

# **Spring Migration Bird Banding 2018**

## Mass Audubon's Wellfleet Bay Wildlife Sanctuary

Prepared by James Junda June 2018

#### **About Wellfleet Banding Station**

Wellfleet Bay Wildlife Sanctuary (41.883 N, 69.996 W) is located in South Wellfleet, MA and is owned and managed by Mass Audubon. James Junda manages the banding station with the cooperation and assistance of sanctuary staff. Two experienced and licensed banders operate the station daily from April 15 - May 31 and September 1 - November 15. Volunteer assistance is used daily and greatly benefits the operation of the station.

It is a valuable addition to a growing collection of banding stations on Cape Cod, being the only station located on the Outer Cape. Two constant-effort banding stations are already in operation on or near Cape Cod: Wing Island Banding Station in Brewster (20 km to the WSW) and Manomet Center for Conservation Science (50 km to the E).

Operations are based upon the protocols of other constant-effort banding stations in the United States and Canada with an emphasis on standardized research protocols. In addition to collecting and analyzing scientific data to assist in management decisions, Wellfleet Banding Station serves to increase public interest on the sanctuary, Cape Cod and around the world.

#### History of Banding at Wellfleet Bay

The bird banding pedigree of this property runs deep. The first bird banding station on the property was established in 1929 when well-known ornithologist Dr. Oliver Austin Jr. founded the Austin Ornithological Research Station with his father, Dr. Oliver Austin Sr. The Austins initially caught and banded waterfowl, shorebirds, terns, sparrows and blackbirds using a variety of traps, and began widely mist netting songbirds in the 1940s and 50s, when Oliver Jr. introduced the first Japanese mist nest to the United States. Mass Audubon took over the property in 1958 and continued the ornithological research begun by the Austins. Some bird banding has occurred on the property in 60 out of the last 85 years. Erma "Jonnie" Fisk banded at the sanctuary regularly between 1972 and 1989, mainly for the purpose of public education. 1989 marked the last year of regular banding on the property until 2014.

The abundance of certain birds in the banding data from the Austin years reflects both the methods used by the Austins (duck, sparrow, and tern trapping), as well as the vastly different landscape of Cape Cod during the first half of the 20<sup>th</sup> century. Open country species like Vesper Sparrow and Grasshopper Sparrow, all but extirpated from the now heavily wooded Outer Cape, were common on the treeless postagricultural landscape of the Austin era. For example, they reported 183 Vesper and 51 Grasshopper Sparrows banded in 1931 alone (Austin 1932). Incomplete banding data were obtained from the Bird Banding Lab from the Austin years, but based on Austin's publications it is clear that much of it is missing. Starting in fall 2016 Elora Grahame has begun the process of digitizing and entering all the historical data. She has only entered a few years of data, but has already discovered much, including that banding using mistnets occurred over a decade earlier than previously thought. As this process continues we look forward to improving our understanding of how things have changed in the last 80 years.

### **Spring Migration Banding**

Spring migration banding is a standardized study undertaken annually. It provides the basis for long-term trend analysis of migrating birds using the sanctuary, and is designed to be comparable with the methodology of other spring migration banding stations. The protocol involves regular standardized banding operations with mist-netting effort remaining constant daily, seasonally and annually. The spring migration season extends from April 15 - May 31 with nets open every day at dawn and remaining open for 5 hours (weather permitting). This period encompasses the majority of spring passerine migration, giving a thorough view of the majority of the process, allowing us to operate the station without conflicting with the popular summer events but still allowing for overlap with spring school programs.

#### **Outreach and Public Programs**

One of our primary goals is to increase knowledge and expose the public to the avian life on the sanctuary. To this end, we scheduled banding demonstrations each Sunday and Wednesday in late May and made the station available to any special visitors to the sanctuary. While the paid banding demonstrations were not completely booked, the switch from Saturday to Sunday and dropping of Wednesday demos in April and early May seemed to be effective with good attendance. In addition to the 8 banding demos, we recorded an additional 12 organized visits from different groups in Spring 2018. There were five school visits where students ranging from primary to high school came to the station, learned about operations and helped release birds. In addition to these arranged school visits, we had two April Adventures programs with children and adults. We also hosted two Wild Wild Wellfleet Breakfast with the Birders winning bid visits, both of which went very well with good birds, good questions and engaging demos. A visit from the south shore sanctuaries and two volunteer naturalist walks rounded out the public programs at the station.

We had one media appearance in 2018, on the WCVB 5 Boston Chronicle, our biggest media exposure for the station to date. It was an excellent program that spent time to focus on the station and covered the biology and science in a thoughtful way. The program was well received and we got a lot of positive feedback. All told, we had 18 visits from various groups in the 47 days of the season, representing a strong outreach effort in Spring 2018.

Our outreach tools were refined and expanded last spring and our daily eBird reports are now standardized to be completed as part of banding operations. The survey is posted on eBird the same day, along with any rare birds captured at the banding station. These standardized counts not only allowed us to document species not caught during mist-netting, but also to increase the visibility of the sanctuary online and attract birders to the property.

The second tool was a dry-erase board in the lobby of the visitor's center, where we posted the top 5 species from the previous week, top 5 species expected in the next week (based on data from previous seasons), top capture of the day (for Wellfleet and Monomoy) and promote the weekly demos. This board was very successful; most visitors liked to see how things change daily and weekly throughout the season, and it functioned to raise awareness of the demos as well as the work conducted at the banding station.

We continued our efforts on social media this spring with a takeover of the @wbws Twitter account by bander Frankie Tousley, who posted a picture of an interesting capture each day. Each post gave a close-up view of a beautiful bird in the hand, along with some natural history information on the species. We posted a total of 30 pictures on Twitter @wbws and Instagram @monomoybirdobs in the spring, gaining an average of 50 likes, or 25% engagement rate on each picture. Note also the outreach by volunteer Nick Dorian, @beesearcher on Instagram, who regularly posts pictures tagging the sanctuary that gain hundreds of likes and comments.

#### Volunteers

In Spring 2017, we found more stability in our core volunteer team at the station, with most of our volunteers returning from the fall. Valerie Bourdeau was our most important volunteer, present from May 11 to the end of the season, attending each day. Mary Lou Heintz, Jeanette Bragger, Warren Mumford, Tod Christie and Teresa Corcoran each a volunteered 1-2 days a week for most of the season, making up our core of volunteers. Frank Mockler was our only new volunteer, attending once a week on Sunday, he proved a welcome addition to our volunteer team. All volunteers practiced extracting birds, helped with erecting nets and undertook the majority of data recording. Volunteers showed interest in returning next season and we will undertake more extensive training, so they may assist further in running the station as well as continue their education in avian biology and conservation.

