

MIGRATIONAL MOVEMENTS AND HABITAT USAGE OF MIGRANT PASSERINES IN THE  
GREAT LAKES REGION: OTTAWA NATIONAL WILDLIFE REFUGE, OHIO

PROGRESS REPORT-2017  
BSBO-18-1

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INTRODUCTION

In 2017, Black Swamp Bird Observatory continued a long term passerine migration study on the Ottawa National Wildlife Refuge complex in the southern Lake Erie region. Specific goals of the project are to monitor the population status of Neotropical migrants in the Great Lakes region and to better understand the relationship between en-route habitat and their breeding and winter ecology in order to inform conservation decisions that protect these species throughout the entire life cycle. Lake Erie represents a barrier to most passerine migrants. Passerines reluctance to navigate open water results in major concentrations along the southwestern shore of Lake Erie, unparalleled in the Midwest. With continuing habitat loss along both the Lake Erie coast and inland, this study will assist in monitoring the effects of habitat isolation and degradation on use by these species. There are only four small segments of beach ridge habitat remaining west of Port Clinton along Ohio's Lake Erie shoreline. The intensive bird use of these ridges in contrast to the adjacent condominium complexes and marinas signifies the importance of this habitat component in the Lake Erie marsh system. A wide range of migration corridor and stopover habitat occurs throughout the region (Ewert et al. 2006), but these sites do not contain bird concentrations as high as the beach ridges. The fall appears to paint a different picture with habitat further from the lake indicating much greater use. A complex of study sites are necessary to fully examine habitat use, migrational timing, and energetic condition of birds.

The importance of understanding avian migration and stopover habitat needs has greatly increased over the past two decades as tropical deforestation and temperate forest fragmentation have expanded and songbird populations have declined. Little information is known about the "problems" migrants contend with along their migratory routes (Morse 1980), not to mention the transition between spring migration and the breeding period. Recent studies have indicated upwards of 80% of annual mortality occur during migration for many landbirds (Sillett and Holmes 2002). To offset the energetic costs of migration, birds deposit substantial lipid reserves which may reach 50% body weight among long distance intercontinental migrants (Berthold 1975). As lipid stores are depleted during migration, birds are capable of replenishing reserves in a few days at rates approaching 10% body weight per day (e.g. Barlein 1985; Biebach *et al.* 1986; Moore & Kerlinger 1987). These lipid deposits are obviously critical for a successful migration, and they may also provide a selective advantage to the migrant

with energy reserves remaining (see Sinclair 1983; Ojanen 1984; Krapu *et al.* 1985; Kremetz & Ankney 1987). Adequate stopover habitat may play an important role in delivering migrating passerines to their breeding grounds with sufficient energy reserves to successfully nest.

In addition to the biological stressors confronting migratory birds, the changing landscape presents increasing risks of human-induced mortality and individual and population stressors. Only in the past year or two has there been a movement to recognize the air column as a vital habitat of birds. Much of their life cycle is spent in this habitat component. A variety of communication towers for radio, television, and cell phones dot the regional landscape. Huge kills have been documented at the battery of guy-wired towers south of Maumee Bay by farmers surveying field preparedness during spring migration. One such incident involved a bushel basket of male Rose-breasted Grosbeaks brought to the state wildlife office in Oak Harbor for identification by the farmer. This was a single night event under one tower and represented a large easy to see species, suggesting that many more cryptic, small birds went undetected. As the 21<sup>st</sup> century unfolds, a new threat has emerged in the form of increasing interest in wind power as an alternative power source. The cumulative negative effect on the avian resource in a highly important stopover area such as the western basin is of great concern to the future maintenance of avian populations through the eastern United States.

To this end, this project is an important part of a massive study being conducted along the western basin of Lake Erie. Multiple methodologies are being brought together to quantify their effectiveness of representing migration and risk to individuals, to identify nocturnal movements and their volume in this highly important stopover habitat, and to quantify ascent and descent trajectories of birds arriving and leaving the region. A study of this size - involving multiple radar units, comprehensive banding operations, and region-wide point counts - has not been conducted in the region to date.

There is no substitute for long-term monitoring to address many pressing questions regarding health of the environment in general and of birds specifically. Annual, site, species, and weather variation results in large uncontrollable parameters that cloud short-term studies. There are few long-term (greater than 20 years) programs for resource managers to utilize to inform decision making processes. These long-term datasets, such as the Navarre banding station, offer the greatest value in the interpretation of long-term ecological change.

### STUDY AREAS

Black Swamp Bird Observatory (BSBO) banding sites are centered along the western basin of Lake Erie in Ohio. The primary site is located at the Navarre Unit of Ottawa National Wildlife Refuge and is located on the largest remaining beach ridge along the western basin of Lake Erie which holds the most complete native beach ridge vegetative complex. Habitat at the site is dominated by Carolinian forest with multiple bands of wetland associations. Hackberry and Kentucky Coffeetree along with Eastern Cottonwood and White Ash make up the majority of overstory. The understory is primarily several species of Dogwood, Buttonbush, and Bush Honeysuckle. Herbaceous layers include a wide variety of herbs, sedges, and grasses. There is a diverse wildflower component but considerable damage from invasive Garlic Mustard and overgrazing by White-tailed Deer are stressors to this layer.

## METHODS AND MATERIALS

In 2017, migrating and resident passerines were sampled on the Navarre Unit of the Ottawa National Wildlife Refuge in the Great Lakes region: Banding and point count efforts covered a minimum of 75% of the migration period for the study site. Every attempt was made to equalize any un-sampled parts of the migration period at the beginning and ending time frame. The migration period covers both short distance and long distance (Neotropical) migrants. Spring migration operation in 2017 began mid-April and continued through early-June. Fall migration banding was mid-August to early November.

Placement of mist nets is designed to represent the habitat at the site and to bisect primary bird movement direction and corridors. Mist nets are considered a random method of capture with the premise being they are undetectable by foraging and traveling birds. This is a broad assumption with many caveats that must be considered in data analysis. In reality not all birds have equal chance of capture. Bird size affects the chances of being captured and held in the net, species behavior can be a factor across species, height of activity is a factor, and weather effects can occur on any given day.

Mist netting was conducted from one-half hour before sunrise to at least 11:00 AM on each day of operation, weather permitting. Birds were captured utilizing 2.6 x 12 meter mist nets of 30mm mesh size. All birds were removed from the net, with the band and net recorded if previously banded, and placed in a mesh holding bag until processing. During processing, each bird was banded with a standard U.S. Fish & Wildlife Service leg band, measured by closed wing chord, body mass recorded, visually inspected for subcutaneous fat deposits using a 7-point ordinal scale (Helms & Drury 1960), and time stamped to net round. Birds were sexed and aged by the use of plumage characteristics (Pyle 1997) and guidelines of the Bird Banding Manual and Woods Manual (Woods 1969). Weather data were compiled from hourly readings of Toledo Edison's Davis Besse Nuclear Power Station.

Point counts were spaced evenly throughout the banding station defined by the area covered by nets. Points are located a minimum of 100 meters apart to reduce the potential of double counting individuals. This assumption may not always be fulfilled as the migration period is characteristic of the definition of an open population as individuals may be actively migrating all day long. The Navarre route follows the primary direction of bird movement.

Point counts were conducted during both spring and fall migration to complement mist-netting operations and document species such as larger birds that are not typically captured by mist-nets. Counts were conducted for five minutes in which all birds seen or heard were recorded. Counts were run after net set up each morning permitted by weather and avian abundance. Point counts were canceled on extremely high wind or high bird activity days.

A daily list of species was compiled to document presence/absence for each site. This method complements the banding and point counts by acknowledging all species seen on a given day. This

assists in rare species documentation and provides more complete information on arrival and departure dates for all species, particularly those that are unlikely to be banded in numbers reflecting their true abundance.

## RESULTS

### SPRING

Spring migration was monitored, weather permitting, daily in the Navarre Unit in 2017. Spring 2017 was characterized by above normal temperatures in April but a very cold early May in Northwest Ohio though with some wide temperature swings (Figure 1). This pattern appeared to affect migration timing for both short-distance migrants and long-distance Neotropical migrants. Low pressure cells had a tendency to track up into the Great Lakes. Good diversity and below average volume, was recorded at the Navarre station.

Through our research, we have found large numbers of Neotropical and short-distance migrants arrive in three “waves”. These waves are generated by weather patterns and migrational drivers of each individual species. Day length is the primary driver initiating migration in birds. This results in definable and predictable timing of migration annually. Weather patterns at the time of movement affects the fine-scale details of the movement. For the Lake Erie Marsh Region a low pressure cell centered in the Arkansas/Oklahoma region spins warm fronts that pick up warm tropical winds and pushes migrants up the Mississippi and Ohio River drainages. This front is depicted by a jump in temperature, southwest winds and stormy weather leading to major movements of passerines. These patterns generally occur approximately every 7 days. Each “wave” of migrants is dominated by certain species and sex classes of birds with a large number of associated species. Males tend to precede a week to ten days ahead of females in most species in migration. For the Lake Erie Marsh Region, the first wave occurs around 24 April and is dominated by male White-throated Sparrow, Hermit Thrush, male Yellow-rumped Warbler, and male Ruby-crowned Kinglet. In 2016, this wave had a good first pulse but had a fair second pulse, peaking 25-27 April. The second wave occurs 07-13 May and is represented by the greatest species diversity of the spring. It is dominated by female White-throated Sparrow, Swainson’s Thrush, female Yellow-rumped Warbler, female Ruby-crowned Kinglet, and male Magnolia Warbler. A second pulse of this wave comes five to seven days later, and usually has the largest volume and contains the same dominant species. This second wave was excellent and occurred 07-11 May with a second pulse on 14-17 May which transitioned into third wave birds. The third wave normally occurs around Memorial Day weekend and is dominated by female Magnolia Warbler, American Redstart, Mourning Warbler, vireos, and flycatchers. In 2016, the third wave peaked 24-26 May. Predation from mink precluded identification of the second pulse of this wave as migration diminished in early June.

