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

PROGRESS REPORT-2018
BSBO-19-1

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INTRODUCTION

In 2018, 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; Krementz & 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 21st 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 2018, migrating and resident passerines were sampled on the Navarre Unit of the Ottawa National Wildlife Refuge in the Great Lakes region following guidelines developed for the Midwest Migration Network (Shieldcastle 2018). 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 2018 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 2018. Spring 2018 was characterized by normal temperatures in April but a varied May in Northwest Ohio though with some wide temperature swings. 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 2018, this wave had a fair first pulse but had a good second pulse, peaking 01-02 May. 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 very good and occurred 06-07 May with a second pulse on 09-14 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 2018, the third wave peaked 20 May. Migration diminished in late May.

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

In spring 2018, the Navarre banding station was operated on 43 days for 4,793.9 net hours. Including hummingbirds, 6,957 new birds were banded and a total of 8,315birds handled (Table 1). The capture rate for new birds was 145.12 birds/100 net hours. This compares to the long-term average (1992-

2017) of 121.0 birds/100 net hours (+20% from average). The long-term average shows no change over time of the capture rate at Navarre. One hundred and four species plus one hybrid warbler were banded in Navarre during spring 2018 (Table 2). The most unusual species and subspecies included Green Heron, Sora, Lawrence's Warbler, and Cerulean Warbler. The ten most abundant species banded were Yellow Warbler (557), Magnolia Warbler (455), Myrtle Warbler (420), Gray Catbird (414), Common Yellowthroat (329), Swainson's Thrush (316), White-throated Sparrow (312), Nashville Warbler (296), Golden-crowned Kinglet (266), Ruby-crowned Kinglet (264), and Traill's (Alder/Willow) Flycatcher (264).

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 44 days during spring 2018. One hundred and thirty-three species and 12,613 individuals were recorded (Table 3). Northern Cardinal, Red-winged Blackbird, Common Grackle, Canada Goose, European Starling, and American Robin were observed each count day. The most abundant species recorded was Red-winged Blackbird (2,345) followed by Canada Goose (859), Blue Jay (776), Common Grackle (743), and Tree Swallow (635).

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 2018. 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 69 days for 7,024.6 net hours. Four thousand five hundred and sixty-six birds were banded with a total of 5,917 birds handled including recaptures (Table 4). This was the 28th fall season in which an extensive netting effort had been conducted on a daily basis. The capture rate for 2018 was 84.2 birds/100 net hours. A total of 89 species were banded during fall 2018 (Table 5). The ten most abundant species banded were Blackpoll Warbler (989), Myrtle Warbler (389), Gray Catbird (344), White-throated Sparrow (294), Swainson's Thrush (241), Golden-crowned Kinglet (183), Hermit Thrush (174), Ruby-crowned Kinglet (153), American Robin (133),Bay-breasted Warbler (129), and Magnolia Warbler (129). Several surprises were captured during the fall season and included green Heron, Eastern Screech Owl, Yellow-billed Cuckoo, Golden-winged Warbler, Marsh Wren, and Prairrie Warbler.

Fall point counts were conducted on 68 days during 2018. A total of 13,607 individuals of 120 species were recorded (Table 6). The Northern Cardinal was observed on all count days. The most abundant species were Red-winged Blackbird (3,462), Canada Goose (1,320), Common Grackle (1,163), European Starling (1,054), American Robin (666), Gray Catbird (445), White-throated Sparrow (362), Northern Cardinal (355), Mallard (342), and Rusty Blackbird (244).

