completed, but the area was scouted for potential future survey locations.

In 2012, we banded from August 30 to November 4 and performed census at Powder Hole and Lighthouse Beach almost daily while on site. This was the first full season and was a big success both in terms of banding and census. In 2013, we had our second complete season operating from August 16 to November 10 and adding Big Station Pond to the census schedule, covering one of each three sites daily through the fall. 2014 was our final season, operating from Aug-15 to Oct-30 under the same protocol as 2013.

Objectives

The primary objective of MRBS is research contributing to the understanding of bird movements on Monomoy NWR. By monitoring both through mist netting and census, we are able to document the diverse groups of birds using the refuge. Additionally, MRBS is one of three banding stations on Cape Cod, but the only one located on a barrier island on the Atlantic. By comparing the captures between these stations and MRBS, we can better understand the use of costal dune vs. near coastal forest habitats by migrating songbirds.

Our secondary goal is to raise awareness of conservation and science of migrating birds on Monomoy NWR, Cape Cod and beyond. Both interns and volunteers at MRBS contribute valuable assistance while learning the specialized skills related to banding and surveying birds, gaining valuable work skills. By sharing our techniques and knowledge, we are expanding the diffusion of our results and contributions to the public. Visits to the station by birding groups have proven valuable for all parties, with banders benefiting from knowledge of local birders and the groups being exposed to valuable research, getting to see special birds up close and learning more about how migration works. Finally, through our website, display in the Refuge's visitors center and distribution of materials, we aim to increase the visibility of our research and the migrating birds on the refuge.

Personnel

There are several roles at MRBS, both daily in site and organizationally from afar (see Table 1). All these roles are critical to the effective running of the MRBS program.

The MRBS Director is a nonpaid position responsible for all the management duties associated with operation of the station. All reports, fundraising, acquisition, data management, external interaction, outreach and future undertakings are accomplished by or under the supervision of the Director.

The Banders-in-Charge (BIC) hold federal banding permits and manage day-to-day operation of the station, including supervising all banding. Additionally, they lead census, manage data on the island, organize passage to and from the island and take care of minor acquisitions during the season.

Assistant Banders are volunteers or paid a small stipend and bring banding experience to the station. They band birds, perform census and other tasks on island under the supervision of the BIC. They often commit to a portion of the season and a number of them provide skilled assistance throughout the season.

Volunteers arrive with little or no banding experience and learn throughout their time on Monomoy. They develop valuable banding and bird identification skills, while working hard to keep the station running smoothly. Always welcome and always helpful, volunteers are a keystone to the operation of MRBS.

	2011	2012	2013	2014
Director	James Junda	James Junda	James Junda	James Junda
Bander-In-	James Junda	Keegan Tranquillo	James Junda	James Junda
Charge				
Assistant	Michael Arnold	Aviad Tarab	Kevin Mortensen	Melanie Mancuso
Banders	Kate Rowe	Ayla Rimon	Michael Novak	Michael Novak
	Alex Chuman	Jesse Reese	Melanie Mancuso	Valerie Bourdeau
	Dana McCoskey			Catie Porro
Volunteers	Chris Junda	Karen Nassi	Claire Revekant	Kaitlin Pizzi
		Lacey Greene	Elizabeth Baldwin	Elizabeth Baldwin
			Valerie Bourdeau	

Table 1: Key personnel contributing to the operation of MRBS for 2011-2014.

Protocol

I. Dates of Operation

August 15 to November 15

II. Opening Procedures

Nets are opened 30 minutes before sunrise, starting with one team opening from F to D and a second team opening from C to A. These extremely early opening times are meant to target early-departing migrants and mitigate rising wind speeds as the morning progresses.

III. Mist Net Types

All nets were American (Avinet) or Japanese (purchased through Avinet) four-tiered 12 x 2.5m, 32mm, black polyester through 2013. In 2015 we had new 12X2.5m 32mm Polish made Ecotone nets.

IV. Weather Conditions

In general, nets are not operated under the following conditions:

- Temperatures over 75-80° in direct sun, as birds can become overheated or hyperthermic
- Temperatures below 40°F
- Steady rain heavier than a light mist/drizzle
- Sustained strong winds or intermittent gusty winds that repeatedly blow the nets into nearby brush or endanger birds caught in nets

V. Net Checks

Nets are checked every 40 minutes, unless conditions warrant more frequent net checks. Nets are checked in the order in which they were opened.

VI. Net Extractions

Extractions are only performed by trained personnel with the utmost care, using techniques approved by the North American Banding Council (Council. 2001).

VII. Bags and Clips

Once extracted, birds are placed in small or medium cloth bags. The net number and orientation of the capture (i.e. the direction from which it hit the net) are noted.

VIII. At the Banding Station

Banders apply bands, take all measurements and fully process each capture in the order they were extracted. After processing, birds are released from the banding site. The condition of all the birds is carefully monitored, with appropriate steps ranging from reduction in data collected to the release of all the birds unbanded if necessary to ensure their safety.

IX. Data Sheets

A. Individual capture data:

- Bander's initials
- Code
- Band number
- Species
- Species alpha code
- Age
- How aged
- Sex
- How sexed
- Fat score

- Breast muscle score
- Skull score
- Wing chord
- Mass
- Date
- Net run time
- Net number
- Status
- Disposition
- Note

B. Daily Journal:

- Number of nets
- Time opened
- Time closed
- Temperature at open, mid-morning, and closing time
- Cloud cover at opening, mid-morning, and closing time
- Wind strength (in mph) and direction at opening, mid-morning, and closing time
- Wind strength and direction over previous night
- Personnel and/or visitors present

C. Daily Estimated Totals:

- Date
- Number banded by species
- Number observed during Census
- Number observed during General Observations
- Daily Estimated Total
- Census conditions
 - 1. Location
 - 2. Personnel
 - 3. Start Time
 - 4. End Time

- 5. Cloud
- 6. Perspiration
- 7. Wind (speed/direction)
- 8. Tide

9. Disturbance	11. Wave
10. Visibility	12. Note

X. Closing the Station

1) Nets are closed, in the order opened, six hours after opening or under the adverse conditions described above.