### Navarre Banding Station, Ottawa County, Ohio (413-0830)

In spring 2017, the Navarre banding station was operated on 48 days for 6,213.9 net hours. Including hummingbirds, 5,775 new birds were banded and a total of 6,828 birds handled (Table 1). The capture

rate was 109.9 birds/100 net hours. This compares to the long-term average (1992-2016) of 121.3 birds/100 net hours (-9% from average). The long-term average shows no change over time of the capture rate at Navarre. One hundred and one species plus one hybrid warbler were banded in Navarre during spring 2017 (Table 2). The most unusual species and subspecies included Northern Saw-whet Owl, Savannah Sparrow, and Kentucky Warbler. The ten most abundant species banded were White-throated Sparrow (432), Magnolia Warbler (430), Traill's (Alder/Willow) Flycatcher (375), Yellow Warbler (342), Gray Catbird (342), Ruby-crowned Kinglet (255), American Redstart (248), Common Yellowthroat (241), Yellow-rumped Warbler (188), and Swainson's Thrush (185).

Point counts were initiated in 1995 as a part of the data collection at the Navarre site. These counts provide the best data for larger birds not sampled by mist nets. Point counts were conducted on 47 days during spring 2017. One hundred and thirty-six species and 17,341 individuals were recorded (Table 3). Northern Cardinal, Red-winged Blackbird, Common Grackle, Song Sparrow, and Tree Swallow were observed each count day. The most abundant species recorded was Red-winged Blackbird (2,729) followed by Blue Jay (2,506), Canada Goose (1,606), Tree Swallow (1,010), and Common grackle (920).

## FALL

Fall migration starts in July for many species and some breeding Neotropical migrants (e.g., Yellow Warbler) have left the study area by mid-August. Fall temperatures were near normal in August with early September below average and late September into October above average (Figure 2). Fall bird migration is dominated by different stimuli than in spring. Weather conditions appear less important and food availability appears to be a key factor. Additional factors include young inexperienced birds and molt status of individuals.

### Navarre Banding Station, Ottawa County, Ohio (413-0830)

The Navarre main station was operated 61 days for 5,761.8 net hours. Three thousand five hundred and eighty-five birds were banded with a total of 4,276 birds handled including recaptures (Table 4). This was the 25th fall season in which an extensive netting effort had been conducted on a daily basis. The capture rate for 2017 was 74.2 birds/100 net hours. A total of 88 species were banded during fall 2017 (Table 5). The ten most abundant species banded were Blackpoll Warbler (449), Swainson's Thrush (390), Gray Catbird (367), Golden-crowned Kinglet (224), White-throated Sparrow (202), Ruby-crowned Kinglet (189), Gray-cheeked Thrush (173), Hermit Thrush (139), Myrtle Warbler (105), and Magnolia Warbler (90). Several surprises were captured during the fall season and included Cooper's Hawk, Eastern Screech Owl, Yellow-billed Cuckoo, Golden-winged Warbler, Marsh Wren, and Kentucky Warbler.

Fall point counts were conducted on 65 days during 2017. A total of 14,762 individuals of 122 species were recorded (Table 6). The Northern Cardinal was observed on all count days. The most abundant species were Red-winged Blackbird (3,589), Canada Goose (1,865), Common grackle (1,094), European Starling (660), Gray Catbird (564), Cedar Waxwing (522), Northern Cardinal (496),

American Robin (432), Swainson's Thrush (429), and White-throated Sparrow (429).

### SUMMARY BANDINGS

Total combined bandings for passerine migration 2017 for the Navarre Station is in Table 7. The ten most abundant species banded at Navarre were Gray Catbird (709), White-throated Sparrow (634), Swainson's Thrush (575), Ruby-crowned Kinglet (544), Blackpoll Warbler (528), Magnolia Warbler (520), Traill's Flycatcher (382), Yellow Warbler (353), Common Yellowthroat (319), and American Redstart (309). A combined total of 107 species of 9,360 individuals (78.2 birds/100 net hrs) were banded.

### RETURNS AND RECOVERIES

A long term study of this type has an added benefit to develop return rates and survival rates over time. One assumption that has not been verified is that passerines often return to the same breeding grounds to nest. There is substantial evidence for this but more research is needed to confirm the rate of this phenomenon. There is less evidence available regarding site fidelity to migration stopover sites. During 2017, 275 birds of 24 species were captured as returning birds at the Navarre site (Table 8). This total includes 59 Yellow Warblers with the oldest being banded in 2009, 72 Gray Catbirds with the oldest from 2011, 13 Common Yellowthroats (oldest from 2012), 23 Red-winged Blackbird (oldest from 2010), 34 Northern Cardinals (oldest from 2011), and 11 Baltimore Orioles (oldest from 2012). The long term study at Navarre has resulted in state longevity records for the Indigo Bunting, Yellow Warbler, Prothonotary Warbler, Warbling Vireo, Eastern Wood Pewee, Brown Creeper, Northern Waterthrush, Ovenbird, Great-crested Flycatcher, Cedar Waxwing, and Hermit Thrush. The Yellow Warbler and Indigo Bunting records surpass the species record as reported by the Bird Banding Laboratory. Foreign encounters of study site birds are shown in Table 9. Continued analysis in this area will hopefully shed some light on turnover rate and site fidelity in some species.

### DISCUSSION

Black Swamp Bird Observatory has conducted bird migration monitoring research in the Lake Erie Marsh Region for more than 40 years. Annual variation in migrational monitoring numbers makes statements concerning populations very risky, even with long-term datasets. This past spring resulted in a below average capture rate which followed a low year in 2016. This cycle that is emerging is interesting and needs to be investigated further. Determining what contributes to this great variability and how can it be quantified is a challenge. Does the variability represent true population fluctuation, is it an artifact of sample design, vagrancy of weather patterns, or some combination of these and untold factors? Understanding these vital questions will provide considerable value to bird conservation initiatives both today and into the future. It is through long-term studies such as this that these answers may be sorted out and some sense of landbird populations be made. To implement and accomplish life cycle conservation many hard questions will need to be addressed. Climate change is on the front burner of many conservation efforts today. Only through long-term comparisons will real change and avian response be documented. Will there be breeding and wintering range changes; will

there be vegetative response to climate change; will migration timing be altered in response to food sources, or will there be biological cost? Long-term studies will allow for a more in depth analysis of weather patterns and bird activities in migration to tease apart annual variability and trend changes.

Long-term data do not support a major change in migrational timing of the core of any population. However, there may be evidence of an increase in early individuals of some species in the spring. This may be an indicator of a larger portion of a species “short-stopping” in southward migration or an increased survival of those that are always an exception to the norm. Fall migration is much more drawn out with heavy age affects on observations. Even with 20 years of data, annual variation still clouds inference of migrational changes. Core timing can be established for both spring and fall for most landbird species covered by this study.

Black Swamp Bird Observatory operates multiple banding stations to acquire a clearer picture of migration along Lake Erie and its environs. Many questions pertaining to stopover habitat values and use can be addressed by multiple sites that can't be by any one site alone. Not all species utilize the stopover habitat that makes up the marsh region the same. Several species such as Yellow-rumped “Myrtle” Warbler and White-crowned Sparrow appear common everywhere but are much more common away from the lake shore. Magnolia Warbler concentrates heavily on the beach ridges and occurs at a much lower frequency a half mile or more from the lake. Station comparisons have identified that a much wider range of habitats are of importance and in need of protection to accomplish conservation goals in the region. Lake effect on migrating landbirds is demonstrated through the multiple banding sites. Lake Erie is a major water barrier to landbirds. Reluctance to cross the lake results in large concentrations seen at birding “hotspots” such as Magee Marsh Wildlife Area and Ottawa National Wildlife Refuge. Banding data from the Navarre station indicate spring averages of 8,000 birds banded and fall at 5,500 when up to four times as many birds should exist in the population. This spring-dominated figure is a direct result of lake effect and how birds use the habitat. Spring and fall comparisons of sites show differential use and species composition which provides valuable information to habitat priorities in land acquisition and management. Lake effect may also be a player when reviewing the data for distance from the lake. Spring indicates concentrations are largely adjacent to the lake on the beach ridges, birds pushing against the barrier. Fall paints another story. Much lower bird concentrations are seen along the lake shore in fall but a vast increase is noted inland during fall migration. This may represent the descending range of those crossing the lake. The species composition also differs with distance from lake. Warblers and thrushes dominate along the shore; while sparrows are most abundant inland. Studying age ratios during migration gives an insight to reproductive success and habitat use variation. Few of these species can be adequately studied on their breeding or wintering grounds, so as a result, migration becomes a window of opportunity to look at population based parameters for conservation. These age ratios can be compared between sites, between years, between seasons to better understand population status, habitat needs, and conservation priorities.