#### 2018 Season Coverage

In 2018, the banding season started on April 15 and ended on May 31, for a total of 47 days. We operated up to a maximum of 22 nets on 41 days for a total of 3790.89 net hours. This is an increase of 4 days of banding from Spring 2017 when we operated on 37 days, the most days we have worked in spring since 2015 when we banded and amazing 44 out of 47 days. It was an increase of 11% of 2016 net hour total of 3388.58, but a large increase over 2016 (2548.44), which was slightly down from 2698.64 in Spring 2015 (44 days in operation).

This increased number of hours reflects the improved weather in 2018 over 2017 as well as a significant increase in nets operated than in either 2015 or 2016, with 5 more nets in use than those early seasons. We encountered several bouts of high wind and, in general, wind was a large factor in net effort, but as spring progressed and leaves began to emerge, the effect of the wind was diminished. We dodged a lot of spring storms in 2018, with rain occurring during the 24-hour period in which we banded, but not during the banding hours.

The standard setup included 22 nets along two loops, but the mesh size, age and make varied slightly among the nets. Net 61 was a 6x2.6m and Net 6 was 12x1.3m, the remaining nets were all 12x2.6m. Wind direction and speed had a huge impact on net effort. On most days, some nets could not be open or had to be closed due to wind. Small variations in direction could change which nets were affected, but in general nets along the Bay View loop were more exposed and closed more often than those along the Dorm loop. Wind is a near constant presence on the Outer Cape and should affect operations in a similar fashion in future seasons.

#### Banding

During Spring 2018 operations, we had 1193 captures of 77 species (Appendix A): 652 newly banded birds, 502 local recaptures, two foreign recaps and 37 unbanded, totaling 814 individuals. Below, we look at the number of birds banded by date, standardizing effort per 100 net hours (Fig 1).



Figure 1- Number of birds banded by date at Wellfleet Bay Wildlife Sanctuary during Spring 2018 operations. Blue line is daily captures, while the red line is a 3-day running average. The first peak in captures occurred in late April with the passage of large number of Golden-crowned Kinglets. This was followed by an early May signaling the return day for Common Yellowthroat, Gray Catbird, Baltimore and Orchard Oriole breeding males. This was followed by a giant peak from May 18-23 when the majority of long-distance migrants bound for northern breeding grounds passed through riding warm SW wind, followed by a NE blast causing fallout conditions during the peak of warbler migration.

The season was generally slow with almost as many recaptures as newly banded birds, but there were a few busy periods. Over one four-day stretch, we banded 163 birds (May 20 (37), May 21 (43), May 22 (56) and May 23 (27)) totalling 24% of our newly banded birds for the entire spring. This peak occured right after a big warbler fallout. SW winds kicked off a big migration movement around May 18, but strong NE winds and storms pushed the birds down and froze migration, but also prevented us from banding much. After the winds returned to SW the migration movement continued, leading to our capture peak.

An additional peak occured around april 20<sup>th</sup> when larger than normal number of Golden-crowned Kinglets passed through the station, signaling a high survival rate for these little birds over last winter. The third peak in early May corresponded with warm weather and SW winds prompting the arrival of local breeding migrant male Gray Catbirds, Common Yellowthroats, Baltimore and Orchard Orioles over a day or two. Other than these peaks, banding was generally slow, showing the same patterns observed most springs.

#### **Banding Rates Between Years**

When we compare capture data among spring seasons from 2015-2018 (Fig. 2), we see some similarities among seasons, but also some striking differences. In 2018, we see a big spike on May 21 as well as a small spike on April 22, with slow captures for the remainder of the season. 2017 had a similar peak around May 18, as on May 17 in 2016 and later on May 24 in 2015. The April peak was seen in 2016 and 2015, but not in 2017. 2015 had the most dispersed and even migration through all of May, while other seasons had a more distinct peak in late May. There is a small peak around May 1<sup>st</sup>, when local breeding catbirds and orioles arrive, visible in each season. By examining this small peak and the major peak in the second half of May we can tell much about the timing of spring migration and local breeding.

Weather is a key driver of this variation, with storms both hindering banding and driving migration patterns. Large migratory pushes tend to come with SW winds experienced after NE storms. In seasons of heavy NE winds and cold weather, migrants will just avoid Cape Cod and migrate over the mainland.



Figure 2- Number of birds banded daily during spring 2015-2018 operations. Capture rates varied among seasons. In general, each season there is a peak in late April/early May associated with the arrival of Neotropical migrant breeders. The major peak of migration occurs in mid-May with the passing through of long-distance boreal-bound migrants. In 2018, this peak of migration occurred around May 21, later than 2016 and 2017, but earlier than 2015; 2017 and 2018 saw more distinct peak, while migration was more dispersed in 2015 and 2016.

#### **Diversity of Captures**

With 77 species captured in Wellfleet in Spring 2018 (up from 76 in 2017, 72 in 2016 and 65 in 2015), we were extremely pleased with the level of diversity encountered in spring on Cape Cod. Species richness peaked on May 21 with 19 species, May 17 with 17 species, May 4 with 16 and April 21 with 16 (Fig. 3). From April 15 to April 23, we averaged just fewer than 10 species a day before dropping to around 6 until May 1. We then averaged around 10 a day before rising to a peak of 19 on May 21 during our busiest stretch. From May 26<sup>th</sup> on diversity was low, hovering around five species per day, until the end of the season.



Figure 3- Number of species banded daily at Wellfleet Bay Wildlife Sanctuary during Spring 2018 operations. Blue line represents daily species total, while the red line represents a running 3-day average. Species richness peaked on May 21 with 19 species before declining for the remainder of the season.

#### **Top 20 Captures**

Next, we will look at some of the more common species encountered to further examine how the sanctuary is used by different passerines. Table 1 lists the top 20 most common species captured in Spring 2017 and earlier seasons. These numbers are corrected for netting effort, with captures per 3500 net hours, an average season of effort with the 22 net setup currently used. Although Diversity varied throughout the season, with capture rates of individual species changing as the season progressed, this simplified list still provides some insight into bird use of the sanctuary. Some of the most common species banded were year-round residents, with Black-capped Chickadee (62 captures), American Goldfinch (54), Northern Cardinal (17), Pine Warbler (19) and Red-winged Blackbird (17) each in the top 15. The rest of the Top 20 is dominated by summer breeders, starting with rank #1

 Table 1- Top 20 most common species captured at Wellfleet Bay

 Wildlife Sanctuary in Spring 2015-2018 number of individuals

 captured per 3500 net hours, controlling for netting effort

 among years

Species	2018	2017	2016	2015
1 Gray Catbird	91	130	128	271
2 Black-capped Chickadee	62	87	143	128
3 American Goldfinch	54	51	91	105
4 Golden-crowned Kinglet	51	5	5	0
5 Magnolia Warbler	30	23	14	6
6 Common Yellowthroat	28	37	25	27
7 Chipping Sparrow	25	24	40	19
7 Tree Swallow	25	22	25	100
9 Blackpoll Warbler	21	12	12	0
10 Baltimore Oriole	19	15	32	44
10 Pine Warbler	19	33	27	27
12 Yellow-rumped Warbler	17	10	16	1
12 Northern Cardinal	17	31	48	35
12 Red-winged Blackbird	17	13	18	51
15 American Robin	14	2	11	18
15 Ruby-crowned Kinglet	14	7	22	1
17 Northern Waterthrush	13	2	4	4
17 Tufted Titmouse	13	12	11	8
18 American Redstart	12	5	3	3
18 Northern Parula	12	3	1	1
18 Yellow Warbler	12	11	5	3

