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

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INTRODUCTION

In 2019, 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 are reluctant to navigate open water which results in major concentrations along the southwestern shore of Lake Erie, a phenomenon that is unparalleled in the Midwest. With continuing habitat loss along both the Lake Erie coast and inland, this study will assist in monitoring the effects 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: birds use habitat further inland much more than habitat along the shore. A complex of study sites is 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), as well as 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, many long-distance intercontinental migrants deposit substantial lipid reserves which may double their body weight (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 for 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 could have been undetected. In addition to communication towers, wind turbines pose a similar threat to migratory birds. The cumulative negative effect on the avian resource by towers and turbines in a highly important stopover area such as the western basin is of great concern to the future maintenance of avian populations throughout the eastern United States.

To this end, this project is an important part of a large scale 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 that resource managers can 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 2019, 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 to the beginning and ending time frame (Shieldcastle 2018). The migration period covers both short-distance and long-distance (Neotropical) migrants. The spring migration operation in 2019 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 impact the probability of a given species being captured, height of bird activity is a factor, as mist-nets only sample part of the airspace, 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, and placed in a cloth holding bag to be carried to a central location for processing. The band number and net were recorded for previously captured birds. During processing, each bird was banded with a standard U.S. Fish & Wildlife Service leg band, then aged and sexed following the guidelines in Pyle 1997, the Bird Banding Manual, and Woods Manual (Woods 1969). Fat and breast muscle were visually inspected and scored: fat on a 7-point scale (Helms and Drury 1960) and muscle on a 3-point scale (Barlien 1995). Morphometric measurements were taken including closed wing chord and body mass. The net round during which each bird was captured was recorded and weather data were compiled from hourly readings of Toledo Edison's Davis Besse Nuclear Power Station.

Point count locations were spaced evenly throughout the banding area which is 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 each banding day, weather- and bird abundance permitting, 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 run immediately after opening nets each morning during which every bird seen and heard within a five minute interval were recorded. Point counts were canceled on extremely high wind or high bird activity days.

A daily list of species was compiled to document presence/absence at the Navarre banding area. 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 2019. Spring 2019 was characterized by cooler temperatures and above normal precipitation in Northwest Ohio, with some wide temperature swings. This pattern appeared to affect migration timing for both short-distance and long-distance Neotropical migrants. Low pressure cells had a tendency to track up into the Great Lakes. There was relatively high species diversity but below average volume at the Navarre station in spring 2019.

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 affect 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. During migration, males tend to precede females a week to ten days in most species. 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 2019, this wave had a poor first pulse but had a good second pulse, peaking 3 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 poor in volume and occurred 09-10 May with a second pulse on 15-17 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 2019, the third wave peaked 23-25 May. The second pulse of this wave was poor with a slight movement on 28 May.

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

In spring 2019, the Navarre banding station was operated on 47 days for 5,292.3 net hours. Including hummingbirds, 6,295 new birds were banded and a total of 7,590 birds handled (Table 1). The capture rate for new birds was 118.9 birds/100 net hours. This is slightly lower than the long-term average (1992-2018) of 120.6 birds/100 net hours (-1% from average). The long-term average capture rate shows no change over time at Navarre. One hundred and four species plus one hybrid warbler were banded in Navarre during spring 2019 (Table 2). The most unusual species included Green Heron, American Kestrel, Nelson's Sparrow (the first spring capture for the project), Clay-colored Sparrow, Worm-eating Warbler, Prairie Warbler, and Louisiana Waterthrush. The ten most abundant species banded were Yellow Warbler (537), Gray Catbird (482), Traill's (Alder/Willow) Flycatcher (465), Ruby-crowned Kinglet (398), White-throated Sparrow (354), Magnolia Warbler (333), Common Yellowthroat (281), American Redstart (273), Myrtle Warbler (240), and Swainson's Thrush (207).

Point counts were initiated in 1995 as 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 49 days during spring 2019. One hundred and thirty-one species and 13,289 individuals were recorded (Table 3). Northern Cardinal was observed each count day. The most abundant species recorded was Blue Jay (2,763) followed by Red-winged Blackbird (1,697), Canada Goose (793), Common Grackle (776), and Tree Swallow (713).