Comparing spring and fall migration is an important part of life cycle conservation. It is not just breeding, wintering, and migration. Considerably different drivers are of importance between the two migrational seasons. Spring migration is driven northward by the urge to breed. These hormonal

factors contribute to individuals pressing against unfavorable environmental conditions that can have serious survival ramifications. Fall migration appears to be more laid back as birds build body condition from the stresses of breeding or are facing their first migrational experience. Fall tends to be slower with longer stopover. Many species demonstrate differential migration routes between the two migrational periods. Three distinct patterns are apparent in the northward migration from Central America. There is the Caribbean route, trans-Gulf route, and the westward passage around the Gulf of Mexico. All three groups join in the Great Lakes. Several species show a more direct route up the Mississippi River in their core movement north to the Northwest Territories of Canada and Alaska. Others are moving through the Lake Erie region to the boreal forest of eastern Canada and northern United States. The Great Lakes also create a funneling affect during fall migration as birds from the prairies to eastern Canada make contact with the lakes north shores. Some cross the continent diagonally from the northwest into the Great Lakes and southward to the Appalachians and Atlantic seaboard. Others come from eastern Canada and continue towards Texas and southward. Another important aspect of avian life cycle conservation is the understanding of connectivity among habitats utilized across the year. A coordination of multiple banding stations provides opportunity to link wintering grounds, migrational pathways, and breeding areas for a species or population. As these linkages are better understood a better ability to manage species will be reached. Many larger well-studied species such as waterfowl are recognized to have many independent populations of a given species; each of these having different stressors, threats, and habitat needs. The importance of population differences is totally unknown among landbird species and hinders strong and sound conservation efforts.

The results of this project suggest the need to establish a standardized sampling protocol across the Great Lakes region. The collection of similar data has the advantage that it allows comparisons across different study sites throughout the landscape. This study has developed a multi-method approach that can be reproduced anywhere in the upper Midwest. A combination of banding, count surveys, and daily species list permits the strengthening of weaknesses of each and builds on their individual strengths. It also allows for the use of other, less skill intensive methods such as counts to be done along a broader front and still be comparable to more detailed banding operations. This protocol will accommodate new methods such as radar and acoustics as they become available.

This study is the building block for such a network being considered for the Great Lakes region by the U.S. Fish and Wildlife Service at this time. This network's goal is to bring multiple field researchers together to collaborate on big picture questions for the region. Similar field methods allow for site comparisons, habitat comparisons, body condition, migrational timing, and decision support for wind turbine placement among regional questions. This network, supported by a central database (the Midwest Avian Data Center) will assist researchers, sample design, and analysis effectiveness. Data from this study will be submitted to the Data Center.

Birds far from breeding or wintering areas are seldom encountered multiple years at the same stopover location. Little is known about how strong migrational route fidelity is in passerines. Before 2011, this study had only two individual birds not known to breed close to the marsh region recaptured at this site in two different migrational seasons, out of 350,000 birds banded. This highlights the importance of the seven returns of Blackpoll Warblers during fall 2011 and an additional two in fall 2012. A



species that breeds from Alaska across the subarctic front and wintering in South America was a long way from terminus locations. To have this many encounters homing to a single stopover location indicates an extreme importance of the region to this species' life cycle conservation. This total included a bird first banded in 2006, an individual that has logged a minimum of 50,000 miles in migration and endured at least five crossings of the Atlantic Ocean to South America, each consisting of 80 hours of non-stop flight. Repeated use of stopover habitat in the marsh region supports the continental importance of the region to migratory birds.

One of the biggest emerging threats to migratory birds in the past decade is the proliferation of wind power in the upper Midwest. Only in the past few years has the importance of the air column as a habitat to birds been recognized. Much of their life cycle is spent in this habitat. With the Lake Erie marsh region being possibly the most important stopover habitat in eastern North America, identifying habitat needs and use of migrants is of utmost priority for informed decision making of regulatory agencies. Risk to migratory birds need to be identified. This includes documentation of ascent and descent rates and angles of migrants into the stopover habitat, elevation and volume of migrants, feeding flight activity, movement in relationship to lake shore, and movement over the open lake. Project personnel have been instrumental in bringing partners together to begin answering these questions. U.S. Geological Survey and Bowling Green University have provided radar units to document nocturnal movements, Ohio State University has a graduate student conducting point counts in the region, while BSBO provides the systematic banding program. Objectives are to answer bird movement questions and to evaluate the effectiveness of banding and point counts to represent migration.

Long-term studies of this nature offer opportunities to annually address research questions but to also consider those that only long-term datasets can access. Personnel are presently working on manuscripts addressing the use of DNA analysis to document a first species record for Ohio, the use of migrational banding stations to address population trends in species of concern, migrational timing and effects of climate change, and use of age ratios in addressing population health. Future analyses will include development of migrational species accounts for the region. Additional manuscripts with partners working with radar technology will be developed as those projects mature.

### ENVIRONMENTAL EDUCATION

A secondary goal of this study is to educate the general public on avian migration, research, habitat management, and ecosystems. During 2017, project personnel entertained 25 groups at Navarre and the Black Swamp Bird Observatory Nature Center educating 1,200 individuals on migration and banding. In addition, six presentations were made to 400 people on avian ecology and migration. In addition, an estimated 70,000 individuals were educated through face to face interaction and print and video media about the importance of the western basin of Lake Erie as a stopover habitat for migrating landbirds during the Biggest Week in American Birding Festival in early May.

### MANAGEMENT RECOMMENDATIONS

Adequate stopover habitat is a necessity if migrating birds are to successfully reach breeding and wintering home ranges each year. While the Lake Erie marsh region may contain extremely important breeding habitats for some species, it is of much greater importance in meeting migration stopover

needs. The combination of quality marshland, scrub-shrub upland and swamps, and wooded beach ridges provide food, water, and shelter for migrants. Intensively managed wetlands form the base for this habitat complex in the Lake Erie Marsh Region. The invertebrate populations required by the massive bird movement are born from these wetlands and shelters in the scrub and on beach ridges. This scrub-shrub and beach ridge habitat provides shelter from weather and protection from predators as well as their food source. Rough-leaved Dogwood dominates the shrub habitat providing vast surface area for invertebrates as well as fall migrating birds. Any management scheme at this latitude needs to recognize the over-riding importance of the region as stopover habitat for migrants. With the exception of the Gulf coast, no other region of eastern North America can demonstrate concentrations of avian migrants like Lake Erie's coast.

Management of these habitats needs to ensure protection of the remaining beach ridges and to provide both healthy wetlands and adequate shrub habitat. The mature forests of the Great Black Swamp once held many breeding species, but this habitat should not be a management priority. While migrational needs can be addressed in concentrated habitat units, to meet acreage requirements to influence breeding volume is presently beyond management resources. Wetland and moist soil habitats need to be managed to ensure water inundation during critical spring months to provide the substrate required for abundant invertebrate production. A well planned rotation of management units must be incorporated for summer and fall management plans to accommodate the habitat needs of the different migrant species, including deep water marshes, shallow water marshes, and moist soil areas. Shrub and grassland habitat management should consider migration as well as breeding needs. Management scenarios should also include food and cover during migration as well as protection during breeding season. Dike systems should be designed to incorporate scrub borders to provide travel lanes for migrants to mimic the limited beach ridges and to augment passerine breeding in shrub management units. Research has not been conducted to determine to what extent dike nesting success may influence overall regional avian production. This needs to be assessed to fully examine this habitat use. In theory, dikes should be looked to as additional habitat for breeders spilling over from more productive shrub habitat blocks. Scrub-shrub habitats need to be maintained to provide adequate surface area for invertebrates, cover for migrant and breeders, and to encourage fruit production for fall migration. This will require periodic rejuvenation of units on a rotational basis.

This study will provide components for an informed decision matrix for regulatory agencies in wind power placement in the Great Lakes region. Black Swamp Bird Observatory will use results from data analysis of this project to formulate comments and positions on regulatory decisions on governmental policy.

Wise management of wetlands, shrub, grasslands, and riparian woodlands will not only benefit passerines on a year-round basis, but will also enhance other avian groups, mammals, reptiles, amphibians, and native plant associations.

#### ACKNOWLEDGMENTS

Field work for this project could not be completed without the dedication of many volunteers that donate their time to assist in bird removal and data collection at each of the study sites. The dedication and expertise of the field site leader Ashli Gorbet and assistant Ryan Jacob deserves special mention. We also wish to thank the staff of the Ottawa National Wildlife Refuge for site assistance and the

USFWS for equipment grants. Additional thanks for funding goes to Frank Merritt of Toledo for his continued support of the project. We also thank FirstEnergy for permission to operate the Navarre station on the Davis Besse Nuclear Power Plant facility. Weather data is supplied by the Davis-Besse Nuclear Power Plant annually providing strong correlation to bird activity observed at the Navarre banding station.

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#### Recommended Citation for this paper

Shieldcastle, M.C. 2018. Migrational Movements and Habitat Usage of Passerines On the the Ottawa National Wildlife Refuge, Ohio. Progress Report-2017. Black Swamp Bird Observatory, BSBO-18-1.