2) Closed nets are furled, secured and left on poles at net lanes (nets are taken down when leaving the island).

3) All captured birds are returned to the banding station and processed normally.

4) Daily Journal and Daily Estimated Totals are filled out and equipment stored.

5) Oral affirmation for each net closed is completed by responsible personnel.

XI. Census

One or more observers conducted a standardized check of one of three key migrant locations daily when on site: Powder Hole (41.555 N, 70.008 W), Lighthouse Beach (41.560 N, 69.990 W) and Big Station Pond (41.5503 N, 70.008 W).

The census schedule is split into two portions, Early Season (peak shorebird migration) and Late Season (peak seabird migration). During the Early Season (August 15 – September 30), Powder Hole is surveyed every other day and Lighthouse Beach every fourth day. During the Late Season (October 18- November 10), Lighthouse Beach is surveyed every other day and Powder Hole every fourth day. Big Station is surveyed every fourth day throughout both periods.

Early Season	Late Season
Powder Hole	Lighthouse Beach
Big Station	Powder Hole
Powder Hole	Lighthouse Beach
Lighthouse Beach	Big Station
Powder Hole	Lighthouse Beach
Big Station	Powder Hole
Powder Hole	Lighthouse Beach
Lighthouse Beach	Big Station

Observers stand in a predetermined and consistent location at each site and, using an Alpen 20-60x80 Angled Spotting Scope and personal binoculars supplied by each participant, count every bird within the census location boundaries.

Census Location Descriptions

Powder Hole - Any bird identifiable to species (by sight or sound) on the water, land or air from tip of small peninsula on south shore between the two pools.

Lighthouse Beach - Any bird identifiable to species (by sight or sound) on the water, land or air from the seaward edge of the largest dune overlooking the beach along the trail from the Monomoy Lighthouse, **BUT NO FURTHER** then bay formed by the curving beach 1000m to the North, the outer edge of the rough water formed by the shoal approximately 1000m offshore.

Big Station - Any bird identifiable to species (by sight or sound) on the water, land or air from small hill next to the two bird boxes directly east of Big Station/Little Station Pond Intersection.

XII. Daily Estimated Totals

At the end of each day, after the completion of banding and census and the end of the observable light, the totals for each species is added up on the DET sheet. Any birds observed by personnel outside of census and banding are added to the list and the total number of individuals on site is estimated.

Results

Songbird Banding

Banding results from 2011 to 2014 are summarized in Table 2. There is a large variation in diversity, with richness increasing each year as effort increased. Species captured went from 70 (2011), 79 (2012), 86 (2013) to 92 in 2014. Abundance increased from 934 captures in 2011 to 1787 in 2012, to 2999 in 2013 and finally 3323 in 2014. The number of species captured per 100 net hour has varied by over 20% from year to year with 2011 (107.47) being the highest, 2012 (81.79) the lowest and 2013 (98.19) and 2014 (89.66) in the middle.

Diversity was high at the station across all four seasons: we captured an average of 13.4 species per banding day in 2011, 12.9 in 2012, 15.1 in 2013 and 11.6 in 2014. The general pattern across the four seasons is for songbird diversity to peak several times through the fall: ~24-Sep, 10-Oct and 24-Oct (Figure 1). Abundance seems to have two peaks each fall around the 9th and 27th of October (Figure 2). Repeats have remained constant with effort from season to season after 2011, when an irregular banding schedule allowed captures to leave the island before being recaptured. Returns have remained constant from year to year and are limited to local breeders. Overall, the number of returns remains low, reflecting the low density of passerines breeding on site and a complete lack of migratory returns.

	2011	2012	2013	2014	Total
Captured (species)	934(70)	1787(79)	2999 (86)	3323(92)	9034(101)
Repeats (species)	62(23)	267(38)	417(32)	484(45)	1230(66)
Returns (species)	0(0)	12(4)	16(5)	13(5)	28(5)
Species observed	120	162	182	174	229
Net hours	930.45	2557.88	3087.02	3709.99	10285.34
Days banding	18	36	49	55	158
Days census	0	33	58	56	147
Captures/100 net hours	107.47	81.79	98.19	89.66	87.92

Table 2. Summary of MRBS banding and observation results 2011-2014.

Through each fall season, the top two species banded has remained constant: Yellow-rumped Warbler (2411 banded) and Tree Swallow (1126). The other species in the yearly top ten are Savannah Sparrow (387), Common Yellowthroat (526), Golden-crowned Kinglet (265), and Song Sparrow (254).



Figure 1. Species richness at MRBS from 2011-2014. Diversity increases from August into late September (the high point for abundance in the fall), stays high until late October then decreases through mid-November.

The **2011** MRBS season was a pilot season, largely consistent with the permanent protocol used in later years, but with less coverage: 18 days banded, no census and a bit of experimentation with net location early in the season. The peak of banding migration diversity was October 9 with 24 species banded and October 10 and 11 with 21 species each. The peak of abundance overlapped with this period, with 123, 154 and 105 individuals banded on October 9 through 11 respectively. An interesting addition to the top ten in 2011 was American Robin with 34 captures, more captures then either 2012 or 2013, even though the effort in 2011 was 50% of 2012 and 30% or 2013.

The **2012** season was meant to be a complete season (August 15 to November 15), but the start was delayed until August 30. Banding took place on 36 days and Census on 33 days at two sites (Powder Hole and Lighthouse Beach) through November 4. The peak of banding diversity was September 16 with 28 species banded (Figure 1), and richness remained high throughout the season with 18 species banded on nine occasions. The peak of abundance was October 10 with 168 individuals banded (Figure 2), overlapping with the busiest day in 2011. 2012 was an irruptive year for pine-nut specialists, with huge captures of Red-breasted Nuthatch (162), Pine Siskin (49) and White-winged Crossbill (6). The combined total for those three species in 2011 and 2013 was two individuals (both Red-breasted Nuthatches).