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 average into October, and with late October cooler than normal. 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 76 days for 7,519.9 net hours during fall migration. Three thousand, eight hundred birds were banded with a total of 4,662 birds handled including recaptures (Table 4). This was the 30th fall season in which an extensive netting effort had been conducted on a daily basis. The capture rate for 2019 was 62.0 birds/100 net hours. A total of 86 species were banded during fall 2019 (Table 5). The ten most abundant species banded were Swainson's Thrush (393), Gray Catbird (320), White-throated Sparrow (310), Blackpoll Warbler (255), Golden-crowned Kinglet (196), Gray-cheeked Thrush (183), Hermit Thrush (135), Ruby-crowned Kinglet (134), Myrtle Warbler (130), and American Robin (128). Several surprises were captured during the fall season and included Eastern Screech-Owl, American Woodcock, Chipping Sparrow, Field Sparrow, Golden-winged Warbler, and Marsh Wren.

Fall point counts were conducted on 76 days during fall 2019. A total of 15,649 individuals of 106 species were recorded (Table 6). The most abundant species were Red-winged Blackbird (3,470),

European Starling (1,830), Canada Goose (1,786), Common Grackle (1,294), American Robin (648), Cedar Waxwing (520), Gray Catbird (450), Northern Cardinal (399), White-throated Sparrow (359), and Mallard (307).

SUMMARY BANDINGS

Total combined bandings for passerine migration 2019 for the Navarre Station is in Table 7. The ten most abundant species banded at Navarre were Gray Catbird (802), White-throated Sparrow (664), Swainson's Thrush (600), Yellow Warbler (369), Ruby-crowned Kinglet (532), Traill's Flycatcher (471), Magnolia Warbler (426), Common Yellowthroat (373), Myrtle Warbler (370), and American Redstart (358). A combined total of 110 species and one hybrid warbler made up of 10,095 individuals (78.8 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 that passerines return to the same breeding grounds but less evidence available regarding site fidelity to migration stopover sites. During 2019, 227 birds of 22 species were captured as returning birds at the Navarre site (Table 8). This total includes 49 Yellow Warbler with the oldest being banded in 2012, 54 Gray Catbird (oldest from 2013), 33 Red-winged Blackbird (oldest from 2012), 13 Northern Cardinal (oldest from 2011), 12 House Wren (oldest from 2016), 10 Warbling Vireo (oldest from 2016), and 10 Baltimore Oriole (oldest from 2015). 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 drawing conclusions about populations very risky, even with long-term datasets. This past spring resulted in a below average capture rate which followed a low year in 2018. This cycle that is emerging is interesting and needs to be investigated further. Determining what contributes to this great variability and how it can 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, with 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, and 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 lax 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.

Establishing a standardized sampling protocol for banding across the Great Lakes and upper Midwest regions will allow for comparison of migration ecology 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 lists creates a holistic dataset to support answering a variety of specific questions. It also allows for the use of other, less labor-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 instituted for the Great Lakes region by the Midwest Migration Network and 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 the station 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 bird annually since. 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. In addition to the apparent Blackpoll connection to Lake Erie a first Magnolia Warbler was captured a second year at Navarre in migration. 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 State University have provided radar units to document nocturnal movements, Ohio State University has a graduate student conducting point counts in the region, and 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 2019, project personnel accommodated 20 groups at Navarre and the Black Swamp Bird Observatory Nature Center educating 1,200 individuals on migration and banding. In addition, seven presentations were made to 500 people on avian ecology and migration. In addition, an estimated 90,000 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 provides 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 shelter 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 meeting acreage requirements to influence breeding volume presently is 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 considered 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 migrants 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.

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Table 1. Daily banding totals for Navarre, spring 2019.