SUMMARY BANDINGS

Total combined bandings for passerine migration 2018 for the Navarre Station is in Table 7. The ten most abundant species banded at Navarre were Blackpoll Warbler (1,026), Myrtle Warbler (809), Gray Catbird (658), White-throated Sparrow (606), Magnolia Warbler (584), Yellow Warbler (566), Swainson's Thrush (557), Golden-crowned Kinglet (449), Ruby-crowned Kinglet (417), and, Common Yellowthroat (387). A combined total of 111 species and one hybrid was 10,861 individuals (88.2 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 2018, 222 birds of 26 species were captured as returning birds at the Navarre site (Table 8). This total includes 46 Yellow Warblers with the oldest being banded in 2011, 55 Gray Catbirds with the oldest from 2011, 11 Common Yellowthroats (oldest from 2016), 28 Red-winged Blackbird (oldest from 2010), 12 Northern Cardinals (oldest from 2011), and 15 Baltimore Orioles (oldest from 2013). 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 improved capture rate which followed a low year in 2017. 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 2018, project personnel entertained 23 groups at Navarre and the Black Swamp Bird Observatory Nature Center educating 1,300 individuals on migration and banding. In addition, seven presentations were made to 450 people on avian ecology and migration. In addition, an estimated 80,000 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. 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. 2019. Migrational Movements and Habitat Usage of Passerines On the the Ottawa National Wildlife Refuge, Ohio. Progress Report-2018. Black Swamp Bird Observatory, BSBO-18-1.

Table 1. Daily banding totals for Navarre, spring 2018.

Date	Net Hour	Banded	Banded/ 100 net hr	Returns	Recaptures	Total birds	Total bird/ 100 net hr
409	103.50	55	53.14	10	0	65	62.80
410	103.50	31	29.95	3	5	39	37.68
411	105.41	36	34.15	3	7	46	43.64
412	26.68	64	239.88	0	1	65	243.63
413	105.41	125	118.59	1	9	135	128.07
414	RAIN						
415	RAIN						
416	51.74	96	185.54	0	5	101	195.20
417	RAIN						
418	109.25	130	118.99	0	15	145	132.72
419	RAIN						
420	105.41	91	86.33	3	42	136	129.02
421	115.00	69	60.00	3	45	117	101.74
422	115.00	45	39.13	0	30	75	65.22
423	115.00	37	32.17	0	15	52	45.22
424	46.00	16	34.78	0	9	25	54.35
425	RAIN						
426	115.00	46	40.00	3	7	56	48.70
427	115.00	161	140.00	0	9	170	147.83
428	RAIN						
429	126.50	115	90.91	4	37	156	123.32
430	115.00	78	67.83	0	14	92	80.00
501	143.75	376	261.57	2	12	390	271.30
502	138.00	497	360.15	2	6	505	365.94
503	RAIN						
504	71.06	186	261.75	3	7	196	275.82
505	124.74	280	224.47	18	24	322	258.14
506	124.74	399	319.87	4	24	427	342.31
507	126.50	253	200.00	12	67	332	262.45
508	121.00	99	81.82	4	52	155	128.10
509	122.76	508	413.82	8	22	538	438.25
510	124.74	424	339.81	13	53	490	392.82
511	128.26	182	141.90	11	55	248	193.36
512	RAIN						
513	RAIN						
514	62.26	234	375.84	11	36	281	451.33
515	6.67	13	194.90	0	0	13	194.90
516	143.75	296	205.91	12	71	379	263.65
517	134.09	134	99.93	11	68	213	158.85
518	RAIN						
519	143.75	238	165.57	14	58	310	215.65
520	92.00	281	305.44	3	23	307	333.70
521	128.34	193	150.38	7	75	275	214.28
522	126.50	199	157.31	4	52	255	201.58
523	132.25	157	118.72	4	29	190	143.67
524	126.50	122	96.44	8	31	161	127.27
525	126.50	135	106.72	7	23	165	130.44
526	132.25	167	126.28	5	12	184	139.13
527	130.41	124	95.09	4	20	148	113.49
528	126.50	83	65.61	4	15	102	80.63
529	132.25	86	65.03	3	21	110	83.18
530	124.43	24	19.29	1	24	49	39.38
531	126.50	78	61.66	2	21	101	79.84
TOTAL	4793.90	6957	145.12	207	1151	8315	173.45

Table 2. Spring banding totals, Navarre, 2018.