Table 1. Daily banding totals for Navarre, spring 2017.

| Date  | Net Hour | Banded | Banded/<br>100 net hr | Returns | Recaptures | Total birds | Total bird/<br>100 net hr |
|-------|----------|--------|-----------------------|---------|------------|-------------|---------------------------|
| 410   | 128.42   | 128    | 99.67                 | 9       | 0          | 137         | 106.68                    |
| 411   | 107.41   | 82     | 76.34                 | 7       | 8          | 97          | 90.31                     |
| 412   | 115.00   | 81     | 70.44                 | 4       | 13         | 98          | 85.22                     |
| 413   | 109.25   | 35     | 32.04                 | 4       | 18         | 57          | 52.17                     |
| 414   | 109.25   | 19     | 17.39                 | 9       | 18         | 46          | 42.11                     |
| 415   | 115.00   | 78     | 67.83                 | 0       | 16         | 94          | 81.74                     |
| 416   | 115.00   | 48     | 41.74                 | 1       | 2          | 51          | 44.35                     |
| 417   | 120.75   | 62     | 51.35                 | 0       | 7          | 69          | 57.14                     |
| 418   | 109.25   | 32     | 29.29                 | 2       | 3          | 37          | 33.87                     |
| 419   | 107.41   | 63     | 58.65                 | 1       | 5          | 69          | 64.24                     |
| 420   | 115.00   | 61     | 53.04                 | 2       | 5          | 68          | 59.13                     |
| 421   | 107.41   | 34     | 31.65                 | 0       | 6          | 40          | 37.24                     |
| 422   | 115.00   | 12     | 10.44                 | 1       | 7          | 20          | 17.39                     |
| 423   | 118.68   | 23     | 19.38                 | 2       | 16         | 41          | 34.55                     |
| 424   | 122.59   | 11     | 8.97                  | 1       | 4          | 16          | 13.05                     |
| 425   | 116.92   | 24     | 20.53                 | 3       | 8          | 35          | 29.94                     |
| 426   | 120.75   | 142    | 117.60                | 3       | 3          | 148         | 122.57                    |
| 427   | 128.42   | 137    | 106.68                | 1       | 2          | 140         | 109.02                    |
| 428   | 122.59   | 24     | 19.57                 | 1       | 5          | 30          | 24.47                     |
| 429   | 115.00   | 38     | 33.04                 | 1       | 8          | 47          | 40.87                     |
| 430   | 138.00   | 108    | 78.26                 | 8       | 14         | 130         | 94.20                     |
| 501   | RAIN     |        |                       |         |            |             |                           |
| 502   | 97.75    | 61     | 62.40                 | 1       | 5          | 67          | 68.54                     |
| 503   | 149.50   | 160    | 107.02                | 8       | 22         | 190         | 127.09                    |
| 504   | RAIN     |        |                       |         |            |             |                           |
| 505   | RAIN     |        |                       |         |            |             |                           |
| 506   | 138.00   | 73     | 52.90                 | 15      | 33         | 121         | 87.68                     |
| 507   | 128.42   | 48     | 37.38                 | 6       | 22         | 76          | 59.18                     |
| 508   | 120.75   | 51     | 42.24                 | 15      | 33         | 121         | 87.68                     |
| 509   | 126.50   | 129    | 101.98                | 10      | 16         | 155         | 122.53                    |
| 510   | 157.17   | 145    | 92.26                 | 6       | 7          | 158         | 100.53                    |
| 511   | 111.17   | 132    | 118.74                | 9       | 4          | 145         | 130.43                    |
| 512   | 120.75   | 86     | 71.22                 | 9       | 25         | 120         | 99.38                     |
| 513   | 155.25   | 220    | 141.71                | 17      | 18         | 255         | 164.25                    |
| 514   | 157.17   | 381    | 242.41                | 17      | 16         | 414         | 263.41                    |
| 515   | 164.83   | 158    | 95.86                 | 8       | 21         | 187         | 113.45                    |
| 516   | 138.00   | 363    | 263.04                | 6       | 15         | 384         | 278.26                    |
| 517   | 161.00   | 524    | 325.47                | 11      | 24         | 559         | 347.21                    |
| 518   | 130.41   | 406    | 311.33                | 7       | 30         | 443         | 339.70                    |
| 519   | RAIN     |        |                       |         |            |             |                           |
| 520   | RAIN     |        |                       |         |            |             |                           |
| 521   | RAIN     |        |                       |         |            |             |                           |
| 522   | 126.50   | 205    | 162.06                | 9       | 37         | 251         | 198.42                    |
| 523   | 161.00   | 322    | 200.00                | 9       | 50         | 381         | 236.65                    |
| 524   | 149.50   | 153    | 102.34                | 2       | 31         | 186         | 124.42                    |
| 525   | 126.50   | 128    | 101.19                | 7       | 38         | 173         | 136.76                    |
| 526   | 157.09   | 196    | 124.77                | 9       | 49         | 254         | 161.69                    |
| 527   | 138.00   | 87     | 63.04                 | 4       | 33         | 124         | 89.86                     |
| 528   | 141.68   | 100    | 70.58                 | 4       | 22         | 126         | 88.93                     |
| 529   | 126.50   | 97     | 76.68                 | 3       | 15         | 115         | 90.94                     |
| 530   | 126.50   | 84     | 66.40                 | 4       | 19         | 107         | 84.59                     |
| 531   | 126.50   | 83     | 65.61                 | 2       | 20         | 105         | 83.00                     |
| 601   | 168.90   | 72     | 42.63                 | 3       | 24         | 99          | 58.61                     |
| 602   | 151.42   | 69     | 45.57                 | 12      | 16         | 97          | 64.06                     |
| TOTAL | 6213.86  | 5775   | 92.94                 | 261     | 792        | 6828        | 109.88                    |

Table 2. Spring banding totals, Navarre, 2017.

| Species                   | Banded | Species                 | Banded | Species                 | Banded |
|---------------------------|--------|-------------------------|--------|-------------------------|--------|
| Sharp-shinned Hawk        | 3      | Slate-colored Junco     | 12     | Blackburnian Warbler    | 21     |
| American Kestrel          | 1      | Song Sparrow            | 45     | Black-th.-Green Warbler | 31     |
| Northern Saw-whet Owl     | 1      | Lincoln Sparrow         | 105    | Western Palm Warbler    | 103    |
| Eastern Screech-Owl       | 2      | Swamp Sparrow           | 113    | Ovenbird                | 66     |
| Yellow-billed Cuckoo      | 1      | Fox Sparrow             | 16     | Northern Waterthrush    | 59     |
| Black-billed Cuckoo       | 2      | Eastern Towhee          | 1      | Louisiana Waterthrush   | 2      |
| Downy Woodpecker          | 10     | Northern Cardinal       | 54     | Kentucky Warbler        | 1      |
| Yellow-bellied Sapsucker  | 3      | Rose-breasted Grosbeak  | 8      | Connecticut Warbler     | 4      |
| Red-bellied Woodpecker    | 4      | Indigo Bunting          | 36     | Mourning Warbler        | 54     |
| Yellow-shafted Flicker    | 3      | Scarlet Tanager         | 1      | Common Yellowthroat     | 241    |
| Whip-poor-will            | 1      | Tree Swallow            | 15     | Yellow-breasted Chat    | 3      |
| Ruby-th. Hummingbird      | 23     | Cedar Waxwing           | 9      | Hooded Warbler          | 5      |
| Eastern Kingbird          | 2      | Red-eyed Vireo          | 94     | Wilson's Warbler        | 191    |
| Great-crested Flycatcher  | 7      | Philadelphia Vireo      | 26     | Canada Warbler          | 81     |
| Eastern Phoebe            | 10     | Warbling Vireo          | 13     | American Redstart       | 248    |
| Olive-sided Flycatcher    | 1      | Yellow-throated Vireo   | 3      | Gray Catbird            | 342    |
| Eastern Wood Pewee        | 22     | Blue-headed Vireo       | 17     | Brown Thrasher          | 14     |
| Yellow-bellied Flycatcher | 97     | White-eyed Vireo        | 4      | Carolina Wren           | 2      |
| Acadian Flycatcher        | 7      | Hybrid Warbler          | 1      | House Wren              | 125    |
| Trail's Flycatcher        | 375    | Black and White Warbler | 30     | Winter Wren             | 14     |
| Least Flycatcher          | 46     | Prothonotary Warbler    | 16     | Marsh Wren              | 1      |
| Blue Jay                  | 27     | Blue-winged Warbler     | 7      | Brown Creeper           | 21     |
| Brown-headed Cowbird      | 15     | Nashville Warbler       | 85     | White-breasted Nuthatch | 1      |
| Red-winged Blackbird      | 154    | Orange-crowned Warbler  | 9      | Red-breasted Nuthatch   | 7      |
| Orchard Oriole            | 2      | Tennessee Warbler       | 50     | Black-capped Chickadee  | 2      |
| Baltimore Oriole          | 22     | Northern Parula         | 19     | Golden-crowned Kinglet  | 36     |
| Rusty Blackbird           | 10     | Cape May Warbler        | 8      | Ruby-crowned Kinglet    | 255    |
| Common Grackle            | 38     | Yellow Warbler          | 342    | Blue-gray Gnatcatcher   | 43     |
| American Goldfinch        | 9      | Black-th.-Blue Warbler  | 39     | Wood Thrush             | 27     |
| Savannah Sparrow          | 1      | Myrtle Warbler          | 188    | Veery                   | 36     |
| White-crowned Sparrow     | 42     | Magnolia Warbler        | 430    | Gray-cheeked Thrush     | 23     |
| White-throated Sparrow    | 432    | Chestnut-sided Warbler  | 103    | Swainson's Thrush       | 185    |
| American Tree Sparrow     | 11     | Bay-breasted Warbler    | 37     | Hermit Thrush           | 112    |
| Field Sparrow             | 5      | Blackpoll Warbler       | 79     | American Robin          | 15     |