The **2013** season was the first where we attempted to cover the entire target period from August 15 until the weather failed on November 8. Banding was conducted on 49 days and census on 58 at three locations: Powder Hole, Lighthouse Beach and Big Station Pond. Even with the suspension of operation for 20 days, from September 29 to October 19, due to a government shutdown, 2013 represented the most complete fall of operation at MRBS. The peak of banding diversity was 28-Sep with a station record of 30 species captured. The mean species captured per day was 15.1, the highest average diversity of any season at MRBS. The peak of banding abundance was October 21 with 179 individuals banded and October 29 with 174. 2013 was a big year for Flycatchers, with each of the nine species breeding widely in Eastern North America (totaling 42 individuals) banded in 2013.

The **2014** season was the final and most complete season stretching from August 15 to October 30 with no significant gap and following census protocols established in 2013. Banding was conducted on 55 days and census on 55 at three locations: Powder Hole, Lighthouse Beach and Big Station Pond. The two most diverse banding days in MRBS history were in 2015: 23-Sep with 32 species captured and 10-Oct with a record 33 species. Even with these two incredibly diverse days, the mean species captured per day was only 11.6, the lowest average diversity of any season at MRBS. The peak of banding abundance was late October, when we experienced the three busiest days in MRBS history: 222 individuals captured on 21-Oct, 210 on Oct-25 and 302 on Oct-29. 2014 was a year of boom or bust for common species with Palm Warblers, Gray Catbirds and Common Yellowthroats each doubling capture totals for all previous seasons combined! Meanwhile Savannah Sparrows had a down year, with only 50% of the capture rates encountered in previous seasons



Figure 2. Number of Birds Banded at MRBS from 2011-2014. Capture rates are steady until mid-September when they drop (corresponding with the peak of diversity) till late September. Rates then rise until they peak in late-October and decline into November.

Owl Banding

Initial testing of the viability of Saw-whet Owl banding was undertaken on three nights in 2012. We used a boom box operated on 8 C-batteries and a digital playback from a flash drive. The playback was a series of Saw-whet Owl calls obtained from Cornell Birds Online and played on repeat from net opening to closing. Two or three Owl Nets (O1,2,3), 9 x 1.5m, 40mm mesh manufactured in Taiwan, were operated after dusk for the times illustrated in Table 3. The capture of two Saw-whet Owls in only three nights and a mere 25 net hours was an encouraging sign in 2012.

Saw-whet Owl banding was continued on six nights in 2013. We used the same boom box as in 2012 running off a portable battery source using the same digital playback from a flash drive. The four "C-nets" used for passerine banding were also used as the Owl Nets (O1-4). These 12x4m, 30mm mesh mist nets were operated after dusk for the times illustrated in Table 6.

Table 3. Operati	ng Times of	f Owl Nets	at MRBS 2012
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Date	Open	Close	Hours	Captures
2-Nov	1830	2130	9.0	0
3-Nov	1800	2100	6.0	0
4-Nov	1700	2200	10	2

Table 4. Operating Times of Owl Nets at MRBS 2013

Date	Open	Close	Hours	Captures
29-Oct	1830	2030	8.0	0
30-Oct	1850	2050	8.0	0
4-Nov	1710	2010	12.0	0
5-Nov	1710	2010	12.0	0
6-Nov	1720	1950	10.0	0
9-Nov	1710	2010	12.0	0

Saw-whet Owl banding was undertaken on only two nights October 24 and 25 in 2014. Equipment and protocol was consistent with that used in 2013.

The capture of two Saw-whet Owls in only three nights and 25 net hours in 2012 was an encouraging beginning. However, a complete lack of captures in 2013 and 2014, even with a more extensive effort (in 2013), limit the value of this undertaking.

Having not captured a single Saw-whet Owl since those two captures on a single night in

Table 5. Operating Times of Owl Nets at MRBS 2014

Date	Open	Close	Hours	Captures
24-Oct	1900	2030	6.0	0
25-Oct	1910	2040	6.0	0

2012, we have begun to doubt the presence of this species in significant numbers on South Monomoy. Of course, this lack of captures could be an artifact of the almost constant winds decreasing the ability of owls migrating overhead to hear the playback and descend to the habitat to be captured.

Census

The schedule for conducting census on site has evolved from 2011 to 2014. In 2011, there was no organized census. In 2012, Lighthouse Beach and Powder Hole were surveyed each day. It was not until 2013 that Big Station Pond was added and that the schedule was adjusted so only one of the three locations was surveyed daily. Lastly, an Early Season/Late Season schedule was developed to maximize effort at the busiest locations as the season progress and different groups of birds arrive and leave. The schedule developed in 2013 was repeated in 2014, the data for all seasons is provided year by year below.

2011

While no formal census or focused observations were recorded, many species not present in the banding data were noted on the site. Some of the more interesting species include: Peregrine Falcon (4), Merlin (1), Great-horned Owl (1), Whimbrel (15), and Piping Plover (6). As a result of this and formal scouting of Powder Hole and Lighthouse Beach, a determination was made to conduct a more formal census at these locations in 2012.

2012

Census was conducted at Powder Hole on 33 days and at Lighthouse Beach on 30 days. Most days, many of the species recorded on census were not recorded during banding operations, highlighting its value. 87 species were documented, 16 of which were exclusive to census: Northern Gannet, Red Knot, Western Sandpiper, Dunlin, Stilt Sandpiper, Short-billed Dowitcher, Lesser Black-backed Gull, Roseate Tern, Black Tern, Pied-billed Grebe, American Widgeon, Northern Shoveler, Northern Pintail, Surf Scoter, Black Scoter, and Black-bellied Plover.