Species	Banded	Species	Banded	Species	Banded
Green Heron	1	Field Sparrow	3	Bay-breasted Warbler	42
Sora	2	Slate-colored Junco	11	Blackpoll Warbler	37
Sharp-shinned Hawk	1	Song Sparrow	78	Blackburnian Warbler	53
American Kestrel	1	Lincoln Sparrow	78	Black-th.-Green Warbler	61
American Woodcock	1	Swamp Sparrow	68	Pine Warbler	6
Mourning Dove	1	Fox Sparrow	87	Western Palm Warbler	177
Yellow-billed Cuckoo	3	Northern Cardinal	52	Ovenbird	80
Black-billed Cuckoo	1	Rose-breasted Grosbeak	4	Northern Waterthrush	69
Belted Kingfisher	2	Indigo Bunting	37	Louisiana Waterthrush	1
Hairy Woodpecker	1	Scarlet Tanager	1	Connecticut Warbler	7
Downy Woodpecker	6	Tree Swallow	19	Mourning Warbler	82
Yellow-bellied Sapsucker	3	Cedar Waxwing	34	Common Yellowthroat	329
Red-bellied Woodpecker	1	Red-eyed Vireo	53	Yellow-breasted Chat	2
Yellow-shafted Flicker	12	Philadelphia Vireo	6	Hooded Warbler	4
Whip-poor-will	1	Warbling Vireo	30	Wilson’s Warbler	151
Ruby-th. Hummingbird	9	Yellow-throated Vireo	1	Canada Warbler	81
Eastern Kingbird	2	Blue-headed Vireo	18	American Redstart	263
Great-crested Flycatcher	26	White-eyed Vireo	5	Gray Catbird	414
Eastern Phoebe	27	Black and White Warbler	66	Brown Thrasher	11
Eastern Wood Pewee	31	Prothonotary Warbler	17	Carolina Wren	2
Yellow-bellied Flycatcher	95	Worm-eating Warbler	1	House Wren	79
Acadian Flycatcher	10	Blue-winged Warbler	17	Winter Wren	24
Traill's Flycatcher	264	Lawrence’s Warbler	1	Brown Creeper	80
Least Flycatcher	66	Golden-winged Warbler	3	White-breasted Nuthatch	2
Blue Jay	11	Nashville Warbler	296	Red-breasted Nuthatch	1
Brown-headed Cowbird	8	Orange-crowned Warbler	8	Black-capped Chickadee	3
Red-winged Blackbird	115	Tennessee Warbler	121	Golden-crowned Kinglet	266
Orchard Oriole	2	Northern Parula	27	Ruby-crowned Kinglet	264
Baltimore Oriole	42	Cape May Warbler	32	Blue-gray Gnatcatcher	22
Rusty Blackbird	4	Yellow Warbler	557	Wood Thrush	13
Common Grackle	22	Black-th.-Blue Warbler	43	Veery	45
American Goldfinch	18	Myrtle Warbler	420	Gray-cheeked Thrush	47
White-crowned Sparrow	15	Magnolia Warbler	455	Swainson’s Thrush	316
White-throated Sparrow	312	Cerulean Warbler	1	Hermit Thrush	136
American Tree Sparrow	8	Chestnut-sided Warbler	90	American Robin	29

Table 3. Number of days observed and totals of species seen on point counts, Navarre spring 2018.