Table 3. Number of days observed and totals of species seen on point counts, Navarre spring 2017.

| Species                | # days | #Observed | Species               | # days | #Observed | Species                 | # days | #Observed |
|------------------------|--------|-----------|-----------------------|--------|-----------|-------------------------|--------|-----------|
| Pied-billed Grebe      | 6      | 6         | Alder Flycatcher      | 10     | 14        | Cape May Warbler        | 6      | 9         |
| Herring Gull           | 9      | 18        | Willow Flycatcher     | 7      | 31        | Yellow Warbler          | 32     | 708       |
| Ring-billed Gull       | 30     | 75        | Traill's Flycatcher   | 1      | 2         | Black-th.-Blue Warbler  | 9      | 20        |
| Bonaparte's Gull       | 2      | 5         | Least Flycatcher      | 7      | 8         | Myrtle Warbler          | 23     | 85        |
| Caspian Tern           | 4      | 6         | Blue Jay              | 44     | 2506      | Magnolia Warbler        | 12     | 37        |
| Dou.-cr. Cormorant     | 36     | 766       | American Crow         | 1      | 1         | Chestnut-sided Warbler  | 9      | 18        |
| Mallard                | 11     | 31        | European Starling     | 45     | 312       | Bay-breasted Warbler    | 5      | 8         |
| Gadwall                | 3      | 7         | Bobolink              | 2      | 5         | Blackpoll Warbler       | 11     | 51        |
| American Wigson        | 1      | 1         | Brown-headed Cowbird  | 44     | 289       | Blackburnian Warbler    | 4      | 9         |
| Northern Shoveler      | 1      | 3         | Red-winged Blackbird  | 47     | 2729      | Black-th.-Green Warbler | 14     | 33        |
| Northern Pintail       | 1      | 2         | Orchard Oriole        | 1      | 1         | W. Palm Warbler         | 16     | 43        |
| Wood Duck              | 24     | 91        | Baltimore Oriole      | 29     | 355       | Ovenbird                | 6      | 7         |
| Canada Goose           | 46     | 1606      | Rusty Blackbird       | 19     | 99        | No. Waterthrush         | 5      | 9         |
| Trumpeter Swan         | 16     | 71        | Common Grackle        | 47     | 920       | Connecticut Warbler     | 2      | 2         |
| Gr.-blue Heron         | 44     | 147       | Purple Finch          | 3      | 3         | Mourning Warbler        | 8      | 16        |
| Great Egret            | 23     | 34        | Am. Goldfinch         | 23     | 110       | Com. Yellowthroat       | 28     | 146       |
| Green Heron            | 1      | 1         | White-cr. sparrow     | 4      | 16        | Yellow-breasted Chat    | 1      | 1         |
| Black-cr. N. Heron     | 1      | 2         | White-th. Sparrow     | 30     | 551       | Hooded Warbler          | 4      | 4         |
| Sandhill Crane         | 23     | 85        | American Tree Sparrow | 3      | 3         | Wilson's Warbler        | 15     | 52        |
| Virginia Rail          | 4      | 5         | Field Sparrow         | 1      | 1         | Canada Warbler          | 9      | 23        |
| Sora                   | 9      | 16        | Slate-colored Junco   | 1      | 2         | American Redstart       | 19     | 92        |
| American Coot          | 1      | 1         | Song Sparrow          | 47     | 352       | Gray Catbird            | 28     | 458       |
| Lesser Yellowlegs      | 1      | 1         | Lincoln Sparrow       | 5      | 8         | Brown Thrasher          | 10     | 15        |
| Solitary Sandpiper     | 1      | 1         | Swamp Sparrow         | 20     | 48        | Carolina Wren           | 10     | 14        |
| Spotted Sandpiper      | 2      | 2         | Fox Sparrow           | 2      | 4         | House Wren              | 42     | 402       |
| Killdeer               | 1      | 1         | Eastern Towhee        | 8      | 19        | Winter Wren             | 2      | 3         |
| Mourning Dove          | 39     | 109       | No. Cardinal          | 47     | 624       | Marsh Wren              | 2      | 2         |
| Sharp-shinned Hawk     | 2      | 2         | Rose-br. Grosbeak     | 10     | 19        | Brown Creeper           | 1      | 1         |
| Red-tailed Hawk        | 1      | 1         | Indigo Bunting        | 13     | 25        | White-breasted Nuthatch | 37     | 73        |
| Bald Eagle             | 19     | 26        | Scarlet Tanager       | 7      | 10        | Red-breasted Nuthatch   | 2      | 2         |
| American Kestrel       | 2      | 2         | Purple Martin         | 8      | 11        | Black-capped Chickadee  | 15     | 17        |
| Osprey                 | 1      | 1         | Barn Swallow          | 8      | 20        | Golden-crowned Kinglet  | 9      | 44        |
| Yellow-billed Cuckoo   | 5      | 6         | Tree Swallow          | 47     | 1010      | Ruby-crowned Kinglet    | 30     | 116       |
| Black-billed Cuckoo    | 3      | 4         | Bank Swallow          | 2      | 2         | Blue-gray Gnatcatcher   | 31     | 96        |
| Belted Kingfisher      | 1      | 2         | Rough-winged Swallow  | 8      | 11        | Wood Thrush             | 8      | 13        |
| Downy Woodpecker       | 27     | 56        | Cedar Waxwing         | 15     | 314       | Veery                   | 7      | 7         |
| Yellow-bellied Sap.    | 1      | 1         | Red-eyed Vireo        | 15     | 62        | Gray-checked Thrush     | 1      | 1         |
| Red-b. Woodpecker      | 29     | 63        | Philadelphia Vireo    | 3      | 3         | Swainson's Thrush       | 15     | 39        |
| Yellow-shafted Flicker | 34     | 83        | Warbling Vireo        | 25     | 149       | Hermit Thrush           | 9      | 10        |
| Common Nighthawk       | 1      | 1         | Yellow-throated Vireo | 1      | 1         | American Robin          | 43     | 265       |
| Chimney Swift          | 4      | 6         | Blue-headed Vireo     | 6      | 9         | Eastern Bluebird        | 1      | 1         |
| Ruby-th. Humming.      | 4      | 4         | Black & White Warbler | 12     | 26        | Unk. Duck               | 4      | 4         |
| Eastern Kingbird       | 18     | 34        | Prothonotary Warbler  | 29     | 55        | Unk. Hawk               | 1      | 1         |
| Great-cr. Flycatcher   | 5      | 11        | Nashville Warbler     | 10     | 27        | Unk. Woodpecker         | 1      | 1         |
| Eastern Phoebe         | 4      | 4         | Orange-cr. Warbler    | 1      | 1         | Unk. Flycatcher         | 1      | 2         |
| Olive-sided Flycatcher | 1      | 1         | Tennessee Warbler     | 13     | 57        | Unk. warbler            | 19     | 108       |
| E. Wood Pewee          | 14     | 31        | Northern Parula       | 8      | 13        | Unk. Kinglet            | 1      | 2         |
| Yellow-bel. Flycatcher | 4      | 5         |                       |        |           |                         |        |           |

Table 4. Daily banding totals for Navarre, fall 2017.