Gray Catbird (91), #6 Common Yellowthroat (28) and #7 Chipping Sparrow and #7 Tree Swallow (23) and other breeding season-only species taking 5 additional slots in the Top 20. Overwinterers took only three spots on the list #4 Golden-crowned Kinglet, #12 Yellow-rumped Warbler (17) and #15 Ruby-crowned Kinglet (14). Five true migrants (migrating through, but not breeding or wintering on the Sanctuary) fall into the list an all time high: Magnolia Warbler (30) Blackpoll Warbler (19), Northern Waterthrush (13), American Redstart (12) and Northern Parula (12).

Comparing the capture numbers between 2018 and previous springs (Table 1) we see some interesting patterns emerge over the years. Gray Catbirds numbers continued their decline after leveling out in 2016 and 2017 down 66% from 2015 levels. Although 2014 was likely as boom year for this species, we look forward to following this pattern in future years. Red-winged Blackbirds and Tree Swallows remained at 2016 levels down over 66% from 2015 totals, likely a result of returning breeders becoming more net savvy after the first season. Many migrant warblers showed much higher numbers in Spring 2017: Magnolia Warblers up 23%, Blackpoll Warbler up 43%, Northern Waterthrush up 85%, American Redstart up 62% and Northern Parula up 77% all had strong seasons, reflecting the strong spring warbler migration.

There may be multiple causes for this variation and the sources of these differences are spread temporally and spatially over the bird's entire previous year. This year's warbler influx was a result of two factors, a successful breeding season for many boreal species last year and local weather conditions causing fallout on Cape Cod this spring. Our fall warbler capture rates, which were up for many species at both Monomoy and Wellfleet, suggested a successful breeding season, which was reflected in more secondyear birds being in the system this spring. This combined with a strong NE storm in the middle of peak warbler migration also contributed to our increased capture rates.

The changes in other species, while sharp are harder to understand without additional research: Northern Cardinals were down almost 50%, while American Robins rebounded to 15 captures after hitting an all time low last spring with only two. We continue to investigate how much variation is driven by migration routes and timing versus an honest reflection of breeding and survivorship among species. It will be interesting to see, as we amass more seasons of data, how local weather affects these and other species in future seasons.

#### **Less Common Captures**

On the other end of the spectrum are the rarer birds, often captured only once per season. These birds may not pass through the sanctuary in large numbers or may be present but not captured often, but they still shed light on habitat use. Species only banded twice this year are: Brown-headed Cowbird, Blue-headed Vireo, Black-throated Green Warbler, Chestnut-sided Warbler, House Sparrow, Rose-breasted Grosbeak, Red-bellied Woodpecker, Red-eyed Vireo, Swainson's Thrush, White-breasted Nuthatch, Wood Thrush and Palm Warbler. Species captured only once were: Blue-gray Gnatcatcher (a station first), Blue-winged Warbler, Cedar Waxwing, Cape May Warbler, Great-crested Flycatcher, Warbling Vireo, White-crowned Sparrow, Willow Flycatcher and Yellow-bellied Sapsucker.

There are a few captures that were especially interesting in terms of their rarity on the site or unlikeliness in mist nets. We captured a single Hooded Warbler, a rare bird on Cape Cod but our third capture over the last three springs. Two Wood Thrushes were unexpected, as we only get them biannually. Cape May Warbler was our first spring capture, following our first fall capture in 2017, reflecting the increased numbers of these birds benefiting from the boreal spruce budworm outbreak.

#### Recaptures

There were 503 recaptures (birds captured while already fitted with a band), representing 287 unique individuals of 46 species in Spring 2017. The volume of recaptures (503) compared to individuals banded (652) represents a recap-to-banded ratio of 5:6. This rate not only implies that individuals captured on site often remain on site, but a low volume of migrants to residents on site. The volume of banded to recaps fell in-between 2017 (1:1) and 2016 and 2015 (3:4) when a larger proportion of newly banded birds were encountered, this is possibly the result of a large proportion of returning year-round residents and breeders being banded the longer the station has been in operation.

Recaptures are often a reflection of mist netting conditions on site. Days with high rates of recaptures are usually days of low wind and overcast skies, i.e. good capture conditions. Rates do however vary as the season progress, reflecting the volume of migrants on site and generally peaking a day or two after a migration peak as the birds banded during the peak remain on site for several days. Recapture rates peaked early on April 21 with 24 recaptures mostly kinglets, chickadees and goldfinches (Fig. 4). From April 23- May 2 rates stayed at about 5-10 a day until more breeders arrived on site around May 3. From May 3-May 17 rates rose as more breeders and migrants added to the number of birds on site, before declining to the end of the season as migrants departed and nesting birds became more sedentary and focused on nesting.



**Figure 4-** Individuals recaptured per 100 net hours daily during Spring 2018 banding operations. The blue line represents the number of recaptures daily and the red line represents the 3-day running average. Recaptures peaked early on April 22 at 24, then settled at 5-10 a day until early May. Rates slowly rose as more breeders and migrants arrived on site until mid-May until declining until the end of the season as migration tapered off and breeding birds settled on territories.

Diversity of recaps follows a similar pattern, without the early peak, starting low at about 5 species per day until early May when migrant breeders arrived. Diversity continued to increase up to May 19, peaking with the peak of migration (Fig. 5). Recapture diversity declined to six-eight a day and stayed steady until the end of the season. The general pattern is for diversity of recaptures to increase as more species arrive to breed on site.



Figure 5- Species recaptured per 100 net hours daily during Spring 2018 banding operations. The blue line represents the number of species recaptured daily and the red line represents the 3-day running average. Recapture diversity follows abundance closely, starting low, held steady around 6 per day until early May. It peaked on May 19, corresponding with the peak of diversity, before hovering around eight species a day until the end of season.

The majority of the recaptures were either year-round or breeding species (Table 2), with Black-capped Chickadees (a year-round resident) alone representing 24% of recaptures. Gray Catbirds and Baltimore Orioles are common summer breeders, and upon their arrival became very common recaptures. Eastern Towhee, Chipping Sparrow, Orchard Oriole, House Wren Common Yellowthroat are also common summer breeders. The rest of the list is mostly filled with year-round residents, however actual population make-up may change or swell from summer to winter.