Date	Net Hour	Banded	Banded/ 100 net hr	Returns	Recaptures	Total birds	Total bird/ 100 net hr
412	46.00	42	91.3	3	0	45	97.8
413	111.09	83	74.7	5	4	92	82.8
414	RAIN						
415	28.75	15	52.2	1	2	18	62.6
416	99.59	48	48.2	5	12	65	65.3
417	105.34	38	36.1	2	6	46	43.7
418	51.75	73	141.1	2	5	80	154.6
419	RAIN						
420	RAIN						
421	109.25	78	71.4	3	14	95	87.0
422	122.59	41	33.4	6	11	58	47.3
423	111.09	126	113.4	0	2	128	115.2
424	118.68	32	27.0	2	13	47	39.6
425	118.68	40	33.7	0	8	48	40.4
426	RAIN						
427	115.00	39	33.9	1	13	53	46.1
428	RAIN						
429	80.50	21	26.1	1	8	30	37.3
430	116.84	51	43.6	2	14	67	57.3
501	124.66	124	98.5	2	8	134	107.5
502	141.68	225	158.8	1	5	231	163.0
503	103.50	488	470.5	5	13	504	486.0
504	92.00	291	316.3	3	28	322	350.0
505	122.59	142	115.8	4	59	205	167.2
506	120.75	214	177.2	8	32	254	210.4
507	124.66	88	70.6	9	22	119	95.5
508	118.68	82	69.1	10	59	151	127.2
509	111.09	232	208.8	8	24	264	237.6
510	134.09	222	165.6	11	26	259	193.2
511	138.00	120	87.0	10	38	168	121.7
512	RAIN						
513	RAIN						
514	143.75	201	139.8	9	98	308	214.3
515	132.25	320	242.0	10	24	354	267.7
516	139.84	347	248.1	4	23	374	267.4
517	134.09	203	151.4	7	40	250	186.4
518	88.09	99	112.4	5	40	144	163.5
519	134.09	348	259.5	11	14	373	278.2
520	132.25	255	192.8	5	48	308	232.9
521	128.34	151	117.7	4	53	208	162.1
522	11.50	2	17.4	0	2	4	34.8
523	105.34	303	287.6	4	28	335	318.0
524	155.25	194	125.0	4	57	255	164.3
525	143.75	306	212.9	2	34	342	237.9
526	40.25	40	99.4	0	4	44	109.3
527	132.25	84	63.5	1	28	115	87.0
528	138.00	143	103.6	6	24	173	125.4
529	78.66	65	82.6	1	15	81	103.0
530	128.34	52	40.5	2	21	75	58.4
531	136.16	40	29.4	3	27	70	51.4
601	126.50	58	45.8	6	10	74	58.5
602	130.41	56	42.9	7	21	84	64.4
603	138.00	30	21.7	6	26	62	44.9
604	128.34	43	33.5	7	24	74	57.7
TOTAL	5292.30	6295	118.9	208	1087	7590	143.4

Table 2. Spring banding totals, Navarre, 2019.

Species	Banded	Species	Banded	Species	Banded
Green Heron	2	Slate-colored Junco	1	Bay-breasted Warbler	49
American Woodcock	1	Song Sparrow	21	Blackpoll Warbler	44
Mourning Dove	1	Lincoln Sparrow	46	Blackburnian Warbler	18
Sharp-shinned Hawk	2	Swamp Sparrow	74	Black-th.-Green Warbler	23
American Kestrel	1	Fox Sparrow	3	Western Palm Warbler	122
Yellow-billed Cuckoo	1	Eastern Towhee	2	Prairrie Warbler	1
Black-billed Cuckoo	2	Northern Cardinal	59	Ovenbird	38
Downy Woodpecker	5	Rose-breasted Grosbeak	16	Northern Waterthrush	58
Yellow-bellied Sapsucker	3	Indigo Bunting	33	Louisiana Waterthrush	2
Red-bellied Woodpecker	3	Scarlet Tanager	4	Connecticut Warbler	4
Yellow-shafted Flicker	4	Summer Tanager	1	Mourning Warbler	55
Ruby-th. Hummingbird	27	Tree Swallow	25	Common Yellowthroat	281
Eastern Kingbird	5	Cedar Waxwing	11	Yellow-breasted Chat	2
Great-crested Flycatcher	20	Red-eyed Vireo	85	Hooded Warbler	6
Eastern Phoebe	5	Philadelphia Vireo	12	Wilson’s Warbler	112
Olive-sided Flycatcher	2	Warbling Vireo	41	Canada Warbler	77
Eastern Wood Pewee	52	Yellow-throated Vireo	2	American Redstart	273
Yellow-bellied Flycatcher	152	Blue-headed Vireo	27	Gray Catbird	482
Acadian Flycatcher	16	White-eyed Vireo	5	Brown Thrasher	15
Traill's Flycatcher	465	Black and White Warbler	50	House Wren	112
Least Flycatcher	76	Prothonotary Warbler	18	Winter Wren	4
Blue Jay	36	Worm-eating Warbler	1	Marsh Wren	4
Brown-headed Cowbird	27	Blue-winged Warbler	11	Brown Creeper	23
Red-winged Blackbird	185	Brewster Warbler	2	White-breasted Nuthatch	1
Baltimore Oriole	19	Golden-winged Warbler	1	Red-breasted Nuthatch	28
Rusty Blackbird	4	Nashville Warbler	87	Black-capped Chickadee	1
Common Grackle	17	Orange-crowned Warbler	10	Golden-crowned Kinglet	22
Purple Finch	2	Tennessee Warbler	47	Ruby-crowned Kinglet	398
American Goldfinch	12	Northern Parula	28	Blue-gray Gnatcatcher	96
Nelson Sparrow	1	Cape May Warbler	22	Wood Thrush	14
White-crowned Sparrow	9	Yellow Warbler	537	Veery	38
White-throated Sparrow	354	Black-th.-Blue Warbler	48	Gray-cheeked Thrush	31
American Tree Sparrow	1	Myrtle Warbler	240	Swainson’s Thrush	207
Clay-colored Sparrow	2	Magnolia Warbler	333	Hermit Thrush	136
Field Sparrow	3	Chestnut-sided Warbler	73	American Robin	20

Table 3. Number of days observed and totals of individuals seen on point counts, Navarre spring 2019.