Powder Hole

Six of the ten most common species observed at Powder Hole are shorebirds, with Black-bellied Plovers and Semipalmated Plovers present in the dozens almost every day. Canada Geese and American Black Ducks were predictable in the brackish pond and other shorebirds were present in lower numbers during most surveys. There was a lot of seasonality with early species (Common Tern, Lesser Yellowlegs) and late species (Dunlin, American Black Duck) as well as a few species present the throughout the season as illustrated in Table 6.

Spacias			Mean			Last
	Species		Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Black-bellied Plover	66.36	84.14	41.47	29-Aug	24-Oct
2.	Semipalmated Plover	36.53	60.29	3.27	29-Aug	24-Oct
3.	Common Tern	25.25	43.29	0.00	29-Aug	14-Sep
4.	Semipalmated Sandpiper	9.75	16.00	1.00	29-Aug	19-Oct
5.	Canada Goose	5.78	8.81	1.53	1-Sep	3-Nov
6.	American Black Duck	4.14	1.10	8.40	30-Aug	3-Nov
7.	Least Sandpiper	3.83	6.29	0.40	31-Aug	6-Oct
8.	Dunlin	3.61	1.24	6.93	2-Sep	24-Oct
9.	Snowy Egret	2.97	5.10	0.00	29-Aug	27-Sep
10.	Lesser Yellowlegs	2.89	4.90	0.07	29-Aug	19-Oct

Table 6. The 10 most common species encountered at Powder Hole in 2012, including the mean encounters by month and first and last encounter dates.

During August and September the same group of ~200 Common Eiders was present each day. In October and November, these numbers swelled to 1000s of Common Eiders and mixed scoters (White-winged, Surf and Black) present every day. Herring and Greater Black-backed Gull numbers decreased in October while Lesser Black-backed Gull numbers increased. Double-crested Cormorants peaked in early in the season while Northern Gannets peaked in later in fall. Table 7 illustrates the seasonal change between summer residents and migrant birds.

	Species	Daily	Mean Aug-Sep	Oct-Nov	First Encounter	Last Encounter
1.	Common Eider	3085.6	163.95	7176.00	29-Aug	4-Nov
2.	White-wing Scoter	246.11	6.14	1804.67	22-Oct	4-Nov
3.	Surf Scoter	244.44	0.00	590.67	5-Oct	4-Nov
4.	Greater Bl-backed Gull	137.58	172.67	78.87	29-Aug	4-Nov
5.	Black Scoter	133.58	0.00	586.67	26-Oct	4-Nov
6.	Herring Gull	106.36	130.57	72.47	29-Aug	4-Nov
7.	Dbl-crested Cormorant	52.97	88.14	3.73	29-Aug	2-Nov
8.	Lesser Black- backed Gull	6.14	1.43	12.73	6-Sep	24-Oct
9.	Sanderling	6.11	8.43	2.87	29-Aug	24-Oct
10.	Northern Gannet	3.97	0.57	8.73	3-Sep	1-Nov

Table 7. The ten most common species encountered at Lighthouse Beach in 2012. Including the mean encounters by month and first and last encounter dates.

2013 and 2014

This season, Big Station Pond was added to the census schedule to ensure that waterfowl migration was documented. Additionally, the Lighthouse Beach census was limited to all birds within 1000m of the observation site. The census schedule was split into two portions, chosen to maximize efforts at key areas during various peaks of migration, Early Season (peak shorebird migration) and Late Season (peak seabird/seaduck migration). During the Early Season (August 15 – September 30), Powder Hole was surveyed every other day and Lighthouse Beach every fourth day. During the Late Season (October 18- November 10), Lighthouse Beach was surveyed every other day and Powder Hole every fourth day. Big Station was survey every fourth day throughout both periods. In 2013, census was conducted at Powder Hole on 23 days, Lighthouse Beach on 20 days, and Big Station Pond on 15 days. Each census site contained many migratory birds not represented by banding data or general observations. In 2014, census was conducted at Powder hole on 19 days, Lighthouse Beach on 21 and Big Station Pond on 16.

2013

Powder Hole: a total of 58 species were observed during census in Fall 2013. We observed an average of 20 species per day (22 per day in Aug/Sep and 11 per day in Oct/Nov). The highest species richness day was 13-Sep with 28 species, the low day 2-Nov with nine species. The most common species was Common Tern (see table 8), which was present in large numbers during early surveys and completely absent from later surveys. Greater Black-backed Gulls, Herring Gulls and Double-crested Cormorants were present in good numbers throughout the season. The rest of the top ten are all shorebirds, by far the most dominant group at Powder Hole. Shorebirds also reflect the majority of the high diversity early in the season and the lack of diversity late in the season once the majority departs. Among shorebirds, only Dunlins increase as the season progresses. Species only observed at Powder Hole this fall include: Willet, Hudsonian Godwit, Parasitic Jaeger, Red-breasted Merganser, Artic Tern, and Sandwich Tern.

Species		Mean			First	Last
	Species	Daily	Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Common Tern	103.9	132.7	0.0	15-Aug	26-Sep
2.	Greater Black backed Gull	97.7	102.4	80.4	15-Aug	8-Nov
3.	Black-bellied Plover	73.6	87.2	24.4	15-Aug	8-Nov
4.	Herring Gull	70.2	88.3	5.2	15-Aug	8-Nov
5.	Semipalmated Plover	66.1	83.9	2.0	15-Aug	3-Nov
6.	Tree Swallow	32.8	41.9	0.0	25-Aug	24-Sep
7.	Semipalmated Sandpiper	31.9	38.9	6.4	15-Aug	3-Nov
8.	Double Crested Cormorant	26.6	29.0	18.0	15-Aug	8-Nov
9.	Dunlin	13.3	1.8	55.0	15-Sep	8-Nov
10.	Sanderling	13.2	14.9	6.8	15-Aug	8-Nov

Table 8. The 10 most common species encountered at Powder Hole in 2013, including the mean encounters in "Early" and "Late" season as well as the first and last encounter dates.