Table 2- Top 15 species recaptured at Wellfleet banding station in Spring 2018 including their resident status. A recapture is each time a banded bird is caught, so may represent multiple captures of the same individuals. This rate of recapture is represented by the mean number of times an individual is captured in the third column.

Species	Recaps	Individuals	Mean Recaps	Resident Status
1. Black-capped Chickadee	120	57	2.11	Year Round
2. Gray Catbird	59	37	1.59	Summer
3. American Goldfinch	39	26	1.50	Year Round
4. Baltimore Oriole	31	10	3.10	Summer
5. Common Yellowthroat	22	10	2.20	Summer
6. Pine Warbler	16	13	1.23	Year Round
7. Ruby-crowned Kinglet	15	7	2.14	Winter
8. Golden-crowned Kinglet	14	8	1.75	Winter
9. Orchard Oriole	14	4	3.50	Summer
10. Song Sparrow	14	4	3.50	Year Round*
11. House Wren	11	3	3.67	Summer
12. Carolina Wren	10	3	3.33	Year Round
13. Chipping Sparrow	9	8	1.13	Summer
14. Eastern Towhee	9	4	2.25	Summer
15. Tree Swallow	9	6	1.50	Summer

more susceptible to recapture, for example, 11 House Wren captures were only 3 individuals. To get a full picture of recapture rates, we need to look at how many times each individual was recaptured. The 120 Chickadees do not represent 120 individuals, but only 57 individuals recaptured a mean of 2.11 times. Orioles, wrens and Song Sparrows were far and away the species most likely to be recaptured multiple times, an average >3 times each. Among Baltimore Orioles these repeats are mostly aggressive males that got caught multiple times while chasing other males. All other species rates were between 1.13 and 2.25, indicating the birds were captured a few times, but generally avoided nets after the initial capture.

Some individuals and species are

\* separate summer and winter populations may be present

In Spring 2017, we had 268 returns (recaptures banded on site prior to 2018) of 141 individuals totaling 26 species (Table 3). All returns were species that breed on site, with the exception of two overwintering White-throated Sparrows, no migrants returned. Black-capped Chickadee was our most common return with 49 individuals captured 100 times, well down from the 69 returned chickadees last year. These were followed by 17 Gray Catbirds captured 34 times (19 returns in 2017), 8 Pine Warblers 10 times, seven American Goldfinches captured nine times (down from 16 in 2017). Other species with notable returns in 2017 were: Downy Woodpecker (5), Common Yellowthroat (2) and Orchard Oriole (2) after not recapturing any Orchard Orioles last spring. This high return rate is a reflection of our high recapture rate at Wellfleet and reinforces the quality of this habitat for resident birds. As this project continues, we look forward to encountering more returns and seeing some of these birds year after year.

#### **Foreign Recaptures**

We had two foreign recaptures in Spring 2018. An afterhatching-year female Tree Swallow captured on May 4<sup>th</sup>, after originally being banded as a nestling in Port Williams Nova Scotia on 6/20/2017. This bird had no brood patch, but during a point in the year when our breeders don't have brood patches, so there is no way to tell if it was a breeder or migrant. And an after-second-year Common Yellowthroat recaptured on May 30 after being originally banded on 5/10/2017 as an after-secondyear in Strafford County New Hampshire. This bird is at least four years old, but could be older and is likely breeding in New Hampshire based upon its previous capture date.

#### **Daily eBird Census**

In Spring 2018, we continued the protocol for visual and auditory counts of birds on site started in Spring 2017. We adopted this expansion of the project to account for birds not captured in mistnets, a major bias to mistnetting operations. In addition, a daily count of birds allowed for more participation of volunteers, who could engage in birding activities even when banding was slow. It also allowed us to do more outreach for the station and sanctuary. By posting birds on eBird daily we hoped to, and succeeded in, attracting visitors to the sanctuary and to our demos.

The protocol for the eBird census was developed so that birds could be counted early in the morning without interfering with banding operations. We started the count during the first net check after set-up, 40 minutes after opening at sunrise. The count continued for two net checks (lasting between 1 hour, 20 minutes and 1 hour, 40 minutes), allowing each paid bander a chance to walk each net loop. It was limited to that duration to not overcount the same birds, as we walk the same loops for the entire day. In addition to walking the two loops, five specific locations (all along or adjacent to the net loops) were carefully monitored each day: 1) the Saltmarsh Overlook near the visitor's center, 2) bird feeders behind the visitor's center, 3) top of Bay View along the trail just past Net 12, to survey flats between the sanctuary and Lieutenant Island, 4) new solar panel field near Net 4, and 5) the saltmarsh creek past Net 13, with

Species	Returns
1. Black-capped Chickadee	49
2. Gray Catbird	17
3. Pine Warbler	8
4. American Goldfinch	7
5. Baltimore Oriole	5
6. Blue Jay	5
7. Downy Woodpecker	5
8. Northern Cardinal	5
9. Tufted Titmouse	5
10. Common Yellowthroat	4
11. Eastern Bluebird	3
12. Eastern Towhee	3
13. Song Sparrow	3
14. Chipping Sparrow	2
15. Common Grackle	2
16. Eastern Phoebe	2
17. Hairy Woodpecker	2
18. House Wren	2
19. Orchard Oriole	2
20. Red-breasted Nuthatch	2
21. White-throated Sparrow	2
22. Yellow-shafted Flicker	2
23. Carolina Wren	1
24. Field Sparrow	1
25. Red-bellied Woodpecker	1
26. Tree Swallow	1

Table 3- Returns (birds banded in previous seasons) captured at Wellfleet in Spring 2018. All species breed on site except White-throated Sparrow, a winter visitor. surveyors walking to the main creek intersection (located 100m into the marsh) when tide cycle allowed. By surveying these specific areas, we were able to account for birds using all habitats found on the sanctuary (for census map, see Appendix B).

During eBird censuses, we observed 116 species, 49 of which were not included in the banding data and would not have otherwise been recorded. We completed 38 eBird counts, one for each day we were on site during the proper survey period in the morning. 10 species were counted on each day of the season, all species known for being loud, visible and common as well as a year-round residents or a breeders arriving prior to the start of banding operations: American Crow, American Goldfinch, Black-capped Chickadee, Blue Jay, Chipping Sparrow, Common Grackle, Northern Cardinal, Red-winged Blackbird, Tufted Titmouse and Song Sparrow. Four additional species were observed 37/38 days: American Robin, Carolina Wren, Red-bellied Woodpecker and Tree Swallow. On the other end of the spectrum 16 species were only observed a single time, reinforcing the need for focused counting daily: Black-throated Blue Warbler, Blackburnian Warbler, Blue-headed Vireo, Canada Warbler, Chestnut-sided Warbler, Dark-eyed Junco, Hermit Thrush, Hooded Merganser, Lincoln's Sparrow, Nashville Warbler, Parasitic Jaeger, Red-shouldered Hawk, Solitary Sandpiper, Wood Duck, Yellow-bellied Sapsucker and Yellow-throated Warbler. For complete list of eBird species and the number of days encountered, see Appendix A.