Species	# days	#Observed	Species	# days	#Observed	Species	# days	#Observed
Pied-billed Grebe	27	92	Great-cr. Flycatcher	15	37	Nashville Warbler	11	43
Herring Gull	11	15	Eastern Phoebe	5	6	Tennessee Warbler	16	61
Ring-billed Gull	26	93	E. Wood Pewee	14	26	Northern Parula	14	34
Bonaparte's Gull	1	1	Yellow-bel. Flycatcher	2	4	Cape May Warbler	7	8
Caspian Tern	1	1	Alder Flycatcher	3	4	Yellow Warbler	27	557
Common Tern	2	2	Willow Flycatcher	8	9	Black-th.-Blue Warbler	10	22
Dou.-cr. Cormorant	20	329	Traill's Flycatcher	3	3	Myrtle Warbler	19	113
Am. White Pelican	1	1	Least Flycatcher	9	14	Magnolia Warbler	16	47
Mallard	19	39	Horned Lark	1	1	Chestnut-sided Warbler	11	19
Gadwall	10	40	Blue Jay	36	776	Bay-breasted Warbler	8	13
Northern Pintail	1	3	European Starling	44	430	Blackpoll Warbler	20	50
Blue-winged Teal	1	1	Brown-headed Cowbird	43	229	Blackburnian Warbler	13	25
Wood Duck	18	60	Red-winged Blackbird	44	2345	Black-th.-Green Warbler	15	34
Lesser Scaup	1	13	Baltimore Oriole	25	256	Pine Warbler	1	1
Ring-necked Duck	3	5	Rusty Blackbird	13	293	W. Palm Warbler	15	52
Canada Goose	44	859	Common Grackle	44	743	Ovenbird	6	7
Trumpeter Swan	13	28	Purple Finch	1	1	No. Waterthrush	13	25
Least Bittern	1	1	Am. Goldfinch	22	53	Mourning Warbler	6	8
Gr.-blue Heron	35	81	White-cr. sparrow	2	4	Com. Yellowthroat	26	184
Great Egret	19	30	White-th. Sparrow	24	197	Hooded Warbler	1	1
Green Heron	10	20	American Tree Sparrow	2	2	Wilson's Warbler	16	62
Black-cr. N. Heron	1	1	Chipping Sparrow	2	2	Canada Warbler	6	10
Sandhill Crane	12	34	Field Sparrow	1	1	American Redstart	22	102
Sora	19	28	Slate-colored Junco	5	12	Gray Catbird	27	304
American Coot	5	5	Song Sparrow	43	258	Brown Thrasher	15	38
Pectoral Sandpiper	1	1	Lincoln Sparrow	2	2	Carolina Wren	27	50
Dunlin	2	10	Swamp Sparrow	15	28	House Wren	31	197
Spotted Sandpiper	2	2	Fox Sparrow	12	89	Winter Wren	8	14
Killdeer	12	17	Eastern Towhee	20	34	Marsh Wren	8	14
Mourning Dove	33	78	No. Cardinal	44	346	Brown Creeper	5	9
Sharp-shinned. Hawk	1	1	Rose-br. Grosbeak	9	16	White-breasted Nuthatch	11	12
Red-tailed Hawk	1	1	Indigo Bunting	7	11	Red-breasted Nuthatch	1	1
Bald Eagle	9	13	Scarlet Tanager	6	9	Black-capped Chickadee	13	21
Eastern Screech-Owl	1	1	Purple Martin	4	4	Golden-crowned Kinglet	17	165
Yellow-billed Cuckoo	8	25	Barn Swallow	10	17	Ruby-crowned Kinglet	23	141
Black-billed Cuckoo	2	3	Tree Swallow	43	635	Blue-gray Gnatcatcher	26	90
Belted Kingfisher	1	2	Bank Swallow	3	3	Wood Thrush	4	5
Downy Woodpecker	35	71	Cedar Waxwing	15	199	Veery	4	4
Yellow-bellied Sap.	6	7	Red-eyed Vireo	18	50	Gray-cheeked Thrush	3	3
Red-h Woodpecker	2	2	Philadelphia Vireo	3	3	Swainson's Thrush	13	25
Red-b. Woodpecker	12	17	Warbling Vireo	25	86	Hermit Thrush	11	12
Yellow-shafted Flicker	29	109	Blue-headed Vireo	1	1	American Robin	44	515
Chimney Swift	4	7	Black & White Warbler	9	18	Eastern Bluebird	1	2
Ruby-th. Humming.	3	3	Prothonotary Warblar	19	37	Unk. warbler	10	37
Eastern Kingbird	11	24	Blue-wing. Warbler	4	5	Unk. Thrush	1	1

Table 4. Daily banding totals for Navarre, fall 2018.