Lighthouse Beach: a total of 32 species were observed at Lighthouse Beach in 2013, with a mean of 10 species per day (8 per day in Aug/Sep and 11 per day in Oct/Nov). The most common species at Lighthouse Beach was Common Eider (see Table 9), which was present in increasingly large numbers later in the season. Greater Black-backed Gulls, Herring Gulls and Double-crested Cormorants were present on almost all days as well. Seaducks, Northern Gannets, and Common Terns round out the top ten with seaduck and gannet numbers greatly increasing towards the end of the season, while terns were gone by October An increase in diversity at Lighthouse Beach occurs in October as more seaducks and pelagic waterbirds arrive. Species unique to Lighthouse Beach in 2013 include Red-throated Loon, Common Murre, Northern Gannet, Red-necked Grebe, Long-tailed Duck, and Harlequin Duck.

Spagios		Mean			First	Last
	Species	Daily	Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Common Eider	178.5	8.1	317.8	20-Aug	10-Nov
2.	Tree Swallow	104.9	228.6	3.6	16-Aug	8-Nov
3.	Greater Black-backed Gull	99.4	135.7	69.7	16-Aug	10-Nov
4.	Herring Gull	43.3	68.1	23.0	20-Aug	10-Nov
5.	White-winged Scoter	35.3	5.7	59.5	24-Aug	10-Nov
6.	Common Tern	27.1	60.1	0.0	16-Aug	18-Sep
7.	Double-crested Cormorant	21.8	7.0	33.9	16-Aug	10-Nov
8.	Northern Gannet	18.6	0.2	33.6	6-Sep	10-Nov
9.	Black Scoter	13.0	0.0	23.5	20-Sep	10-Nov
10.	Surf Scoter	9.6	0.6	16.9	18-Sep	10-Nov

Table 9. The 10 most common species encountered at Lighthouse Beach in 2013, including the mean encounters in "Early" and "Late" season as well as the first and last encounter dates.

Big Station Pond: a total of 48 species were observed in 2013. A mean of 19 species per day were observed for the fall (19 per day for Aug/Sep and 21 per day in Oct/Nov). The most common species at Big Station was Tree Swallow, with tens and hundreds feeding over the reeds most days. Black-backed Gull, Herring Gull and Double-crested Cormorants were present throughout. Every other species in the top 15 are all waterfowl, with the list composed of early and late migrants (Table 10).

Species			Mean	First	Last	
	Species	Daily	Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Tree Swallow	90.3	150.0	0.83	18-Aug	11-Nov
2.	Gadwall	80.0	84.9	72.67	18-Aug	11-Nov
3.	Herring Gull	78.8	121.0	15.50	18-Aug	11-Nov
4.	Mallard	74.6	107.4	25.33	18-Aug	11-Nov
5.	Greater Black-backed Gull	70.9	72.1	69.17	18-Aug	11-Nov
6.	Ring-necked Duck	63.4	0.9	157.17	27-Sep	11-Nov
7.	Canada Goose	40.7	63.1	7.00	18-Aug	4-Nov
8.	American Black Duck	34.9	44.3	20.67	18-Aug	11-Nov
9.	Green-winged Teal	20.1	6.6	40.50	18-Aug	4-Nov
10.	Bufflehead	15.9	0.0	39.83	25-Oct	11-Nov
11.	Northern Pintail	15.5	3.6	33.3	18-Aug	11-Nov
12.	Northern Shoveler	12.5	4.0	25.3	26-Aug	11-Nov
13.	American Widgeon	11.7	2.8	25.2	18-Aug	8-Nov
14.	Blue-winged Teal	11.7	19.4	0.0	18-Aug	27-Sep
15.	Double-crested Cormorant	10.7	11.0	10.3	18-Aug	11-Nov

Table 10. The 15 most common species encountered at Big Station Pond in 2013, including the mean encounters in "Early" and "Late" periods as well as the first and last encounter dates.

Powder Hole: a total of 50 species were observed during Powder Hole census in Fall 2014. We observed an average of 17 species per day (Fig. 9); 23 per day until 6-Sep and 11 per day until end of Sep. The highest species richness day was 20-Aug with 35 species, the low day 22-Sep with nine species. The most common species was Common Tern (Table 11), while present in large numbers during early surveys and declined into September. Shorebirds and terns, by far the most dominant groups at Powder Hole, dominate the remainder of the top 15. Shorebirds also reflect the majority of the high diversity early in the season and the lack of diversity late in the season once the majority departs (Figure 3). The blockage of tidal flow into Powder Hole led to an early departure of species from this area. Species only observed at Powder Hole this fall include: Marbled Godwit, Hudsonian Godwit, Red Knot, Black Skimmer and Arctic Tern.

	Species		Mean			Last
	Species	Daily	Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Common Tern	333	596	40	16-Aug	12-Sep
2.	Greater Black-backed Gull	261	288	231	16-Aug	26-Sep
3.	Herring Gull	83	75	93	18-Aug	26-Sep
4.	Black-bellied Plover	76	89	61	16-Aug	11-Nov
5.	Semipalmated Plover	73	104	39	16-Aug	24-Sep
6.	Double-crested Cormorant	23	20	26	18-Sep	24-Sep
7.	Semipalmated Sandpiper	17	14	21	16-Aug	26-Sep
8.	Laughing Gull	15	29	1	16-Aug	22-Sep
9.	Lesser Yellowlegs	9	14	3	16-Aug	24-Sep
10.	Sanderling	9	10	8	16-Oct	24-Sep
11.	Snowy Egret	8	15	0	18-Aug	4-Sep
12.	Short-billed Dowitcher	7	10	4	16-Aug	26-Sep
13.	Roseate Tern	6	12	0	16-Aug	6-Sep
14.	Least Tern	6	11	0	16-Aug	4-Sep
15.	Piping Plover	5	8	0	16-Aug	12-Sep

Table 11. The 15 most common species encountered at Powder Hole, including the mean encounters in periods before and after sand began to close entrance, slowing tidal flow. This also corresponded with seasonal departures.