| Date * | Net Hour | Banded | Banded/100 net hr | Returns | Recaptures | Total birds | Total bird/ 100 net hr |
|--------|----------|--------|-------------------|---------|------------|-------------|------------------------|
| 814    | 120.75   | 61     | 50.52             | 1       | 6          | 68          | 56.32                  |
| 815    | 115.00   | 37     | 32.17             | 3       | 5          | 45          | 39.13                  |
| 816    | 69.00    | 22     | 31.88             | 2       | 4          | 28          | 40.58                  |
| 818    | 23.00    | 6      | 26.09             | 0       | 2          | 8           | 34.78                  |
| 821    | 107.41   | 53     | 49.34             | 0       | 12         | 65          | 60.52                  |
| 822    | 46.00    | 6      | 13.04             | 0       | 3          | 9           | 19.57                  |
| 823    | 107.41   | 35     | 32.59             | 1       | 7          | 43          | 40.03                  |
| 824    | 74.75    | 15     | 20.07             | 1       | 2          | 18          | 24.08                  |
| 825    | 92.00    | 15     | 16.30             | 0       | 4          | 19          | 20.65                  |
| 826    | 92.00    | 19     | 20.65             | 1       | 4          | 24          | 26.09                  |
| 827    | 69.00    | 22     | 31.88             | 0       | 3          | 25          | 36.23                  |
| 828    | 72.68    | 17     | 23.39             | 0       | 0          | 17          | 23.39                  |
| 829    | 69.00    | 14     | 20.29             | 0       | 1          | 15          | 21.74                  |
| 830    | 69.00    | 21     | 30.44             | 1       | 4          | 26          | 37.68                  |
| 831    | 76.59    | 26     | 33.95             | 1       | 3          | 30          | 39.17                  |
| 901    | 69.00    | 18     | 26.09             | 0       | 1          | 19          | 27.54                  |
| 902    | 72.68    | 23     | 31.65             | 1       | 7          | 31          | 42.65                  |
| 903    | 80.50    | 35     | 43.48             | 0       | 3          | 38          | 47.21                  |
| 904    | 76.59    | 56     | 73.12             | 0       | 3          | 59          | 77.03                  |
| 905    | 115.00   | 93     | 80.87             | 0       | 5          | 98          | 85.22                  |
| 906    | 109.25   | 93     | 85.13             | 0       | 12         | 105         | 96.11                  |
| 907    | 109.25   | 78     | 71.40             | 0       | 11         | 89          | 81.47                  |
| 908    | 109.25   | 76     | 69.57             | 0       | 11         | 87          | 79.63                  |
| 909    | 40.25    | 27     | 67.08             | 0       | 8          | 35          | 86.96                  |
| 911    | 85.50    | 30     | 35.09             | 0       | 8          | 38          | 44.44                  |
| 912    | 115.00   | 57     | 49.57             | 0       | 9          | 66          | 57.39                  |
| 913    | 109.25   | 47     | 43.02             | 0       | 11         | 58          | 53.09                  |
| 914    | 107.41   | 62     | 57.72             | 0       | 11         | 73          | 67.96                  |
| 915    | 126.50   | 90     | 71.15             | 0       | 19         | 109         | 86.17                  |
| 916    | 107.41   | 79     | 73.55             | 0       | 11         | 90          | 83.79                  |
| 917    | 111.09   | 99     | 89.12             | 0       | 9          | 108         | 97.22                  |
| 918    | 97.75    | 54     | 55.24             | 0       | 6          | 60          | 61.39                  |
| 919    | 69.00    | 47     | 68.12             | 0       | 7          | 54          | 78.26                  |
| 920    | 115.00   | 116    | 100.87            | 0       | 19         | 135         | 117.39                 |
| 921    | 95.68    | 78     | 81.52             | 0       | 17         | 95          | 99.29                  |
| 922    | 107.41   | 46     | 42.83             | 0       | 10         | 56          | 52.14                  |
| 924    | 107.41   | 59     | 54.93             | 1       | 15         | 75          | 69.83                  |
| 925    | 107.41   | 42     | 39.10             | 1       | 11         | 54          | 50.28                  |
| 927    | 111.09   | 61     | 54.91             | 0       | 15         | 76          | 68.41                  |
| 928    | 109.25   | 47     | 43.02             | 0       | 11         | 58          | 53.09                  |
| 930    | 99.59    | 78     | 78.32             | 0       | 14         | 92          | 92.38                  |
| 1001   | 93.92    | 54     | 57.50             | 0       | 16         | 70          | 74.53                  |
| 1002   | 101.58   | 41     | 40.36             | 1       | 22         | 64          | 63.01                  |
| 1003   | 84.41    | 41     | 48.57             | 0       | 18         | 59          | 69.90                  |
| 1004   | 51.75    | 29     | 56.04             | 0       | 5          | 34          | 65.70                  |
| 1005   | 103.50   | 87     | 84.06             | 0       | 11         | 98          | 94.69                  |
| 1006   | 30.59    | 21     | 68.65             | 0       | 4          | 25          | 81.73                  |
| 1007   | 103.50   | 75     | 72.46             | 0       | 18         | 93          | 89.86                  |
| 1008   | 99.59    | 60     | 60.25             | 0       | 33         | 93          | 93.38                  |
| 1009   | 95.68    | 40     | 41.81             | 0       | 17         | 57          | 59.57                  |
| 1010   | 97.75    | 113    | 115.60            | 0       | 13         | 126         | 128.90                 |
| 1013   | 118.68   | 231    | 194.64            | 0       | 23         | 254         | 214.02                 |
| 1014   | 88.09    | 119    | 135.09            | 0       | 20         | 139         | 157.79                 |
| 1015   | 63.25    | 31     | 49.01             | 0       | 8          | 39          | 61.66                  |
| 1016   | 118.68   | 200    | 168.52            | 1       | 10         | 211         | 177.79                 |
| 1017   | 80.50    | 57     | 70.81             | 1       | 21         | 79          | 98.14                  |
| 1018   | 103.50   | 79     | 76.33             | 0       | 21         | 100         | 96.62                  |
| 1019   | 86.25    | 34     | 39.42             | 3       | 10         | 47          | 54.49                  |
| 1020   | 92.00    | 90     | 97.83             | 0       | 18         | 108         | 117.39                 |
| 1021   | 99.59    | 75     | 75.31             | 1       | 25         | 101         | 101.42                 |
| 1022   | 69.00    | 20     | 28.99             | 0       | 11         | 31          | 44.93                  |
| TOTAL  | 5761.75  | 3585   | 62.22             | 22      | 669        | 4276        | 74.21                  |

\* Missing dates were weather events



Table 5. Fall banding totals, Navarre 2017.

| <b>Species</b>            | <b>Banded</b> | <b>Species</b>          | <b>Banded</b> | <b>Species</b>          | <b>Banded</b> |
|---------------------------|---------------|-------------------------|---------------|-------------------------|---------------|
| Sharp-shinned Hawk        | 1             | Lincoln's Sparrow       | 8             | Black-th.-Green Warbler | 9             |
| Cooper's Hawk             | 1             | Swamp Sparrow           | 48            | Western Palm Warbler    | 1             |
| Eastern Screech Owl       | 1             | Fox Sparrow             | 3             | Ovenbird                | 42            |
| Yellow-billed Cuckoo      | 2             | Rufous-sided Towhee     | 1             | Northern Waterthrush    | 41            |
| Hairy Woodpecker          | 1             | Northern Cardinal       | 46            | Kentucky Warbler        | 1             |
| Downy Woodpecker          | 15            | Indigo Bunting          | 2             | Connecticut Warbler     | 9             |
| Yellow-bellied Sapsucker  | 6             | Scarlet Tanager         | 1             | Mourning Warbler        | 9             |
| Red-bellied Woodpecker    | 3             | Cedar Waxwing           | 42            | Common Yellowthroat     | 78            |
| Yellow-shafted Flicker    | 7             | Red-eyed Vireo          | 58            | Hooded Warbler          | 1             |
| Ruby-th. Hummingbird      | 10            | Philadelphia Vireo      | 17            | Wilson's Warbler        | 13            |
| Eastern Kingbird          | 2             | Warbling Vireo          | 24            | Canada Warbler          | 2             |
| Great-crested Flycatcher  | 1             | Blue-headed Vireo       | 8             | American Redstart       | 61            |
| Eastern Phoebe            | 17            | White-eyed Vireo        | 1             | Gray Catbird            | 367           |
| Olive-sided Flycatcher    | 1             | Black and White Warbler | 14            | Brown Thrasher          | 2             |
| Eastern. Wood Pewee       | 14            | Prothonotary Warbler    | 8             | Carolina Wren           | 3             |
| Yellow-bellied Flycatcher | 27            | Golden-winged Warbler   | 1             | House Wren              | 62            |
| Trail's Flycatcher        | 7             | Nashville Warbler       | 14            | Winter Wren             | 57            |
| Least Flycatcher          | 6             | Orange-crowned Warbler  | 4             | Marsh Wren              | 1             |
| Blue Jay                  | 2             | Tennessee Warbler       | 29            | Brown Creeper           | 36            |
| Red-winged Blackbird      | 12            | Northern Parula         | 7             | White-breasted Nuthatch | 2             |
| Baltimore Oriole          | 36            | Cape May Warbler        | 19            | Black-capped Chickadee  | 9             |
| Rusty Blackbird           | 20            | Yellow Warbler          | 11            | Golden-crowned Kinglet  | 224           |
| Common Grackle            | 24            | Black-th.-Blue Warbler  | 41            | Ruby-crowned Kinglet    | 189           |
| House Finch               | 1             | Myrtle Warbler          | 105           | Wood Thrush             | 9             |
| American Goldfinch        | 2             | Magnolia Warbler        | 90            | Veery                   | 11            |
| White-crowned Sparrow     | 1             | Chestnut-sided Warbler  | 10            | Gray-checked Thrush     | 173           |
| White-throated Sparrow    | 202           | Bay-breasted Warbler    | 53            | Swainson's Thrush       | 390           |
| Field Sparrow             | 1             | Blackpoll Warbler       | 449           | Hermit Thrush           | 139           |
| Slate-colored Junco       | 16            | Blackburnian Warbler    | 3             | American Robin          | 61            |
| Song Sparrow              | 48            |                         |               |                         |               |
|                           |               |                         |               |                         |               |

Table 6. Number of days observed and totals of species seen on point counts, Navarre fall 2017.