Date *	Net Hour	Banded	Banded/100 net hr	Returns	Recaptures	Total birds	Total bird/ 100 net hr
813	97.75	55	56.27	2	2	59	60.36
814	115.00	42	36.52	1	2	45	39.13
815	116.84	22	18.83	1	1	24	20.54
817	107.41	14	13.03	1	4	19	17.69
820	115.00	31	26.96	2	6	39	33.91
822	113.08	29	25.65	0	15	44	38.91
823	113.08	20	17.69	0	0	20	17.69
824	111.17	35	31.48	0	8	43	38.68
825	76.59	18	23.50	0	4	22	28.72
826	109.25	19	17.39	0	5	24	21.97
827	115.00	33	28.70	1	9	43	37.39
828	103.50	27	26.09	0	7	34	32.85
829	107.41	21	19.55	0	3	24	22.34
830	107.41	22	20.48	1	2	25	23.28
831	132.25	40	30.25	0	6	46	34.78
901	109.25	24	21.97	0	10	34	31.12
902	109.25	25	22.88	0	6	31	28.38
903	107.41	17	15.83	0	6	23	21.41
904	105.41	25	23.72	0	8	33	31.31
905	70.91	28	39.49	0	6	34	47.95
906	107.41	22	20.48	0	5	27	25.14
907	105.41	33	31.31	0	6	39	37.00
911	109.25	153	140.05	1	8	162	148.28
912	107.41	65	60.52	1	10	76	70.76
913	111.09	28	25.21	0	10	38	34.21
914	115.00	57	49.57	1	11	69	60.00
916	99.59	37	37.15	0	5	42	42.17
917	115.00	54	46.96	0	14	68	59.13
918	107.41	53	49.34	0	5	58	54.00
919	101.43	29	28.59	0	6	35	34.51
920	109.25	79	72.31	0	12	91	83.30
921	103.50	79	76.33	0	8	87	84.06
922	109.75	34	30.98	0	16	50	45.56
923	99.59	59	59.24	0	6	65	65.27
924	92.17	61	66.18	0	8	69	74.86
925	42.09	11	26.13	0	5	16	38.01
926	115.00	297	258.26	0	19	316	274.78
927	118.68	140	117.96	1	21	162	136.50
928	109.25	93	85.13	0	19	112	102.52
929	99.59	63	63.26	1	21	85	85.35
930	105.41	69	65.46	0	13	82	77.79
1001	99.59	36	36.15	0	14	50	50.21
1002	103.50	196	189.37	0	20	216	208.70
1003	113.08	98	86.66	0	33	131	115.85
1004	23.00	12	52.17	0	4	16	69.57
1005	90.35	207	229.11	0	19	226	250.14
1007	115.00	197	171.30	0	27	224	194.78
1008	97.75	99	101.28	0	18	117	119.69
1009	118.68	183	154.20	0	31	214	180.32
1010	126.50	169	133.60	0	31	200	158.10
1011	99.59	144	144.59	0	60	204	204.84
1012	130.50	179	137.17	0	102	281	215.33
1013	99.59	103	103.42	1	102	206	206.85
1014	95.68	84	87.79	1	75	160	167.22
1015	97.75	70	71.61	0	42	112	114.58
1016	105.41	55	52.18	0	50	105	99.61
1017	95.68	84	87.79	0	39	123	128.55
1018	92.00	62	67.39	0	36	98	106.52
1019	97.75	61	62.40	1	42	104	106.39
1020	90.16	59	65.44	0	30	89	98.71
1021	69.00	61	88.40	0	26	87	126.09
1022	101.43	60	59.15	0	43	103	101.55
1023	105.41	67	63.56	0	30	97	92.02
1024	92.00	31	33.70	0	14	45	48.91

1025	113.08	48	42.45	0	32	80	70.75
1026	61.41	14	22.80	0	13	27	43.97
1028	86.25	72	83.48	0	21	93	107.83
1029	88.09	16	18.16	1	30	47	53.36
1030	90.16	36	39.93	0	11	47	52.13
TOTAL	7024.64	4566	65.00	18	1333	5917	84.23

* Missing dates were weather events

Table 5. Fall banding totals, Navarre 2018.