Figure 3. Species richness at Powder Hole in 2014. Richness at Powder Hole decreased in early September when sand began to block the entrance; in early October surveys were abandoned when the entrance was entirely blocked by sand ending tidal flow.

Lighthouse Beach: a total of 28 species were observed at Lighthouse Beach in 2014, with a mean of 7 species per day (Fig. 10); 6 per day in Aug/Sep and 8 per day in Oct. The most common species at Lighthouse Beach was Common Eider (Table 12), which along with the three scoter species were present in increasingly large numbers later in the season. Gulls were present most days throughout fall. Double-crested Cormorants, Northern Gannets, and Common Terns round out the top ten with cormorant and gannet numbers greatly increasing towards the end of the season, while the terns had departed by October. An increase in diversity at Lighthouse Beach (Figure 4) occurs in October as thousands of seaducks and pelagic waterbirds arrive. Species unique to Lighthouse Beach in 2014 include: Wilson's Storm-petrel, Great Cormorant, and Northern Gannet. Table 6 illustrates the annual variation in seaducks; 2012 and 2014 with high numbers and 2012 with lower numbers (Table 7). What is driving this annual variation?

	Spaaias		Mean	First	Last	
	Species	Daily	Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Common Eider	3414	7	7578	25-Aug	28-Oct
2.	White-wing Scoter	995	53	2145	6-Oct	28-Oct
3.	Black Scoter	874	0	1943	4-Oct	28-Oct
4.	Surf Scoter	601	0	1336	9-Sep	28-Oct
5.	Herring Gull	86	139	23	25-Aug	28-Oct
6.	Greater Black-backed Gull	78	122	24	17-Aug	28-Oct
7.	Common Tern	14	26	0	17-Aug	15-Sep
8.	Double-crested Cormorant	10	2	20	17-Aug	10-Nov
9.	Laughing Gull	3	6	0	17-Aug	19-Sep
10.	Northern Gannet	3	0	7	25-Oct	28-Oct

Table 12. The 10 most abundant species encountered at Lighthouse Beach in 2014, including the mean encounters in "Early" and "Late" season as well as the first and last encounter dates.



Figure 4. Species richness at Lighthouse Beach in 2014. Richness increases as the season progresses and seaducks and seabirds arrive in greater number and diversity.

	Species	2012	2013	2014
Table 13 Annual variation in October	Common Eider	7176	317	7578
seaduck numbers during Lighthouse Beach	White-wing	1804	59	2145
surveys in 2012 2014	Black Scoter	586	23	1943
surveys in 2012-2014.	Surf Scoter	2012 7176 1804 586 590	16	1336

Big Station Pond: a total of 44 species were observed in 2014. A mean of 14 species per day were observed for the fall (down from 19 spp per day in 2014). Diversity was consistent (Fig. 5) throughout the fall with 13 species per day for Aug/Sep and 15 per day in Oct. Black-backed Gull, Herring Gull and Double-crested Cormorants were present throughout, though numbers varied as fall progressed (Table 14). The remainder of the top 15 is filled mainly with waterfowl, with the list divided among early and late migrants. High water levels in all the freshwater bodies on South Monomoy in late fall negatively impacted marsh duck numbers in 2014, as these bird found reduced foraging potential. Species only observed at Big Station include: American Bittern, Common Goldeneye, Lesser Scaup and Horned Grebe.

	Spacios		Mean			Last
	Species	Daily	Aug-Sep	Oct-Nov	Encounter	Encounter
1.	Double-crested Cormorant	106	52	196	19-Aug	29-Oct
2.	Greater Black-backed Gull	83	110	37	19-Aug	29-Oct
3.	Mallard	21	24	16	19-Aug	29-Oct
4.	Herring Gull	19	15	25	19-Aug	29-Oct
5.	American Black Duck	16	14	20	19-Aug	26-Oct
6.	Green-winged Teal	16	0	43	25-Sep	15-Oct
7.	Canada Goose	14	18	8	19-Aug	29-Oct
8.	Northern Pintail	8	9	7	3-Sep	26-Oct
9.	Gadwall	8	5	12	18-Aug	24-Oct
10.	Ring-necked Duck	7	0	19	10-Oct	15-Oct
11.	Northern Shoveler	6	7	5	7-Sep	26-Oct
12.	American Widgeon	4	0	12	5-Oct	24-Oct
13.	Common Tern	4	7	0	19-Aug	23-Aug
14.	Blue-winged Teal	4	2	8	19-Aug	27-Sep
15.	American Coot	4	0	10	10-Oct	29-Oct

Table 14. The 15 most common species encountered at Big Station Pond in 2014, including the mean encounters in "Early" and "Late" periods as well as the first and last encounter dates.



Figure 5. Species richness at Big Station Pond in 2014. Richness increases as the season progresses as marsh ducks arrive in greater numbers and diversity.