The diversity of eBird counts roughly corresponds with the diversity of the banding data. We started the season on April 15 with about 35-40 species a day. By early May, we were averaging between 40-50 species a day (Fig.6). By mid-May, the average was up to 50-60 species daily before peaking on May 21 with 68 (same day as the peak last year, with only 67 species in 2017). After this peak, the species total went down to about 50 a day until the season completed on May 31st.



Figure 6- Species documented daily during 2018 morning eBird census at Wellfleet Bay. Census took place starting on the second net round (~40 minutes after sunrise) and continued for two net runs lasting from 1:20-1:40 minutes depending on bird numbers. All birds that could be heard or seen during the net checks were counted and with five additional locations check daily: Saltmarsh Overlook, Visitor's Center feeders, new solar array field, upper Bay View Trail looking towards Lt. Island and Saltmarsh Creek past Net 13 along Bay View Trail.

#### **Net Productivity**

We assessed the productivity and usage of all nets (see map in Appendix B) and summarized the data in Table 3. Nets are placed along two loops, the Dorm Loop 1-7, 17, 18, 21, 24, 26 and the Bay View Loop 9-15, 17, 19, 22, 26 and 61. Nets fell into four broad habitats: semi-open Upland Fields (1, 3, 9, 11, 18, 19, 22, 61), freshwater mature forest/thicket along Silver Spring (2, 4, 5, 6, 7, 16, 21, 24, 25), dense Black Locust forest in the Maze (10, 12, 15, 26) and Saltmarsh Edge (13, 14). Net 23 was dropped after last spring due to low capture rates and high wind impact, this was the only change since Spring 2017 and we do not foresee any further changes to net locations.

All nets except for 61 and 6 were 12m nylon mist nets with 32mm mesh purchased from Avinet in Fall 2016 and were in very good condition. Net 61 was a 6x2.6m 4-tier net and Net 6 was a 12x1.3m 2-tier net, each with 36mm mesh. The change in mist net size from 38mm nets in previous seasons to 32mm mesh size used in Spring 2017 appeared to impact capture rates as laid out in Heimerdinger and Leberman (1966). Larger passerines such as Eastern Towhees and blackbirds as well as larger woodpeckers were captured at lower rates, while smaller species like warblers, chickadees and sparrows were captured in larger numbers. Additionally, when the larger nets do capture small birds, they are more likely to become entangled among the larger mesh. Now we have settled on a consistent mesh size and captures between seasons will become more directly comparable.

Net	Net hours	Banded	Recaps	Total Captures	Banded /100 Net Hours	Recaptures /100 Net Hours
1	189.66	12	11	23	6.3	5.8
2	193.99	39	28	67	20.1	14.4
3	184.16	15	12	27	8.1	6.5
5	193.33	49	31	80	25.3	16.0
6 <sup>1</sup>	92.345	45	24	69	48.7	26.0
7	190.99	47	29	76	24.6	15.2
9	180.17	41	31	72	22.8	17.2
10	193.99	34	39	73	17.5	20.1
11	148.83	18	14	32	12.1	9.4
12	189.16	14	13	27	7.4	6.9
13	129.15	7	18	25	5.4	13.9
14	174.32	13	30	43	7.5	17.2
15	193.99	19	18	37	9.8	9.3
16	174.66	40	38	78	22.9	21.8
18	188.33	23	26	49	12.2	13.8
19	166.83	26	25	51	15.6	15.0
21	194.66	56	33	89	28.8	17.0
22	143.00	7	7	14	4.9	4.9
24	193.33	54	36	90	27.9	18.6
25	191.33	37	29	66	19.3	15.2
26	193.99	37	36	73	19.1	18.6
61 <sup>1</sup>	90.675	15	10	25	16.5	11.0
Total	3790.89	648	538	1186	17.1	14.2

<sup>1</sup>12x1.3m net = 0.5 net hours

 Table 4- Net effort and capture rates for newly banded and recaptures during Spring 2018 operations at Wellfleet Bay

 Wildlife Sanctuary.

The net hours (effort) varied among nets (Table 4) from 194.66 hours at Net 21 to 129.15 hours at Net 13 (Net 6 and 61 only count as 50% effort, as they only cover 50% as much area as a standard 12x2.6m 4-tier net). The primary factor contributing to these differences in effort is wind, with the Upland Field and Saltmarsh Edge nets being much more susceptible to wind than the more forested and protected nets along Silver Spring and to a lesser extent The Maze.

#### **Captures by Habitat**

The banding station is composed of a mix of habitats attracting a diverse collection of bird species; with our nets occupying active locations in each habitat, we can obtain a well-rounded idea of passerine usage across the sanctuary. Silver Spring was by far the most active habitat in Spring 2017 (Table 5), with 43.2 captures per 100 net hours, 37% higher capture rate than The Maze, the next busiest habitat. Upland Field was the one of the slowest habitats, whereas in fall it is the busiest habitat, showing that this area is less utilized in the spring. 

 Table 5- Captures in each habitat at Wellfleet

 Banding Station in Spring 2017. Totals are

 standardized for effort in the last column.

Habitat	Captures	/100 Net Hours
Saltmarsh Edge	116	22.4
Silver Spring	529	43.2
The Maze	193	27.2
Upland Field	244	22.7

Some common captures like Gray Catbird, American Goldfinch and Black-capped Chickadee were common in all habitats (Table 6). Other species like Magnolia Warbler and Blackpoll Warbler primarily occur in a single habitat, with most captures along Silver Springs.

Chipping Sparrows and Tree Swallows not surprisingly preferred the Upland Fields, while Northern Cardinals, House Wrens and Ruby-throated Hummingbirds preferred the denser habitat adjacent to the fields in The Maze. Baltimore Orioles were common in all habitats except Saltmarsh Edge, which was the preferred site for Savannah Sparrow, Song Sparrow and Eastern Towhee. Golden-crowned Kinglets had a big spring and we encountered them often along Silver Springs, in The Maze and surprisingly along the Saltmarsh Edge. Avian diversity in each zone drives home the importance of maintaining a mosaic of habitats for different species.