Species	Banded	Species	Banded	Species	Banded
Green Heron	2	Lincoln's Sparrow	5	Black-th.-Green Warbler	14
Eastern Screech Owl	4	Swamp Sparrow	16	Pine Warbler	2
Yellow-billed Cuckoo	4	Fox Sparrow	14	Prairie Warbler	1
Hairy Woodpecker	5	Eastern Towhee	2	Ovenbird	52
Downy Woodpecker	24	Northern Cardinal	56	Northern Waterthrush	16
Yellow-bellied Sapsucker	3	Rose-breasted Grosbeak	5	Connecticut Warbler	5
Red-bellied Woodpecker	2	Indigo Bunting	2	Mourning Warbler	6
Yellow-shafted Flicker	19	Scarlet Tanager	1	Common Yellowthroat	58
Ruby-th. Hummingbird	8	Cedar Waxwing	1	Wilson's Warbler	14
Eastern Kingbird	1	Red-eyed Vireo	46	Canada Warbler	6
Great-crested Flycatcher	1	Philadelphia Vireo	14	American Redstart	71
Eastern Phoebe	21	Warbling Vireo	12	Gray Catbird	344
Eastern. Wood Pewee	17	Blue-headed Vireo	9	Brown Thrasher	3
Yellow-bellied Flycatcher	37	White-eyed Vireo	4	Carolina Wren	4
Traill's Flycatcher	3	Black and White Warbler	8	House Wren	42
Least Flycatcher	7	Prothonotary Warbler	26	Winter Wren	36
Blue Jay	9	Golden-winged Warbler	1	Marsh Wren	2
Red-winged Blackbird	12	Nashville Warbler	21	Brown Creeper	32
Baltimore Oriole	15	Orange-crowned Warbler	5	White-breasted Nuthatch	5
Rusty Blackbird	29	Tennessee Warbler	97	Red-breasted Nuthatch	27
Common Grackle	102	Northern Parula	2	Black-capped Chickadee	9
Purple Finch	8	Cape May Warbler	47	Golden-crowned Kinglet	183
House Finch	1	Yellow Warbler	9	Ruby-crowned Kinglet	153
American Goldfinch	9	Black-th.-Blue Warbler	77	Wood Thrush	5
White-crowned Sparrow	2	Myrtle Warbler	389	Veery	12
White-throated Sparrow	294	Magnolia Warbler	129	Gray-cheeked Thrush	81
Am. Tree Sparrow	1	Chestnut-sided Warbler	8	Swainson's Thrush	241
Chipping Sparrow	2	Bay-breasted Warbler	129	Hermit Thrush	174
Slate-colored Junco	17	Blackpoll Warbler	989	American Robin	133
Song Sparrow	45	Blackburnian Warbler	7		

Table 6. Number of days observed and totals of species seen on point counts, Navarre fall 2018.