Table 15. Species Encountered at MRBS 2011-2014

	Species	2011	2012	2013	2014
1.	Red-throated Loon	А	А	0	0
2.	Common Loon	0	0	0	0
3.	Pied-billed Grebe	А	0	0	0
4.	Horned Grebe	А	А	0	0
5.	Red-necked Grebe	А	А	0	А
6.	Cory's Shearwater	А	0	А	А
7.	Wilson's Storm-petrel	А	А	А	0
8.	Northern Gannet	А	0	0	0
9.	Double-crested	0	0	0	0
10.	Great Cormorant	А	А	А	0
11.	American Bittern	А	0	0	0
12.	Great Blue Heron	0	0	0	0
13.	Great Egret	А	0	0	0
14.	Snowy Egret	0	0	0	0
15.	Green Heron	А	0	А	А
16.	Black-crowned Night	0	0	0	А
17.	Glossy Ibis	А	А	0	А
18.	Turkey Vulture	А	0	А	А
19.	Canada Goose	0	0	0	0
20.	Greater White-fronted	А	А	0	А
21.	Brant	А	0	А	0
22.	Mute Swan	0	0	0	0
23.	Tundra Swan	А	А	0	А
24.	Gadwall	0	0	0	0
25.	American Widgeon	А	0	0	0
26.	American Black Duck	0	0	0	0
27.	Mallard	0	0	0	0
28.	Green-winged Teal	А	0	0	0
29.	Blue-winged Teal	0	0	0	0
30.	Northern Shoveler	А	0	0	0
31.	Northern Pintail	0	0	0	0
32.	Ring-necked Duck	А	А	0	0
33.	Greater Scaup	А	А	0	А
34.	Lesser Scaup	А	А	А	0
35.	Common Eider	Ο	0	0	0
36.	Surf Scoter	Ο	Ο	0	0

Each species is designated as: (A) Absent, (B) Banded, (O) Observed.

	Species	2011	2012	2013	2014
37.	White-wing Scoter	А	0	0	0
38.	Black Scoter	0	0	0	0
39.	Long-tailed Duck	А	А	0	А
40.	Harlequin Duck	А	А	0	А
41.	Bufflehead	А	0	0	0
42.	Common Merganser	А	Ο	0	0
43.	Red-breasted	А	А	0	0
44.	Ruddy Duck	А	А	0	А
45.	Wood Duck	А	0	0	А
46.	Common Goldeneye	А	А	А	0
47.	Osprey	А	0	0	0
48.	Bald Eagle	А	0	0	А
49.	Northern Harrier	0	0	0	0
50.	Sharp-shinned Hawk	0	А	0	0
51.	Cooper's Hawk	А	0	А	0
52.	Red-shouldered Hawk	А	0	А	А
53.	Broad-winged Hawk	А	0	А	А
54.	Red-tailed Hawk	А	0	0	А
55.	American Kestrel	А	0	0	0
56.	Merlin	0	0	0	0
57.	Peregrine Falcon	А	0	0	0
58.	Sora	А	А	0	0
59.	Virginia Rail	А	А	А	0
60.	American Coot	А	А	0	0
61.	Black-bellied Plover	0	0	0	0
62.	American Golden	А	А	0	А
63.	Semipalmated Plover	А	0	0	0
64.	Piping Plover	0	0	0	0
65.	Killdeer	0	0	0	0
66.	Black-necked Stilt	0	0	А	0
67.	American	0	0	0	А
68.	Greater Yellowlegs	А	0	0	0
69.	Lesser Yellowlegs	0	0	0	0
70.	Solitary Sandpiper	А	А	А	0
71.	Willet	А	0	0	0
72.	Spotted Sandpiper	А	А	0	0
73.	Upland Sandpiper	А	А	0	А
74.	Whimbrel	Ο	0	0	0
75.	Hudsonian Godwit	А	А	0	0

Species	2011	2012	2013	2014
76. Marbled Godwit	А	А	А	0
77. Ruddy Turnstone	0	0	0	0
78. Red Knot	0	0	0	0
79. Sanderling	0	0	0	0
80. Semipalmated	0	0	0	0
81. Western Sandpiper	А	0	0	0
82. Least Sandpiper	0	0	0	0
83. White-rumped	0	0	0	0
84. Baird's Sandpiper	0	А	А	А
85. Pectoral Sandpiper	0	0	0	0
86. Buff-breasted	А	0	А	А
87. Dunlin	0	0	0	0
88. Stilt Sandpiper	А	0	А	0
89. Short-billed	А	0	0	0
90. Common Snipe	А	0	А	А
91. Parasitic Jaeger	А	0	0	А
92. Long-tailed Jaeger	А	А	0	А
93. Laughing Gull	0	0	0	0
94. Bonaparte's Gull	А	А	0	А
95. Ring-billed Gull	А	А	0	0
96. Herring Gull	0	0	0	0
97. Lesser Black-backed	А	0	0	0
98. Greater Black-backed	0	0	0	0
99. Sandwich Tern	А	А	0	А
100. Roseate Tern	А	0	0	0
101. Common Tern	0	0	0	0
102. Arctic Tern	А	А	0	0
103. Forster's Tern	А	А	0	0
104. Least Tern	0	0	0	0
105. Black Tern	А	0	0	0
106. Black Skimmer	А	А	А	0
107. Common Murre	А	А	0	А
108. Rock Dove	0	А	А	0
109. Mourning Dove	0	0	0	0
110. Yellow-billed Cuckoo	В	А	А	В
111. Great Horned Owl	Ο	А	0	А
112. Northern Saw-whet	А	В	А	А
113. Common Nighthawk	А	А	0	А
114. Ruby-throated	А	0	0	0

Species	2011	2012	2013	2014
115. Belted Kingfisher	0	0	0	0
116. Yellow-bellied	А	В	В	В
117. Downy Woodpecker	А	В	В	В
118. Hairy Woodpecker	В	А	А	В
119. Red-bellied	В	В	В	В
120. Northern Flicker	В	В	В	В
121. Eastern Wood-peewee	В	В	В	В
122. Yellow-bellied	В	В	В	В
123. Acadian Flycatcher	А	А	В	В
124. Alder Flycatcher	А	А	В	А
125. Willow Flycatcher	В	В	В	В
126. Least Flycatcher	В	В	В	В
127. Eastern Phoebe	А	В	В	В
128. Great-crested	А	А	В	А
129. Eastern Kingbird	В	В	В	В
130. White-eyed Vireo	А	А	А	В
131. Yellow-throated	А	А	А	В
132. Blue-headed Vireo	В	В	В	В
133. Warbling Vireo	А	В	А	В
134. Philadelphia Vireo	А	В	В	В
135. Red-eyed Vireo	В	В	В	В
136. American Crow	0	0	0	А
137. Horned Lark	В	В	В	В
138. Tree Swallow	В	В	В	В
139. Northern Rough-	А	А	В	А
140. Bank Swallow	А	В	В	А
141. Cliff Swallow	А	0	А	А
142. Barn Swallow	А	0	В	В
143. Red-breasted	А	В	В	В
144. White-breasted	В	В	А	В
145. Brown Creeper	В	В	В	В
146. Carolina Wren	А	А	А	В
147. House Wren	А	В	В	В
148. Winter Wren	В	А	А	В
149. Marsh Wren	А	А	А	В
150. Golden-crowned	В	В	В	В
151. Ruby-crowned	В	В	В	В
152. Blue-gray	А	В	В	А
153. Veery	В	В	В	В