a) Upland Fields:		b) Silver Spring:		
Nets 1,3,9,11,18,19,22	2,61	Nets 2,5,6,7,16,21,24	l,25	
Species	Captured	Species	Captured	
1. Bl-capped Chickadee	41	1. Gray Catbird	88	
2. Tree Swallow	30	2. Goldcrowned Kinglet	51	
3. Chipping Sparrow	29	3. Magnolia Warbler	34	
4. American Goldfinch	23	4. Common Yellowthroat	33	
5. Gray Catbird	18	5. Baltimore Oriole	27	
6. Baltimore Oriole	12	6. Blcapped Chickadee	25	
7. Pine Warbler	10	7. Ruby-crowned Kinglet	24	
8. American Robin	9	8. American Goldfinch	20	
9. Carolina Wren	7	9. Red-winged Blackbird	19	
10. Northern Mockingbird	7	10. Blackpoll Warbler	19	
c) The Maze: Nets 10,12,	15,25	d) Saltmarsh Edge: Nets 14,15		
Species	Captured	Species	Captured	
1. Bl-capped Chickadee	41	1. Bl-capped Chickadee	22	
2. Gray Catbird	32	2. American Goldfinch	17	
3. American Goldfinch	23	3. Song Sparrow	5	
4. Goldcrowned Kinglet	15	4. Common Yellowthroat	4	
5. Northern Cardinal	8	5. Goldcrowned Kinglet	3	
6. House Wren	7	<b>6.</b> Gray Catbird	2	
7. Baltimore Oriole	6	7. Red-winged Blackbird	2	
8. Ruby-thr. Hummingbird	6	8. Eastern Towhee	2	
<b>9.</b> Pine Warbler	6	<b>9.</b> Savannah Sparrow	2	
10. American Redstart	5			

 Table 6 The ten most common captures in each habitat type in Spring 2018. Some species such as Black-capped Chickadees are present in all habitats. Others like Ruby-crowned Kinglet and Common Grackle were usually only captured in a single habitat.

#### Habitat Selection by Migrants

The resident status of songbirds at Wellfleet Bay can be broadly separated into 4 categories: 1) Yearround Resident - present on Cape Cod 12 months of the year (individuals present seasonally may be from different populations), 2) Summer Breeder - present as summer breeder, absent in winter 3) Winter Resident - present only in nonbreeding season, overwintering on Cape Cod, 4) Migrant - present only in spring or fall migration, neither breeding nor wintering on Cape Cod. Much of our interest is focused on how birds in the migrant category are using the Sanctuary. In Spring 2017, we caught 218 migrants across all habitats, well up from the 83 encountered in 2017, as a result of the heavy warbler migration.

Table 7- Number of migrant captures per habitat andnet loop during Spring 2018 banding operations atWellfleet Bay Wildlife Sanctuary. Migrants aredefined as species ONLY present during migration,not breeding or overwintering on Cape Cod.

Habitat	Migrant Captures	/100 Net Hours	Net Loop
Upland Fields	22	1.70	Dorm/Bay View
The Maze	32	2.72	Bay View
Saltmarsh Edge	3	0.99	Bay View
Silver Spring	172	12.07	Dorm Loop

Migrants appeared to favor the Silver Spring habitat during spring migration, with 78% or 172 of 218 migrants captures occurring in this habitat (Table 7). We captured 22 migrants in the Upland Field nets, split between the Dorm Loop and Bay View Loop. The Maze had 32 migrant captures and the Saltmarsh Edge only three. This preference for Silver Springs is just as pronounced when we control for net effort, with Silver Springs (12.07 migrants captures per 100 net hours) being 4-12 times higher than the other habitats. This is

springs and in the opposite to our findings in fall, when Bay View habitats are preferred, accounting for 80% of migrant captures while only accounting for 20% of net effort. Silver Spring's more protected and warmer inland location, with abundant oaks, is probably more conducive to insect activity in the spring, while the abundance of edge and open field habitat along the Bay View loop is preferred in the fall.

#### Summary

The 2018 season was a great continuation of spring banding at Wellfleet Bay Wildlife Sanctuary. Although the combination of strong migration and high banding effort lead to our highest capture totals for any spring, the wind associated with the Outer Cape did have a large impact early in the season, as there were no leaves to break it. Most of our captures were limited to local breeders or migrants breeding in habitats similar to the station, with a sprinkling of migrants to keep things interesting. Overlapping with the start of breeding also provides some good data on the timing of species breeding locally. While we are already gathering interesting findings on habitat use by land birds on the Sanctuary, it will only become more useful as we collect more data and consistent patterns begin to emerge.

Our outreach efforts reached new heights this spring, with many organized visits by paid groups, students of all ages, donor groups and our new focus on volunteer contributions. These visits went very well and our outreach efforts are paying dividends for all parties involved, educating the public and giving them the unique experience of seeing songbirds up close. This research belongs in a much wider scientific effort at the sanctuary and by Mass Audubon, and we are very pleased to contribute to these endeavors, content in the knowledge that our research will be combined with other findings to help influence conservation action and policy.

#### **Moving Forward**

We had a wonderful spring banding season in 2018, as we had a nice collection of captures and many wonderful opportunities for public outreach. All of our group visits went well and we introduced a lot of folks to bird banding in the hope of increasing their understanding and empathy for these animals. We look forward to building on our successes in Fall 2018 and beyond, improving both the quality of our data collection and the volume and impact of our outreach efforts.

The first and most important improvement for Spring 2018 was the continuation of the eBird census. Through eBird census, not only do we take additional scientifically valuable data to expand the scope of the project, but we also create opportunities for volunteers to become involved and get banders to "look beyond the nets" and notice more bird activity on site. Daily posting on eBird has enhanced the presence of Wellfleet Bay on the website during the banding season, and it has led to verified sanctuary visits by "twitchers" seeking specific species.

This was the second spring with an entire new collection of 22 (21 active, one spare) mist nets, all 32mm mesh size. This has reduced the number of tangled birds and challenging extractions, making the station safer for birds and more efficient to run while putting our effort more in line with other banding stations and setting the standard for future seasons.

We have reached our final net composition for the station and do not foresee any additional net changes. Net 23 had been slow for both seasons it has been in operation and is additionally very susceptible to wind and was dropped for this spring. All other nets were appropriate and will be kept in their current locations.

We must also work to increase the volume and quality of our outreach activities. While we were disappointed by the attendance of paid banding demonstration groups at the station this spring, we hope to improve on this in future seasons. The longer the station is established, the more it will be known among the Mass Audubon audience. Increased effort by sanctuary staff to inform the public about the station and our activities should help drive attendance. The daily update of the display in the visitor's center was well received and studied by many sanctuary visitors, increasing visibility and interest in the banding station.

To improve outreach, online daily eBird postings will continue and we will focus on targeting our potential audience through regular posting on Mass Audubon's Facebook and Twitter feeds. Although it is difficult to measure engagement in social media, this type of posting fits our research very well and we plan to refine our efforts in future seasons. It would also be nice to see more information about the bird research project (perhaps even sharing these reports) on the website, as it is currently limited to a mention in the Program Catalog. Organized school and donor groups were a huge hit this spring. Feedback from educators and fundraisers is universally positive and we hope to expand and improve these visits in upcoming seasons.

#### Acknowledgements

First and foremost, we thank our skilled and dedicated banders for their hard work and perseverance through the spring. Thank you Frankie Tousley and Valerie Bourdeau for making daily operation of the station possible and enjoyable. Thank you to our volunteers Mary Lou Heintz, Jeanette Bragger, Teresa Corcoran, Warren Mumford, Tod Christie and Frank Mockler as well as Jen and Jaden Henry for their interest and effort. We acutely missed Peg Dolan after her passing over the winter and our station was diminished in her absence, but we are happy for the seasons we shared with her.