| Species               | # days | #Observed | Species               | # days | #Observed | Species                | # days | #Observed |
|-----------------------|--------|-----------|-----------------------|--------|-----------|------------------------|--------|-----------|
| Herring Gull          | 12     | 22        | Downy Woodpecker      | 61     | 181       | Nashville Warbler      | 2      | 2         |
| Ring-billed Gull      | 49     | 306       | Yellow-bel. Sapsucker | 10     | 11        | Tennessee Warbler      | 2      | 2         |
| Bonaparte's Gull      | 10     | 29        | Red-bell. Woodpecker  | 15     | 15        | Northern Parula        | 3      | 3         |
| Caspian Tern          | 10     | 20        | Yellow-sh. Flicker    | 39     | 87        | Cape May Warbler       | 6      | 6         |
| Forster's Tern        | 1      | 1         | Chimney Swift         | 31     | 165       | Yellow Warbler         | 2      | 3         |
| Common Tern           | 1      | 10        | Ruby-th. Hummingbird  | 9      | 13        | Bl-th-blue Warbler     | 2      | 2         |
| D-c. Cormorant        | 14     | 53        | Eastern Kingbird      | 9      | 24        | Myrtle Warbler         | 18     | 55        |
| Mallard               | 32     | 386       | Eastern Phoebe        | 9      | 11        | Magnolia Warbler       | 5      | 5         |
| American Black Duck   | 6      | 13        | Eastern Wood Pewee    | 16     | 25        | Chestnut-sided Warbler | 2      | 2         |
| Gadwall               | 10     | 26        | Yellow-bellied Fly.   | 2      | 3         | Bay-breasted Warbler   | 10     | 11        |
| American Wigeon       | 2      | 4         | Acadian Flycatcher    | 1      | 1         | Blackpoll Warbler      | 43     | 245       |
| Am. Green-winged Teal | 2      | 2         | Least Flycatcher      | 2      | 2         | Blackburnian Warbler   | 3      | 3         |
| Blue-winged Teal      | 3      | 4         | Horned Lark           | 1      | 1         | Blk.-th-green Warbler  | 4      | 4         |
| Northern Shoveler     | 3      | 7         | Blue Jay              | 60     | 290       | Ovenbird               | 6      | 6         |
| Northern Pintail      | 7      | 44        | European Starling     | 59     | 660       | Common Yellowthroat    | 11     | 11        |
| Wood Duck             | 35     | 119       | Brown-headed Cowbird  | 14     | 39        | Wilson Warbler         | 3      | 3         |
| Redhead               | 1      | 1         | Red-winged Blackbird  | 62     | 3589      | Canada Warbler         | 1      | 1         |
| Canada Goose          | 63     | 1865      | Baltimore Oriole      | 22     | 148       | American Redstart      | 5      | 6         |
| Cackling Goose        | 1      | 1         | Rusty Blackbird       | 19     | 144       | Gray Catbird           | 53     | 564       |
| Trumpeter Swan        | 6      | 16        | Common Grackle        | 54     | 1094      | Brown Thrasher         | 7      | 8         |
| Great- blue Heron     | 46     | 79        | House Finch           | 7      | 8         | Carolina Wren          | 27     | 51        |
| Great Egret           | 21     | 28        | American Goldfinch    | 39     | 79        | House Wren             | 24     | 35        |
| Green Heron           | 12     | 13        | Pine Siskin           | 9      | 60        | Winter Wren            | 9      | 12        |
| Black-cr. Night-Heron | 1      | 1         | White-th. Sparrow     | 26     | 429       | Brown Creeper          | 3      | 4         |
| Sandhill Crane        | 4      | 19        | Chipping Sparrow      | 1      | 3         | White-br. Nuthatch     | 27     | 49        |
| Virginia Rail         | 1      | 1         | Slate-colored Junco   | 2      | 4         | Red-br. Nuthatch       | 7      | 7         |
| Sora                  | 6      | 8         | Song Sparrow          | 36     | 70        | Black.-cap. Chickadee  | 31     | 52        |
| Common Gallinule      | 6      | 7         | Swamp Sparrow         | 2      | 2         | Golden-cr. Kinglet     | 26     | 201       |
| American Woodcock     | 1      | 1         | Eastern Towhee        | 3      | 3         | Ruby-cr. Kinglet       | 20     | 63        |
| Lesser Yellowlegs     | 1      | 1         | Northern Cardinal     | 65     | 496       | Wood Thrush            | 1      | 2         |
| Solitary Sandpiper    | 1      | 1         | Rose-br. Grosbeak     | 3      | 3         | Verry                  | 9      | 16        |
| Spotted Sandpiper     | 1      | 1         | Indigo Bunting        | 3      | 3         | Gray-cheeked Thrush    | 28     | 89        |
| Killdeer              | 3      | 4         | Purple Martin         | 14     | 187       | Swainson's Thrush      | 39     | 429       |
| Mourning Dove         | 14     | 35        | Cliff Swallow         | 1      | 1         | Hermit Thrush          | 10     | 35        |
| Red-tailed Hawk       | 1      | 1         | Barn Swallow          | 28     | 273       | American Robin         | 60     | 432       |
| Bald Eagle            | 17     | 31        | Tree Swallow          | 24     | 121       | Eastern Bluebird       | 1      | 1         |
| Peregrine Falcon      | 1      | 1         | Bank Swallow          | 10     | 29        | Unk. Duck              | 4      | 78        |
| Osprey                | 1      | 1         | No. Rough-wing Swal.  | 6      | 23        | Unk. Swallow           | 7      | 34        |
| Eastern Screech Owl   | 2      | 3         | Cedar Waxwing         | 57     | 522       | Unk. Warbler           | 34     | 146       |
| Great Horned Owl      | 3      | 3         | Red-eyed Vireo        | 14     | 24        | Unk. Woodpecker        | 1      | 1         |
| Yellow-billed Cuckoo  | 2      | 2         | Warbling Vireo        | 21     | 36        | Unk. Kinglet           | 1      | 4         |
| Belted Kingfisher     | 6      | 7         | Blue-headed Vireo     | 1      | 1         |                        |        |           |
| Hairy Woodpecker      | 17     | 18        | Black & White Warbler | 2      | 2         |                        |        |           |

Table 7. Total bandings Navarre Banding Station, passerine migration , 2017.

| Species                       | Banded | Species                      | Banded | Species                      | Banded |
|-------------------------------|--------|------------------------------|--------|------------------------------|--------|
| Sharp-shinned Hawk            | 4      | Field Sparrow                | 6      | Blackburnian Warbler         | 24     |
| Cooper's Hawk                 | 1      | Slate-colored Junco          | 28     | Blk.-th. Grn. Warbler        | 40     |
| American Kestrel              | 1      | Song Sparrow                 | 93     | West. Palm Warbler           | 104    |
| Norhtern Saw-whet Owl         | 1      | Lincoln's Sparrow            | 113    | Ovenbird                     | 108    |
| Eastern Screech Owl           | 3      | Swamp Sparrow                | 161    | Northern Waterthrush         | 100    |
| Yellow-billed Cuckoo          | 3      | Fox Sparrow                  | 19     | Louisiana Waterthr.          | 2      |
| Black-billed Cuckoo           | 2      | Eastern Towhee               | 2      | Kentucky Warbler             | 2      |
| Hairy Woodpecker              | 1      | Northern Cardinal            | 100    | Connecticut Warbler          | 13     |
| Downy Woodpecker              | 25     | Rose-breasted Grosbeak       | 8      | Mourning Warbler             | 63     |
| Yellow-bell. Sapsucker        | 9      | Indigo Bunting               | 38     | <b>(9)</b> C. Yellowthroat   | 319    |
| Red-bellied Woodpecker        | 7      | Scarlet Tanager              | 2      | Yellow-breasted Chat         | 3      |
| Yellow-shafted Flicker        | 10     | Tree Swallow                 | 15     | Hooded Warbler               | 6      |
| Whip-poor-will                | 1      | Cedar Waxwing                | 51     | Wilson's Warbler             | 204    |
| Ruby-th. Hummingbird          | 33     | Red-eyed Vireo               | 152    | Canada Warbler               | 83     |
| Eastern Kingbird              | 4      | Philadelphia Vireo           | 43     | <b>(10)</b> Amer. Redstart   | 309    |
| Great-crested Flycatcher      | 8      | Warbling Vireo               | 37     | <b>(1)</b> Gray Catbird      | 709    |
| Eastern Phoebe                | 27     | Yellow-throated Vireo        | 3      | Brown Thrasher               | 16     |
| Olive-sided Flycatcher        | 2      | Blue-headed Vireo            | 25     | Carolina Wren                | 5      |
| Eastern Wood-Pewee            | 36     | White-eyed Vireo             | 5      | House Wren                   | 187    |
| Yellow-bell. Flycatcher       | 124    | Hybrid Warbler               | 1      | Winter Wren                  | 71     |
| Acadian Flycatcher            | 7      | Black and White Warbler      | 44     | Marsh Wren                   | 2      |
| <b>(7)</b> Trail's Flycatcher | 382    | Prothonotary Warbler         | 24     | Brown Creeper                | 57     |
| Least Flycatcher              | 52     | Blue-winged Warbler          | 7      | White-br Nuthatch            | 3      |
| Blue Jay                      | 29     | Golden-winged Warbler        | 1      | Red-br. Nuthatch             | 7      |
| Brown-headed Cowbird          | 15     | Nashville Warbler            | 99     | Black-cap. Chickadee         | 11     |
| Red-winged Blackbird          | 166    | Orange-crowned Warbler       | 13     | Gold.-cr. Kinglet            | 260    |
| Orchard Oriole                | 2      | Tennessee Warbler            | 79     | <b>(4)</b> Ruby-cr Kinglet   | 544    |
| Baltimore Oriole              | 58     | Northern Parula              | 26     | Blue-gray Gnatcatch.         | 43     |
| Rusty Blackbird               | 30     | Cape May Warbler             | 27     | Wood Thrush                  | 36     |
| Common Grackle                | 62     | <b>(8)</b> Yellow Warbler    | 353    | Veery                        | 47     |
| House Finch                   | 1      | Black-th. Blue Warbler       | 80     | Gray-cheek Thrush            | 196    |
| American Goldfinch            | 11     | Myrtle Warbler               | 293    | <b>(3)</b> Swainson's Thrush | 575    |
| Savannah Sparrow              | 1      | <b>(6)</b> Magnolia Warbler  | 520    | Hermit Thrush                | 251    |
| White-cr. Sparrow             | 43     | Chestnut-sided Warbler       | 113    | American Robin               | 76     |
| <b>(2)</b> White-th. Sparrow  | 634    | Bay-breasted Warbler         | 90     |                              |        |
| Am. Tree Sparrow              | 11     | <b>(5)</b> Blackpoll Warbler | 528    |                              |        |