Species	2011	2012	2013	2014
154. Gray-cheeked Thrush	В	В	В	А
155. Swainson's Thrush	В	В	А	В
156. Hermit Thrush	В	В	В	В
157. Townsends Solitaire	А	В	А	А
158. American Robin	В	В	В	В
159. Gray Catbird	В	В	В	В
160. Northern	В	В	В	В
161. Brown Thrasher	В	В	В	В
162. European Starling	А	В	В	Α
163. American Pipit	А	В	В	Α
164. Cedar Waxwing	В	В	В	В
165. Blue-winged Warbler	А	А	В	В
166. Tennessee Warbler	А	О	А	В
167. Orange-crowned	В	А	В	В
168. Nashville Warbler	В	В	В	В
169. Northern Parula	В	В	В	В
170. Yellow Warbler	В	В	В	В
171. Chestnut-sided	А	А	В	В
172. Magnolia Warbler	В	В	В	В
173. Cape May Warbler	В	В	В	В
174. Black-throated Blue	В	В	В	В
175. Yellow-rumped	В	В	В	В
176. Black-throated Green	В	В	В	В
177. Black-throated Grey	А	В	А	Α
178. Yellow-throated	В	А	А	Α
179. Blackburnian Warbler	В	А	В	В
180. Pine Warbler	В	В	В	В
181. Prairie Warbler	В	В	В	В
182. Palm Warbler	В	В	В	В
183. Bay-breasted Warbler	А	В	В	В
184. Blackpoll Warbler	В	В	В	В
185. Black-and-White	В	В	В	В
186. American Redstart	В	В	В	В
187. Ovenbird	А	В	В	В
188. Northern Waterthrush	В	В	В	В
189. Mourning Warbler	В	А	В	А
190. Common	В	В	В	В
191. Wilson's Warbler	В	В	В	В
192. Hooded Warbler	А	А	А	В

Species	2011	2012	2013	2014
193. Canada Warbler	В	А	А	В
194. Yellow-breasted Chat	В	В	А	В
195. Scarlet Tanager	В	В	В	В
196. Eastern Towhee	В	В	В	В
197. American Tree	А	А	В	А
198. Chipping Sparrow	В	В	В	В
199. Clay-colored Sparrow	В	А	А	В
200. Field Sparrow	А	В	В	В
201. Savannah Sparrow	В	В	В	В
202. Fox Sparrow	А	В	А	В
203. Song Sparrow	В	В	В	В
204. Lincoln's Sparrow	В	В	В	А
205. Swamp Sparrow	А	В	В	В
206. White-throated	В	В	В	В
207. White-crowned	В	В	В	В
208. Lark Sparrow	В	А	В	В
209. Saltmarsh Sparrow	А	А	А	0
210. Dark-eyed Junco	В	В	В	В
211. Snow Bunting	А	А	0	А
212. Northern Cardinal	В	В	В	В
213. Rose-breasted	А	В	В	В
214. Blue Grosbeak	В	В	В	А
215. Indigo Bunting	В	В	В	В
216. Dickcissel	В	А	В	А
217. Bobolink	А	В	0	А
218. Red-winged	В	В	В	В
219. Eastern Meadowlark	А	0	А	А
220. Rusty Blackbird	В	А	В	А
221. Common Grackle	0	0	А	А
222. Brown-headed	А	В	В	В
223. Baltimore Oriole	А	В	В	В
224. Purple Finch	А	В	В	В
225. House Finch	А	А	В	В
226. White-winged	А	В	А	А
227. Pine Siskin	А	В	А	В
228. American Goldfinch	В	В	В	В
229. House Sparrow	В	В	В	В
Yearly Total	120	162	182	174
L. L		Grand	l Total	229







Figure 7. Map and List of Net Locations on Monomoy Refuge Banding Station

Net	Lat	Long	Direction	Notes
A1	41.5604	-69.9955	175	Connect A2
A2	41.5603	-69.9957	40	Connect A!
A3	41.5604	-69.9957	140	
A4	41.5603	-69.9958	45	
B1	41.5593	-69.9958	45	
C1	41.5596	-69.9935	90	Connect C2
C2	41.5596	-69.9932	265	Connect C1/3
C3	41.5598	-69.9932	175	Connect C2
C4	41.5598	-69.9934	180	
D1	41.5585	-69.996	355	
D2	41.5586	-69.9962	85	
D3	41.5584	-69.9965	10	Connect D4
D4	41.5584	-69.9964	85	Connect D3
F1	41.5591	-69.9937	135	Connect F2/5
F2	41.5592	-69.9936	225	Connect F1/3
F3	41.5592	-69.9935	250	Connect F2
F4	41.5592	-69.9938	220	6M NET
F5	41.5592	-69.9939	135	Connect F1

Table 16. GPS locations and net direction for nets at MRBS. All nets are 12x2.4m unless noted.



Figure 8. Map of Monomoy Refuge Banding Station Census Locations

 Import Return fanding Station (MRB)
 Lighthouse Beach

 Powder Hole

 Big Station Fond

 Big Station Fond

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