Thanks to everyone at the sanctuary, but especially Mark Faherty, Bob Prescott and Julie Towne for helping to keep the station funded and operational, to Jenette Kerr for spreading our pictures across the internet and to Emily, Joel, Emily, Dana, Morgan and Spring for leading all the excited groups out to see the birds. Of course, we appreciate all the help from the Sanctuary volunteers and staff, too many to name, but thanks to you all the same. Thanks to the Junda family for all the support on Cape Cod and beyond. And finally, to all the classes and visitors who came to the station, we are always happy to see you and share our love of these birds.

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## Appendix A- Lists of All Species Captured and Censused At Wellfleet Bay Spring 2017

**Table 8-** A list of the 109 species banded during the first five seasons of banding operations at Wellfleet Bay Wildlife Sanctuary.

Species	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2016	Spring 2017
1 Acadian Flycatcher	0	0	1	0	0	0	1	0
2 Alder Flycatcher	0	0	0	0	о	1	0	0
3 American Goldfinch	48	63	1	56	147	36	159	82
4 American Redstart	5	2	14	2	27	4	29	18
5 American Robin	14	9	22	5	12	1	4	18
6 American Tree-sparrow	2	0	1	0	1	0	0	0
7 Baltimore Oriole	10	21	11	15	3	13	1	45
8 Barn Swallow	0	2	0	1	0	0	0	0
9 Black-and-white Warbler	1	4	1	9	3	5	4	14
10 Bay-breasted Warbler	0	0	0	0	0	1	0	0
11 Black-billed Cuckoo	1	0	0	1	1	0	1	0
12 Black-capped Chickadee	136	33	94	36	100	11	55	128
13 Blue-gray Gnatcatcher	0	0	0	0	0	0	1	1
14 Blue-headed Vireo	5	0	12	0	8	2	8	2
15 Blue Jay	16	10	47	2	56	5	30	10
16 Blackpoll Warbler	9	0	18	9	44	11	19	23
17 Brown Creeper	10	0	3	1	18	0	6	5
18 Brown-headed Cowbird	0	5	0	5	0	3	0	2
19 Brown Thrasher	0	2	2	1	4	0	0	0
20 Black-throated Blue Warbler	1	2	2	1	20	3	6	5
21 Black-throated Green Warbler	1	1	6	0	4	1	5	2
22 Blue-winged Warbler	1	0	0	1	0	0	0	1
23 Canada Warbler	0	0	0	1	0	4	2	5
24 Carolina Wren	7	0	5	1	7	6	8	1
25 Cape May Warbler	0	0	0	0	0	0	6	14
26 Cedar Waxwing	0	1	1	2	2	7	1	1
27 Chestnut-sided Warbler	0	1	0	1	0	0	134	2
28 Chipping Sparrow	47	11	20	27	26	21	2	33
29 Clay-colored Sparrow	0	0	0	0	2	0	6	0
30 Common Grackle	0	28	2	15	5	20	2	12
31 Common Yellowthroat	9	18	28	13	13	29	35	47
32 Connecticut Warbler	0	0	1	0	1	0	0	0
33 Dickcissel	1	0	0	0	1	0	0	0
34 Downy Woodpecker	10	1	12	0	25	0	3	7
35 Eastern Bluebird	13	0	18	0	46	1	5	8
36 Eastern Kingbird	0	1	0	2	0	1	0	6
37 Eastern Phoebe	17	0	14	4	19	4	25	6

Species	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2016	Spring 2017
38 Eastern Towhee	21	17	43	10	22	5	7	9
39 Eastern Wood Pewee	0	0	0	0	1	1	1	0
40 Eurasian Starling	0	0	0	0	0	1	0	0
41 Field Sparrow	23	3	20	9	12	4	9	9
42 Fox Sparrow	1	0	1	0	0	0	0	0
43 Great-crested Flycatcher	0	4	1	4	0	1	0	1
44 Golden-crowned Kinglet	6	0	14	4	32	5	20	68
45 Gray-cheeked Thrush	3	0	1	1	0	0	0	0
46 Gray Catbird	88	155	184	78	129	105	101	141
47 Hairy Woodpecker	5	3	3	0	4	1	3	3
48 Hermit Thrush	16	0	10	5	8	0	2	0
49 House Finch	32	5	14	5	12	1	10	6
50 House Sparrow	1	2	0	6	1	7	0	3
51 Hooded Warbler	0	0	0	1	0	1	0	1
52 House Wren	1	3	2	0	2	1	10	14
53 Indigo Bunting	3	1	1	0	0	1	2	0
54 Kentucky Warbler	0	0	0	0	0	1	0	0
55 Least Flycatcher	0	1	0	0	2	1	1	3
56 Lincoln Sparrow	1	0	1	3	6	1	6	4
57 Louisiana Waterthrush	0	1	0	0	0	0	0	0
58 Magnolia Warbler	3	5	0	10	6	20	10	40
59 Marsh Wren	1	0	0	0	2	0	1	0
60 Mourning Warbler	0	0	0	0	1	1	3	0
61 Myrtle Warbler	132	1	50	12	102	9	105	20
62 Nashville Warbler	3	0	11	0	4	2	13	3
63 Northern Cardinal	68	20	29	27	46	20	25	21
64 Northern Mockingbird	0	1	0	3	0	2	0	10
65 Northern Flicker	9	1	8	2	5	1	3	5
66 Northern Parula	0	1	0	1	0	3	2	18
67 Northern Waterthrush	3	3	5	3	4	2	19	14
68 Northern Rough-winged Swallow	0	0	0	1	0	0	0	0
69 Orange-crowned Warbler	5	0	3	0	4	0	7	0
70 Orchard Oriole	0	6	0	1	0	3	0	17
71 Olive Sided Flycatcher	0	0	0	0	0	1	0	0
72 Ovenbird	0	2	2	2	1	3	4	4
73 Palm Warbler	5	0	3	5	18	6	31	2
74 Philadelphia Vireo	2	0	0	0	1	0	6	0
75 Pine Siskin	1	0	0	0	0	0	0	0
76 Pine Warbler	33	12	32	16	136	25	173	29
77 Prairie Warbler	0	3	2	7	4	5	8	3
78 Purple Finch	2	1	0	0	2	0	0	0