Species	# days	#Observed	Species	# days	#Observed	Species	# days	#Observed
Pied-billed Grebe	25	54	WHip-poor-will	1	1	Nashville Warbler	10	38
Herring Gull	20	44	Common Nighthawk	1	1	Tennessee Warbler	13	36
Ring-billed Gull	10	17	Chimney Swift	3	4	Northern Parula	9	21
Bonaparte's Gull	4	10	Eastern Kingbird	21	42	Cape May Warbler	10	14
Caspian Tern	1	1	Great-cr. Flycatcher	14	22	Yellow Warbler	39	547
Rorster Tern	1	1	Eastern Phoebe	2	2	Black-th.-Blue Warbler	14	27
Dou.-cr. Cormorant	33	214	Olive-sided Flycatcher	1	1	Myrtle Warbler	15	50
Am. White Pelican	1	2	E. Wood Pewee	11	29	Magnolia Warbler	19	45
Mallard	17	46	Yellow-bel. Flycatcher	6	11	Chestnut-sided Warbler	12	24
Gadwall	4	6	Alder Flycatcher	9	34	Bay-breasted Warbler	5	6
Blue-winged Teal	1	3	Willow Flycatcher	4	6	Blackpoll Warbler	13	37
Northern Pintail	2	6	Traill's Flycatcher	6	10	Blackburnian Warbler	8	21
Wood Duck	26	64	Least Flycatcher	14	23	Black-th.-Green Warbler	13	21
Redhead	1	4	Blue Jay	36	2763	Pine Warbler	1	1
Lesser Scaup	2	9	European Starling	48	500	W. Palm Warbler	9	22
Canada Goose	45	793	Brown-headed Cowbird	46	409	Ovenbird	9	13
Trumpeter Swan	15	67	Red-winged Blackbird	48	1697	No. Waterthrush	10	14
Gr.-blue Heron	37	69	Baltimore Oriole	30	268	Connecticut Warbler	1	1
Great Egret	11	14	Rusty Blackbird	12	65	Mourning Warbler	6	8
Green Heron	17	44	Common Grackle	48	776	Com. Yellowthroat	28	136
Black-cr. N. Heron	1	1	Am. Goldfinch	20	46	Wilson's Warbler	12	27
Sandhill Crane	10	22	White-cr. sparrow	2	2	Canada Warbler	8	11
Virginia Rail	1	1	White-th. Sparrow	32	219	American Redstart	23	112
Sora	15	19	Chipping Sparrow	1	1	Gray Catbird	31	253
Common Gallinule	1	1	Slate-colored Junco	1	1	Brown Thrasher	13	19
Lessere Yellowlegs	1	1	Song Sparrow	46	242	House Wren	43	236
Solitary Sandpiper	1	1	Lincoln Sparrow	1	1	Winter Wren	1	1
Spotted Sandpiper	6	6	Swamp Sparrow	6	9	Marsh Wren	15	18
Killdeer	4	9	Fox Sparrow	2	2	Brown Creeper	3	3
Mourning Dove	45	124	Eastern Towhee	5	8	White-breasted Nuthatch	19	28
Northern Harrier	1	1	No. Cardinal	49	309	Red-breasted Nuthatch	10	13
Sharp-shinned. Hawk	1	1	Rose-br. Grosbeak	7	17	Black-capped Chickadee	17	29
Bald Eagle	19	26	Indigo Bunting	19	37	Golden-crowned Kinglet	5	13
Osprey	2	2	Scarlet Tanager	5	6	Ruby-crowned Kinglet	29	166
Eastern Screech-Owl	2	2	Purple Martin	11	28	Blue-gray Gnatcatcher	35	123
Great Horned Owl	1	1	Barn Swallow	20	72	Wood Thrush	6	11
Yellow-billed Cuckoo	10	23	Tree Swallow	48	713	Veery	4	4
Black-billed Cuckoo	2	2	Cedar Waxwing	17	245	Gray-cheeked Thrush	2	3
Belted Kingfisher	9	10	Red-eyed Vireo	16	29	Swainson's Thrush	7	11
Hairy Woodpecker	5	5	Warbling Vireo	32	124	Hermit Thrush	8	11
Downy Woodpecker	28	45	Yellow-throated Vireo	1	1	American Robin	46	230
Yellow-bellied Sap.	2	2	Blue-headed Vireo	2	2	Eastern Bluebird	1	1
Red-h Woodpecker	1	1	Black & White Warbler	19	29	Unk. Duck	1	1
Red-b. Woodpecker	23	35	Prothonotary Warblar	20	47	Unk. Blackbird	3	89
Yellow-shafted Flicker	30	73	Blue-wing. Warbler	3	3	Unk. warbler	15	55