Species	# days	#Observed	Species	# days	#Observed	Species	# days	#Observed
Pied-billed Grebe	3	3	Ruby-th. Hummingbird	7	9	Cape May Warbler	5	5
Herring Gull	10	10	Eastern Kingbird	8	16	Yellow Warbler	1	1
Ring-billed Gull	40	165	Great-cr. Flycatcher	1	1	Bl-th-blue Warbler	5	7
Bonaparte's Gull	5	11	Eastern Phoebe	15	15	Myrtle Warbler	24	117
Caspian Tern	15	21	Olive-sided Flycatcher	1	1	Magnolia Warbler	9	21
D-c. Cormorant	11	27	Eastern Wood Pewee	3	5	Chestnut-sided Warbler	1	1
Am. White Pelican	1	1	Blue Jay	54	172	Bay-breasted Warbler	7	9
Mallard	29	342	American Crow	6	12	Blackpoll Warbler	36	206
American Black Duck	7	21	European Starling	66	1054	Blackburnian Warbler	2	4
Gadwall	15	107	Brown-headed Cowbird	9	24	Blk.-th-green Warbler	1	1
American Wigeon	3	5	Red-winged Blackbird	66	3462	Prairie Warbler	1	1
Am. Green-winged Teal	1	1	Baltimore Oriole	26	155	Ovenbird	2	2
Blue-winged Teal	1	1	Rusty Blackbird	12	244	Northern Waterthrush	1	1
Northern Shoveler	6	21	Common Grackle	65	1163	Mourning Warbler	1	1
Northern Pintail	7	72	Purple Finch	3	4	Common Yellowthroat	13	15
Wood Duck	43	162	House Finch	10	17	Wilson Warbler	1	1
Redhead	3	9	American Goldfinch	42	93	Canada Warbler	2	2
Canada Goose	61	1320	Pine Siskin	10	29	American Redstart	6	6
Trumpeter Swan	2	6	White-th. Sparrow	27	362	Gray Catbird	48	445
Least Bittern	12	18	Slate-colored Junco	6	6	Brown Thrasher	3	3
Great- blue Heron	36	44	Song Sparrow	32	59	Carolina Wren	44	74
Great Egret	4	5	Swamp Sparrow	1	1	House Wren	22	28
Green Heron	3	3	Fox Sparrow	2	2	Winter Wren	8	10
Sandhill Crane	2	5	Eastern Towhee	6	6	Marsh Wren	1	1
Virginia Rail	2	2	Northern Cardinal	68	355	Brown Creeper	1	1
Sora	1	1	Rose-br. Grosbeak	8	9	White-br. Nuthatch	56	115
American Coot	1	1	Indigo Bunting	1	1	Red-br. Nuthatch	35	103
Killdeer	4	6	Purple Martin	23	164	Black.-cap. Chickadee	16	25
Mourning Dove	11	35	Cliff Swallow	1	1	Golden-cr. Kinglet	23	141
Sharp-shinned Hawk	1	1	Barn Swallow	22	137	Ruby-cr. Kinglet	20	48
Bald Eagle	44	94	Tree Swallow	27	115	Wood Thrush	2	3
Merlin	1	1	Bank Swallow	3	10	Verry	7	7
Eastern Screech Owl	6	8	No. Rough-wing Swal.	5	10	Gray-cheeked Thrush	15	23
Yellow-billed Cuckoo	2	2	Cedar Waxwing	35	198	Swainson's Thrush	34	87
Belted Kingfisher	5	8	Red-eyed Vireo	22	30	Hermit Thrush	11	17
Hairy Woodpecker	22	28	Philadelphia Vireo	6	7	American Robin	56	666
Downy Woodpecker	64	208	Warbling Vireo	21	51	Eastern Bluebird	1	1
Yellow-bel. Sapsucker	3	3	Blue-headed Vireo	1	1	Unk. Duck	17	202
Red-head. Woodpecker	2	5	Black & White Warbler	1	1	Unk. Flycatcher	1	3
Red-bell. Woodpecker	16	20	Prothonotary Warbler	1	1	Unk. Warbler	30	144
Yellow-sh. Flicker	51	109	Tennessee Warbler	1	1	Unk. Thrush	2	2
Chimney Swift	30	141						

Table 7. Total bandings Navarre Banding Station, passerine migration , 2018.

Species	Banded	Species	Banded	Species	Banded
Green Heron	3	Chipping Sparrow	2	**(1)**Blackpoll Warbler	1026
Sora	2	Field Sparrow	3	Blackburnian Warbler	60
American Woodcock	1	Slate-colored Junco	28	Blk.-th. Grn. Warbler	75
Mourning Dove	1	Song Sparrow	123	Pine Warbler	8
Sharp-shinned Hawk	1	Lincoln's Sparrow	83	West. Palm Warbler	177
American Kestrel	1	Swamp Sparrow	84	Prairie Warbler	1
Eastern Screech Owl	4	Fox Sparrow	101	Ovenbird	132
Yellow-billed Cuckoo	7	Eastern Towhee	2	Northern Waterthrush	85
Black-billed Cuckoo	1	Northern Cardinal	108	Louisiana Waterthr.	1
Belted Kingfisher	2	Rose-breasted Grosbeak	9	Connecticut Warbler	12
Hairy Woodpecker	6	Indigo Bunting	39	Mourning Warbler	88
Downy Woodpecker	30	Scarlet Tanager	2	**(10)**C. Yellowthroat	387
Yellow-bell. Sapsucker	6	Tree Swallow	19	Yellow-breasted Chat	2
Red-bellied Woodpecker	3	Cedar Waxwing	35	Hooded Warbler	4
Yellow-shafted Flicker	31	Red-eyed Vireo	99	Wilson's Warbler	165
Whip-poor-will	1	Philadelphia Vireo	20	Canada Warbler	87
Ruby-th. Hummingbird	17	Warbling Vireo	42	Amer. Redstart	334
Eastern Kingbird	3	Yellow-throated Vireo	1	**(6)**Gray Catbird	658
Great-crested Flycatcher	27	Blue-headed Vireo	27	Brown Thrasher	14
Eastern Phoebe	27	White-eyed Vireo	9	Carolina Wren	6
Eastern Wood-Pewee	69	Black and White Warbler	74	House Wren	121
Yellow-bell. Flycatcher	132	Prothonotary Warbler	43	Winter Wren	60
Acadian Flycatcher	10	Worm-eating Warbler	1	Marsh Wren	2
Traill's Flycatcher	267	Blue-winged Warbler	17	Brown Creeper	112
Least Flycatcher	73	Lawrence's Warbler	1	White-br Nuthatch	7
Blue Jay	20	Golden-winged Warbler	4	Red-br. Nuthatch	28
Brown-headed Cowbird	8	Nashville Warbler	317	Black-cap. Chickadee	12
Red-winged Blackbird	127	Orange-crowned Warbler	13	**(8)**Gold.-cr. Kinglet	449
Orchard Oriole	2	Tennessee Warbler	218	**(9)** Ruby-cr Kinglet	417
Baltimore Oriole	57	Northern Parula	29	Blue-gray Gnatcatch.	22
Rusty Blackbird	33	Cape May Warbler	79	Wood Thrush	18
Common Grackle	124	**(5)** Yellow Warbler	566	Veery	57
Purple Finch	8	Black-th. Blue Warbler	120	Gray-cheek Thrush	128
House Finch	1	**(2)**Myrtle Warbler	809	**(7)**Swainson's Thrush	557
American Goldfinch	27	**(4)** Magnolia Warbler	584	Hermit Thrush	310
White-cr. Sparrow	17	Cerulean Warbler	1	American Robin	162
(3) White-th. Sparrow	606	Chestnut-sided Warbler	98		
Am. Tree Sparrow	9	Bay-breasted Warbler	171		