Species	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2016	Spring 2017
79 Red-bellied Woodpecker	2	0	2	2	0	1	2	2
80 Red-breasted Nuthatch	0	1	2	6	13	2	7	11
81 Rose-breasted Grosbeak	0	0	1	0	0	0	4	2
82 Ruby-crowned Kinglet	28	1	14	15	51	7	30	27
83 Red-eyed Vireo	23	2	28	1	36	2	30	5
84 Red-winged Blackbird	2	38	1	13	1	13	1	22
85 Savannah Sparrow	2	0	0	2	0	2	0	5
86 Slate-colored Junco	48	1	5	0	34	3	6	0
87 Scarlet Tanager	2	1	1	0	0	1	1	0
88 Song Sparrow	58	6	61	8	43	10	23	22
89 Summer Tanager	0	0	1	0	0	0	0	0
90 Swamp Sparrow	14	0	0	3	20	4	14	0
91 Swainson's Thrush	0	0	1	0	3	0	0	2
92 Tennessee Warbler	0	1	0	0	0	0	3	0
93 Tree Swallow	0	71	0	17	0	19	0	34
94 Tufted Titmouse	24	1	38	4	33	6	23	16
95 Veery	1	1	2	1	1	1	1	0
96 Warbling Vireo	0	0	0	0	3	0	0	1
97 White-breasted Nuthatch	3	3	2	4	4	2	1	2
98 White-crowned Sparrow	1	1	0	0	1	0	0	1
99 White-eyed Vireo	1	0	2	0	0	0	3	0
100 White-throated Sparrow	45	2	15	25	12	4	22	15
101 Willow Flycatcher	0	0	0	2	0	0	0	1
102 Wilson's Warbler	0	0	3	1	6	5	10	15
103 Winter Wren	0	0	0	0	2	0	0	0
104 Wood Thrush	0	0	0	2	0	0	0	2
105 Yellow-bellied Flycatcher	0	1	0	0	0	0	0	0
106 Yellow-breasted Chat	1	0	3	0	3	0	3	0
107 Yellow-bellied Sapsucker	2	0	1	1	0	0	2	1
108 Yellow-billed Cuckoo	0	0	1	0	0	0	2	0
109 Myrtle Warbler	132	1	50	12	102	9	105	20
111 Yellow Warbler	1	2	0	4	2	11	2	17
112 Yellow-throated Warbler	0	0	0	0	0	1	0	0
Season Total	67	59	68	65	72	72	74	72

## Appendix A- Lists of All Species Captured and Censused At Wellfleet Bay Spring 2018

 Table 7- A list of the 116 species and number of days observed during daily eBird census at Wellfleet Bay

 Wildlife Sanctuary during Spring 2018 banding operations.

Species	Days	Species	Days
1 American Crow	38	60 Cedar Waxwing	12
2 American Goldfinch	38	61 Eastern Screech-Owl	12
3 Black-capped Chickadee	38	62 Green Heron	12
4 Blue Jay	38	63 Northern Parula	12
5 Common Grackle	38	64 Ruby-crowned Kinglet	12
6 Mourning Dove	38	65 Yellow Warbler	11
7 Northern Cardinal	38	66 Common Loon	10
8 Red-winged Blackbird	38	67 Yellow-rumped Warbler	9
9 Song Sparrow	38	68 Mallard	8
10 Tufted Titmouse	38	69 Golden-crowned Kinglet	6
11 American Robin	37	70 Great Blue Heron	6
12 Carolina Wren	37	71 Red-breasted Merganser	6
13 Red-bellied Woodpecker	37	72 Ring-billed Gull	6
14 Tree Swallow	37	73 Ruby-throated Hummingbird	6
15 Fastern Bluehird	36	74 Sanderling	6
16 Field Sparrow	26	75 Blackpoll Warblor	5
17 Northorn Elister	30	75 Blackpoll Waldel	5
	30		5
18 Pine Warbler	35	77 American Redstart	4
19 Wild Turkey	35	78 Brown Thrasher	4
20 Chipping Sparrow	34	79 Eastern Kingbird	4
21 Northern Mockingbird	34	80 Lesser Yellowlegs	4
22 Red-breasted Nuthatch	34	81 Magnolia Warbler	4
23 Hairy Woodpecker	33	82 Semipalmated Plover	4
24 Downy Woodpecker	32	83 Short-billed Dowitcher	4
25 Eastern Towhee	32	84 Black-and-white Warbler	3
26 Herring Gull	31	85 Black-throated Green	3
27 Willet	31	86 Bufflehead	3
28 Greater Yellowlegs	30	87 Least Sandniner	3
29 Fastern Phoehe	28	88 Palm Warbler	3
20 House Einch	20	80 American Kestrol	2
21 Brown booded Cowbird	20	00 Ray broasted Warbler	2
31 Brown-neaded Cowbird	27	90 Bay-Dreasted Warbier	2
32 Canada Goose	26	91 Blue-gray Ghatcatcher	2
33 Great Black-backed Gull	26	92 Cape May Warbler	2
34 House Sparrow	26	93 Eastern Wood-Pewee	2
35 Brant	25	94 Least Flycatcher	2
36 American Black Duck	24	95 Northern Gannet	2
37 Baltimore Oriole	24	96 Rusty Blackbird	2
38 Gray Catbird	24	97 Savannah Sparrow	2
39 Snowy Egret	24	98 Warbling Vireo	2
40 Barn Swallow	23	99 Wilson's Warbler	2
41 Belted Kingfisher	23	100 Wood Thrush	2
42 Common Yellowthroat	22	101 Black-throated Blue Warbler	1
43 Double-crested Cormorant	22	102 Blackburnian Warbler	1
10 Double crested connordine	22	103 Blue-beaded Vireo	1
45 White breasted Nutbatch	22	105 Bide-fielded Wieb	1
45 White-bleasted Nuthatch	22	104 Callada Walblei	1
40 Black-Dellieu Plover	21	105 Criestriut-sided Warbier	1
47 Prairie Warbler	20	106 Dark-eyed Junco	1
48 European Starling	19	107 Hermit Thrush	1
49 Fish Crow	19	108 Hooded Merganser	1
50 Great Crested Flycatcher	18	109 Lincoln's Sparrow	1
51 House Wren	17	110 Nashville Warbler	1
52 Osprey	17	111 Parasitic Jaeger	1
53 White-throated Sparrow	16	112 Red-shouldered Hawk	1
54 Great Egret	15	113 Solitary Sandpiper	1
55 Laughing Gull	15	114 Wood Duck	1
56 Orchard Oriole		115 Yellow-bellied Sansucker	-
57 Dunlin	13	116 Vellow-bened Sapsucker	1
57 Dunini E8 Overbird	10		T
	13		

## Appendix B- Maps of Wellfleet Wildlife Sanctuary Banding Station



Figure 8- Map of Wellfleet Banding Station in Spring 2018.

## Appendix B- Maps of Wellfleet Wildlife Sanctuary Banding Station

Figure 9- Map of Wellfleet Banding Station eBird Census loop. The Dorm Loop is marked in red and The Bay View loop is marked in pink. In addition to walking each loop twice, five specific spots (marked with an X) are check each day: Saltmarsh Creek, Bay View Overlook, Saltmarsh Overlook, Visitor's Center Feeder and Solar Panels.