Table 4. Daily banding totals for Navarre, fall 2019.

Date *	Net Hour	Banded	Banded/100 net hr	Returns	Recaptures	Total birds	Total bird/ 100 net hr
812	116.68	121	103.7	0	9	130	111.4
813	115.00	42	36.5	2	7	51	44.3
814	118.91	30	25.2	1	9	40	33.6
815	111.09	30	27.0	1	5	36	32.4
816	109.25	18	16.5	0	11	29	26.5
817	115.00	22	19.1	0	7	29	25.2
818	61.41	9	14.7	0	7	16	26.1
819	105.54	23	21.8	1	8	32	30.3
820	109.25	21	19.2	1	3	25	22.9
821	103.50	24	23.2	0	5	29	28.0
822	82.80	14	16.9	0	1	15	18.1
823	111.09	22	19.8	1	4	27	24.3
824	115.00	10	8.7	1	8	19	16.5
825	113.16	11	9.7	0	7	18	15.9
826	111.30	18	16.2	0	6	24	21.6
828	113.16	26	23.0	0	5	31	27.4
829	105.34	19	18.0	0	5	24	22.8
830	109.25	44	40.3	0	9	53	48.5
831	113.16	26	23.0	0	6	32	28.3
901	109.25	12	11.0	0	5	17	15.6
902	109.25	16	14.6	0	7	23	21.1
903	101.66	57	56.1	0	5	62	61.0
904	113.16	37	32.7	1	12	50	44.2
905	109.25	39	35.7	0	0	39	35.7
906	109.25	33	30.2	0	7	40	36.6
907	109.25	29	26.5	1	5	35	32.0
908	107.41	46	42.8	0	11	57	53.1
909	105.34	38	36.1	0	8	46	43.7
910	109.25	29	26.5	0	13	42	38.4
911	113.16	36	31.8	0	9	45	39.8
912	103.50	21	20.3	1	13	35	33.8
913	115.00	32	27.8	1	9	42	36.5
914	101.43	39	38.5	0	9	48	47.3
915	109.25	72	65.9	1	5	78	71.4
916	107.41	40	37.2	0	8	48	44.7
917	107.41	27	25.1	0	10	37	34.4
918	111.09	26	23.4	1	8	35	31.5
919	107.41	32	29.8	0	6	38	35.4
920	105.34	63	59.8	0	11	74	70.2
921	109.25	65	59.5	2	13	80	73.2
922	105.34	96	91.1	0	13	109	103.5
923	86.25	68	78.8	0	10	78	90.4
924	111.09	122	109.8	0	16	138	124.2
925	101.66	78	76.7	1	19	98	96.4
926	111.09	61	54.9	0	4	65	58.5
927	111.09	104	93.6	0	18	122	109.8
928	95.91	47	49.0	0	23	70	73.0
929	99.59	80	80.3	0	25	105	105.4
930	15.41	9	58.4	0	7	16	103.8
1001	99.59	135	135.6	0	21	156	156.6
1002	105.34	111	105.4	0	32	143	135.8
1003	101.66	71	69.8	0	18	89	87.5
1004	98.89	103	104.2	0	31	134	135.5
1005	115.00	114	99.1	0	32	146	127.0
1006	86.25	85	98.6	0	23	108	125.2
1007	95.91	59	61.5	0	28	87	90.7
1008	93.84	77	82.1	0	21	98	104.4
1009	103.50	47	45.4	0	18	65	62.8
1010	95.91	32	33.4	0	21	53	55.3
1011	92.00	29	31.5	2	19	50	54.3
1012	99.59	73	73.3	0	18	91	91.4
1013	89.93	39	43.4	1	18	58	64.5
1014	93.38	36	38.6	0	21	57	61.0