( ) numbers in bold are top ten banded species

Table 8. Banding year of returning birds captured at Navarre study site, 2018.

Species	2017	2016	2015	2014	2013	2012	2011	2010	Total
Hairy Woodpecker					1				1
Downy Woodpecker	6	2							8
Red-bellied Woodpecker	1								1
Yellow-shafted Flicker	1	1							2
Eastern Phoebe	1								1
Eastern Wood Pewee		1							1
Brown-headed Cowbird	1								1
Red-winged Blackbird	6	3	6	5	4	2	1	1	28
Baltimore Oriole	8	3	2	1	1				15
Common Grackle	1			1	1				3
White-throated Sparrow		1							1
American Tree Sparrow	1								1
Song Sparrow	3	4							7
Northern Cardinal	5	3	1	1	1		1		12
Tree Swallow	1	1							2
Warbling Vireo		3		1					4
Prothonotary Warbler	1	1		1					3
Yellow Warbler	20	10	6	7		2	1		46
Myrtle Warbler		1							1
Northern Waterthrush			1						1
Com. Yellowthroat	10	1							11
Gray Catbird	32	9	4	4	4		2		55
Carolina Wren	1	1							2
House Wren	7			1					8
Black-cap. Chickadee	2	2							4
American Robin	2		1						3
Total	110	47	21	22	12	4	5	1	222

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

Species	Band Number	Band Date	Band Location*	Recovery Date	Recovery Location
White-th. Sparrow	2791-25696	4-26-18	Navarre	5-7-18	Michigan 425-0823
Song Sparrow	2791-25565	10-13-17	Navarre	5-9-18	Ontario 444-0794
Yellow Warbler	2780-96958	5-7-17	Ohio 414-0824	5-4-18	Navarre
Mrytle Warbler	2670-26005	5-8-16	Wisconsin 432-0883	5-5-18	Navarre
Blackpoll Warbler	2870-10635	9-26-18	Ohio 414-0824	10-7-18	Navarre
Northern Waterthrush	0010181	9-5-2015	Mexico 212-0864	5-1-18	Navarre
Com. Yellowthroat	2730-12838	9-15-14	Navarre	5-3-18	Ohio 412-0824
House Wren	2780-39329	8-23-17	Navarre	5-9-18	Ohio 414-0824
Swainson Thrush	2711-49790	9-14-17	Navarre	5-4-18	Indiana 413-0860
Hermit Thrush	2571-98167	4-10-14	Navarre	4-21-18	Wisconsin 434-0894

*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.