**( ) numbers in bold are top ten banded species**

Table 8. Banding year of returning birds captured at Navarre study site, 2017.

| Species                 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | Total |
|-------------------------|------|------|------|------|------|------|------|------|-------|
| Hairy Woodpecker        |      |      |      | 1    | 1    |      |      |      | 2     |
| Downy Woodpecker        | 6    |      |      |      |      |      |      |      | 6     |
| Red-bellied Woodpecker  | 1    |      |      |      |      |      |      |      | 1     |
| Yellow-shafted Flicker  | 1    |      |      |      |      |      |      |      | 1     |
| Eastern Wood Pewee      | 2    |      |      |      |      |      |      |      | 2     |
| Blue Jay                | 1    |      | 1    |      |      |      |      | 1    | 3     |
| Red-winged Blackbird    | 4    | 7    | 5    | 3    | 2    | 1    | 1    |      | 23    |
| Baltimore Oriole        | 3    | 1    | 4    | 1    | 2    |      |      |      | 11    |
| Common Grackle          |      |      |      |      | 1    |      |      |      | 1     |
| White-throated Sparrow  | 4    |      |      |      |      |      |      |      | 4     |
| Song Sparrow            | 7    | 3    |      |      |      |      |      |      | 10    |
| Swamp Sparrow           | 2    |      |      |      |      |      |      |      | 2     |
| Northern Cardinal       | 16   | 13   | 4    |      |      | 1    |      |      | 34    |
| Tree Swallow            | 3    |      |      |      |      |      |      |      | 3     |
| Warbling Vireo          | 1    |      |      |      |      |      |      |      | 1     |
| Prothonotary Warbler    |      | 2    | 1    | 3    |      |      |      |      | 6     |
| Yellow Warbler          | 22   | 11   | 12   | 5    | 3    | 5    |      | 1    | 59    |
| Com. Yellowthroat       | 10   | 1    | 1    |      | 1    |      |      |      | 13    |
| Gray Catbird            | 36   | 17   | 11   | 4    | 2    | 2    |      |      | 72    |
| Carolina Wren           | 2    | 1    |      |      |      |      |      |      | 3     |
| House Wren              | 8    | 2    |      |      |      |      |      |      | 10    |
| White-breasted Nuthatch | 1    |      |      |      |      |      |      |      | 1     |
| Black-cap. Chickadee    | 2    |      |      |      |      | 1    |      |      | 3     |
| American Robin          | 3    | 3    | 1    |      |      |      |      |      | 7     |
| Total                   | 135  | 59   | 40   | 17   | 12   | 9    | 1    | 2    | 275   |

Table 9. Foreign recoveries of study banded birds since last progress report.

| <b>Species</b>     | <b>Band Number</b> | <b>Band Date</b> | <b>Band Location*</b> | <b>Recovery Date</b> | <b>Recovery Location</b> |
|--------------------|--------------------|------------------|-----------------------|----------------------|--------------------------|
| Blue Jay           | 1272-12927         | 10-5-16          | Ontario 435-0765      | 05-07-17             | Navarre                  |
| American Goldfinch | 2730-14809         | 05-08-17         | Shaker Lakes          | 7-1-17               | Ohio 412-0813            |
| Indigo Bunting     | 1771-05490         | 7-28-16          | BSBO                  | 5-18-18              | Ohio 412-0830            |
| Yellow Warbler     | 2550-16253         | 7-27-09          | Navarre               | 5-14-11              | Ohio 413-0831            |
| Hooded Warbler     | 2750-28568         | 5-18-15          | Navarre               | 8-1-17               | Ontario 424-0802         |
| Swainson' Thrush   | 2691-19481         | 10-4-17          | Shaker Lakes          | 11-7-17              | Honduras 161-0863        |
| Swainson's Thrush  | 2711-49790         | 9-14-17          | Navarre               | 5-4-18               | Indiana 413-0860         |

\*Banding coordinates for study sites: Navarre 413-0830, Shaker Lakes 412-0813, Ottawa NWR 413-0831, Creek Bend 412-0832, Petersburg 415-0833, BSBO 413-0831.

Figure 1. Spring temperature patterns, long-term average and 2017 (9 AM, 100 meters).

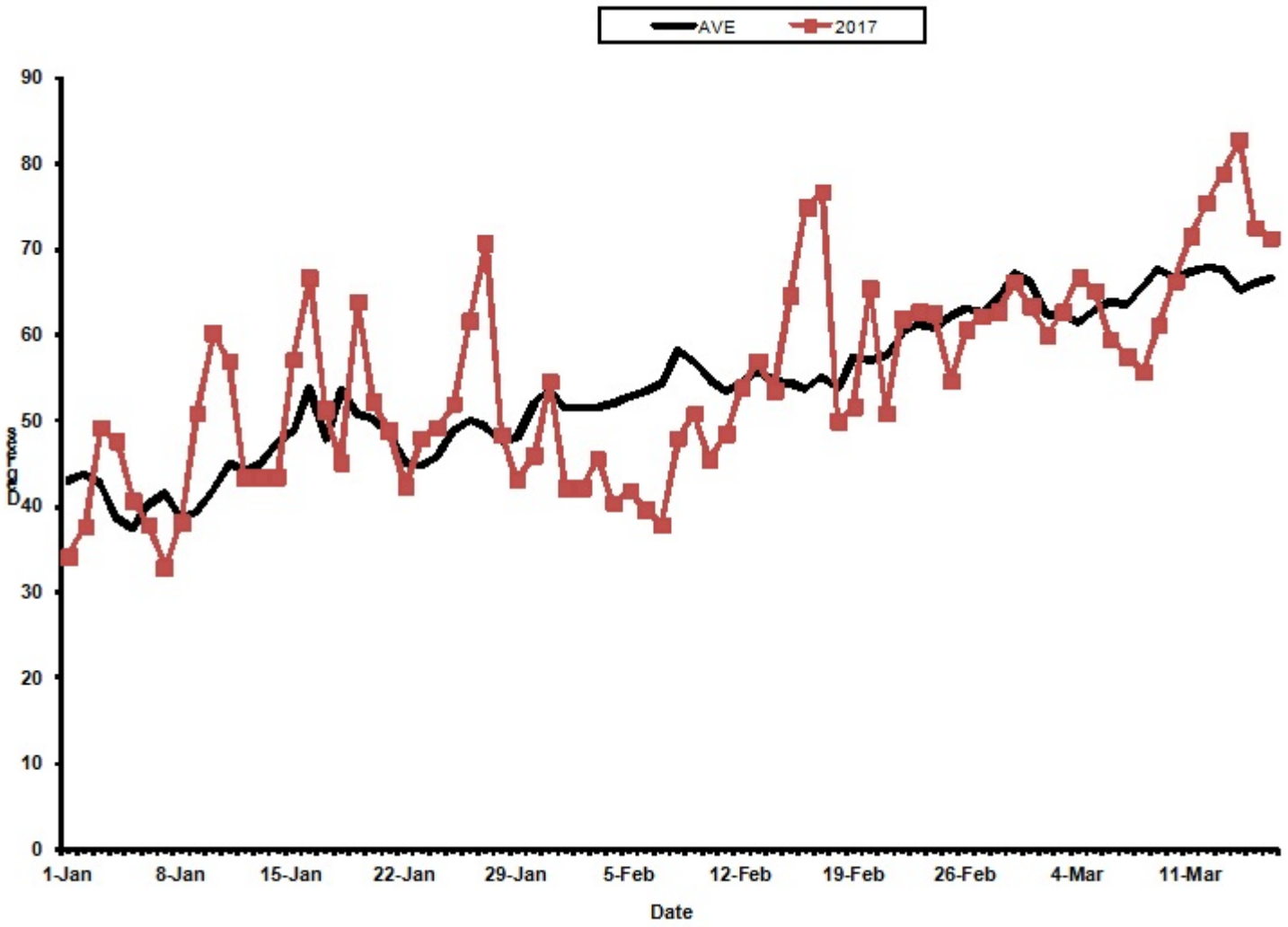


Figure 2. Fall temperature patterns, long-term average and 2017 (9 AM, 100 meters).