1015	101.66	78	76.7	0	19	97	95.4
1016	69.00	43	62.3	0	5	48	69.6
1017	30.59	33	107.9	0	12	45	147.1
1018	92.00	117	127.2	0	12	129	140.2
1019	93.84	72	76.7	0	23	95	101.2
1020	90.16	58	64.3	0	7	65	72.1
1021	92.00	44	47.8	0	15	59	64.1
1024	103.50	110	106.3	0	23	133	128.5
1025	86.25	126	146.1	0	5	131	151.9
1026	34.50	18	52.2	0	3	21	60.9
1028	84.18	58	68.9	0	8	66	78.4
1029	88.09	26	29.5	0	4	30	34.1
1030	32.66	22	67.4	0	4	26	79.6
TOTAL	7519.86	3800	50.5	20	842	4662	62.0

* Missing dates were weather events

Table 5. Fall banding totals, Navarre 2019.

Species	Banded	Species	Banded	Species	Banded
American Woodcock	1	Swamp Sparrow	27	Blackburnian Warbler	4
Eastern Screech Owl	3	Fox Sparrow	3	Black-th.-Green Warbler	11
Hairy Woodpecker	3	Eastern Towhee	2	Western Palm Warbler	2
Downy Woodpecker	16	Northern Cardinal	28	Ovenbird	58
Yellow-bellied Sapsucker	15	Rose-breasted Grosbeak	5	Northern Waterthrush	41
Yellow-shafted Flicker	17	Indigo Bunting	2	Connecticut Warbler	4
Ruby-th. Hummingbird	25	Scarlet Tanager	1	Mourning Warbler	7
Eastern Kingbird	3	Cedar Waxwing	39	Common Yellowthroat	92
Eastern Phoebe	22	Red-eyed Vireo	87	Wilson's Warbler	12
Olive-sided Flycatcher	2	Philadelphia Vireo	11	Canada Warbler	8
Eastern. Wood Pewee	26	Warbling Vireo	18	American Redstart	85
Yellow-bellied Flycatcher	27	Yellow-throated Vireo	1	Gray Catbird	320
Traill's Flycatcher	6	Blue-headed Vireo	7	Brown Thrasher	2
Least Flycatcher	4	White-eyed Vireo	3	Carolina Wren	4
Blue Jay	4	Black and White Warbler	33	House Wren	68
Brown-headed Cowbird	3	Prothonotary Warbler	36	Winter Wren	94
Red-winged Blackbird	26	Golden-winged Warbler	1	Marsh Wren	4
Baltimore Oriole	20	Nashville Warbler	18	Brown Creeper	28
Rusty Blackbird	10	Orange-crowned Warbler	1	White-breasted Nuthatch	1
Common Grackle	74	Tennessee Warbler	62	Black-capped Chickadee	6
House Finch	5	Northern Parula	3	Golden-crowned Kinglet	196
American Goldfinch	8	Cape May Warbler	15	Ruby-crowned Kinglet	134
White-crowned Sparrow	2	Yellow Warbler	32	Wood Thrush	11
White-throated Sparrow	310	Black-th.-Blue Warbler	51	Veery	18
Chipping Sparrow	1	Myrtle Warbler	130	Gray-cheeked Thrush	183
Field Sparrow	1	Magnolia Warbler	93	Swainson's Thrush	393
Slate-colored Junco	12	Chestnut-sided Warbler	11	Hermit Thrush	135
Song Sparrow	40	Bay-breasted Warbler	88	American Robin	128
Lincoln's Sparrow	3	Blackpoll Warbler	255		

Table 6. Number of days observed and totals of individuals seen on point counts, Navarre fall 2019.

Species	# days	#Observed	Species	# days	#Observed	Species	# days	#Observed
Pied-billed Grebe	1	1	Chimney Swift	32	142	Yellow Warbler	8	11
Herring Gull	22	48	Ruby-th. Hummingbird	11	16	Bl-th-blue Warbler	5	5
Ring-billed Gull	49	198	Eastern Kingbird	12	25	Myrtle Warbler	18	97
Bonaparte's Gull	14	49	Eastern Phoebe	4	4	Magnolia Warbler	7	8
Caspian Tern	9	11	Eastern Wood Pewee	10	13	Bay-breasted Warbler	7	18
D-c. Cormorant	15	92	Traill Flycatcher	1	1	Blackpoll Warbler	29	153
Mallard	36	307	Least Flycatcher	1	1	Blackburnian Warbler	2	2
American Black Duck	5	8	Blue Jay	65	246	Blk.-th-green Warbler	1	1
Gadwall	12	71	European Starling	72	1830	Western Palm Warbler	1	2
American Wigeon	6	17	Brown-headed Cowbird	22	106	Ovenbird	5	6
Blue-winged Teal	2	2	Red-winged Blackbird	71	3470	Common Yellowthroat	9	9
Northern Pintail	7	61	Baltimore Oriole	24	149	Wilson Warbler	1	1
Wood Duck	44	195	Rusty Blackbird	20	264	American Redstart	7	7
Canada Goose	62	1786	Common Grackle	66	1294	Gray Catbird	59	450
Trumpeter Swan	18	41	House Finch	17	34	Brown Thrasher	1	1
Least Bittern	7	7	American Goldfinch	22	50	Carolina Wren	27	36
Great- blue Heron	26	33	Pine Siskin	6	8	House Wren	35	65
Great Egret	4	4	White-th. Sparrow	27	359	Winter Wren	17	22
Green Heron	14	29	Slate-colored Junco	2	4	Brown Creeper	5	5
Sandhill Crane	8	22	Song Sparrow	37	98	White-br. Nuthatch	53	97
Sora	3	3	Eastern Towhee	4	4	Red-br. Nuthatch	1	1
Solitary Sandpiper	1	1	Northern Cardinal	73	399	Black.-cap. Chickadee	22	32
Killdeer	3	5	Rose-br. Grosbeak	13	18	Golden-cr. Kinglet	22	105
Mourning Dove	7	9	Purple Martin	19	142	Ruby-cr. Kinglet	17	43
Cooper Hawk	1	1	Barn Swallow	22	165	Blue-gray Gnatcatcher	4	4
Red-tailed Hawk	1	1	Tree Swallow	28	116	Wood Thrush	4	5
Bald Eagle	33	56	Bank Swallow	6	125	Verry	7	9
American Kestrel	1	1	No. Rough-wing Swal.	1	2	Gray-cheeked Thrush	23	83
Osprey	2	2	Cedar Waxwing	64	520	Swainson's Thrush	37	194
Eastern Screech Owl	13	17	Red-eyed Vireo	9	10	Hermit Thrush	12	18
Yellow-billed Cuckoo	1	1	Warbling Vireo	30	79	American Robin	69	648
Belted Kingfisher	2	2	Blue-headed Vireo	1	1	Eastern Bluebird	3	3
Hairy Woodpecker	17	19	Black & White Warbler	2	2	Unknown Duck	4	106
Downy Woodpecker	67	186	Prothonotary Warbler	2	2	Unknown Woodpecker	1	1
Yellow-bel. Sapsucker	9	11	Nashville Warbler	3	4	Unknown Swallow	3	10
Red-bell. Woodpecker	10	12	Tennessee Warbler	4	5	Unknown Warbler	34	184
Yellow-sh. Flicker	55	179	Cape May Warbler	4	4	Unknown Thrush	4	7

Table 7. Total bandings Navarre Banding Station, passerine migration , 2019.

Species	Banded	Species	Banded	Species	Banded
Green Heron	2	Clay-colored Sparrow	2	Bay-breasted Warbler	137
American Woodcock	1	Field Sparrow	4	Blackpoll Warbler	299
Mourning Dove	1	Slate-colored Junco	13	Blackburnian Warbler	22
Sharp-shinned Hawk	2	Song Sparrow	61	Blk.-th. Grn. Warbler	34
American Kestrel	1	Lincoln's Sparrow	49	West. Palm Warbler	124
Eastern Screech Owl	3	Swamp Sparrow	101	Prairie Warbler	1
Yellow-billed Cuckoo	1	Fox Sparrow	6	Ovenbird	96
Black-billed Cuckoo	2	Eastern Towhee	4	Northern Waterthrush	99
Hairy Woodpecker	3	Northern Cardinal	87	Louisiana Waterthr.	2
Downy Woodpecker	21	Rose-breasted Grosbeak	21	Connecticut Warbler	8
Yellow-bell. Sapsucker	18	Indigo Bunting	35	Mourning Warbler	62
Red-bellied Woodpecker	3	Scarlet Tanager	5	**(8)**C. Yellowthroat	373
Yellow-shafted Flicker	21	Summer Tanager	1	Yellow-breasted Chat	2
Ruby-th. Hummingbird	52	Tree Swallow	25	Hooded Warbler	6
Eastern Kingbird	8	Cedar Waxwing	50	Wilson's Warbler	124
Great-crested Flycatcher	20	Red-eyed Vireo	172	Canada Warbler	85
Eastern Phoebe	27	Philadelphia Vireo	23	**(10)** Amer. Redstart	358
Olive-sided Flycatcher	4	Warbling Vireo	59	**(1)**Gray Catbird	802
Eastern Wood-Pewee	78	Yellow-throated Vireo	3	Brown Thrasher	17
Yellow-bell. Flycatcher	179	Blue-headed Vireo	34	Carolina Wren	4
Acadian Flycatcher	16	White-eyed Vireo	8	House Wren	180
(6) Traill's Flycatcher	471	Black and White Warbler	83	Winter Wren	98
Least Flycatcher	80	Prothonotary Warbler	54	Marsh Wren	8
Blue Jay	40	Worm-eating Warbler	1	Brown Creeper	51
Brown-headed Cowbird	30	Blue-winged Warbler	11	White-br Nuthatch	2
Red-winged Blackbird	211	Brewster's Warbler	2	Red-br. Nuthatch	28
Baltimore Oriole	39	Golden-winged Warbler	2	Black-cap. Chickadee	7
Rusty Blackbird	14	Nashville Warbler	105	Gold.-cr. Kinglet	218
Common Grackle	91	Orange-crowned Warbler	11	**(5)** Ruby-cr Kinglet	532
Purple Finch	2	Tennessee Warbler	109	Blue-gray Gnatcatch.	96
House Finch	5	Northern Parula	31	Wood Thrush	25
American Goldfinch	20	Cape May Warbler	37	Veery	56
Nelson Sparrow	1	**(4)** Yellow Warbler	569	Gray-cheek Thrush	214
White-cr. Sparrow	11	Black-th. Blue Warbler	99	**(3)**Swainson's Thrush	600
(2) White-th. Sparrow	664	**(9)**Myrtle Warbler	370	Hermit Thrush	271
Am. Tree Sparrow	1	**(7)** Magnolia Warbler	426	American Robin	148
Chipping Sparrow	1	Chestnut-sided Warbler	84		

( ) numbers in bold are top ten banded species

Table 8. Banding year of returning birds captured at Navarre study site, 2019.

Species	2018	2017	2016	2015	2014	2013	2012	2011	Total
Eastern Screech Owl	1	2	1						4
Hairy Woodpecker	1					1			2
Downy Woodpecker			1						1
Blue Jay	1								1
Red-winged Blackbird	11	6	3	7	1	3	2		33
Baltimore Oriole	5	3	1	1					10
Common Grackle		1	1		1				3
White-throated Sparrow			1						1
Song Sparrow	5	2	1						8
Northern Cardinal	8	2	1	1				1	13
Tree Swallow	1								1
Warbling Vireo	6	1	3						10
Prothonotary Warbler	4	1			2				7
Yellow Warbler	28	9	2	4	3	1	2		49
Magnolia Warbler	1								1
Blackpoll Warbler		1							1
Com. Yellowthroat	2	2	2	2					8
Gray Catbird	28	12	3	4	6	1			54
House Wren	8	3	1						12
White-breasted Nuthatch	1								1
Black-cap. Chickadee	2	1							3
American Robin	2		1	1					4
Total	115	46	22	20	13	6	4	1	227

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

Species	Band Number	Band Date	Band Location*	Recovery Date	Recovery Location
Common Grackle	1803-37069	10-05-18	Navarre	06-28-19	Ohio 413-0825
White-th. Sparrow	2771-91269	05-02-19	Ohio 413-0825	05-15-19	Navarre
Yellow Warbler	2830-60925	05-09-18	Navarre	05-16-18	Ohio 413-0824
Magnolia Warbler	2860-29776	05-21-18	Navarre	05-25-19	Navarre
Blackpoll Warbler	2840-73355	10-02-17	Navarre	10-11-19	Navarre
Blackpoll Warbler	2840-75471	09-26-18	Navarre	08-29-19	Alberta 534-1131
Common Yellowthroat	2840-74726	05-22-18	Navarre	10-17-19	So. Car. 323-0800
Gray Catbird	1891-66845	05-15-19	Ohio 413-0825	05-17-19	Navarre
Gray Catbird	2671-03757	07-19-18	Ohio 414-0833	05-17-19	Navarre
Gray Catbird	2731-04169	07-16-18	BSBO	05-06-19	Navarre
Gray Catbird	2731-04535	05-09-18	Navarre	05-15-18	Ohio 413-0814
Ruby-cr. Kinglet	2900-01562	10-07-18	Navarre	04-23-19	Penn. 400-0791
American Robin	1412-07125	08-12-18	Navarre	04-24-19	Ohio 413-0831

*Banding coordinates for study sites: Navarre 413-0830, BSBO 413-0831.