

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

PROGRESS REPORT-2021
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INTRODUCTION

In 2021, Black Swamp Bird Observatory continued a long-term passerine migration study on the Ottawa National Wildlife Refuge complex in the southern Lake Erie region under modifications due to Covid-19 restrictions. 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 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 corridors 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 three 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 (Sillert 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; Kremetz & Ankney 1987). Adequate stopover habitat may play an important role in delivering migrating passerines to their breeding grounds with sufficient energy reserves to successfully nest.

In addition to the biological stressors confronting migratory birds, the changing landscape presents increasing risks of human-induced mortality and individual and population stressors. Only in the past decade 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.

Due to the Covid-19 global pandemic, field operations at the Navarre study site were cancelled for spring 2020 and only point counts were conducted during the fall 2020 migration. In 2021, the full fall migration protocol was re-instituted with Covid safety protocols. Spring 2021, began with a full point count and modified banding protocols that are described in the method section. This annual report covers those findings and a comparison to the long-term point count dataset for the site.

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 2021, migrating and resident passerines were sampled on the Navarre Unit of the Ottawa National Wildlife Refuge in the Great Lakes region. Spring migration efforts centered on a full point count regime as called for in the protocols (Shieldcastle 2018) and a banding program targeting Prothonotary Warblers for a habitat use and migrational pathways telemetry program using Motus nanotags (Taylor et. al. 2017). This limitation was dictated by Covid protocols and safety for volunteers. Banding effort was centered on the time frame of arrival of Prothonotary Warblers and involved nets most likely to capture this species. All birds captured were banded and energetic condition recorded for long-term comparisons. In fall, 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 2021 began mid-April for point counts and late-April for banding and continued through early-June for point counts and late-May for banding. 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 an 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 Energy Harbor 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 by point count in the Navarre Unit in 2021. Banding operations were curtailed to specifically target migrant Prothonotary Warblers and gather energetic data on any captured birds. Spring 2021 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.

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 drainage. 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 2021, this wave was not addressed by banding operations. 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 not addressed by banding data but point counts indicated a normal migration. The third wave normally occurs around Memorial Day weekend and is dominated by female Magnolia Warbler, American Redstart, Mourning Warbler, vireos, and flycatchers. In 2021, the third wave was not addressed by banding data.

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

In spring 2021, the Navarre banding station was partially operated on 23 days for 989.9 net hours. Including hummingbirds, 2,142 new birds were banded and a total of 2,378 birds handled (Table 1). The capture rate for new birds was 216.4 birds/100 net hours. The long-term average capture rate shows no change over time at Navarre. Seventy-six species plus one hybrid warbler were banded in Navarre during spring 2021 (Table 2). The most unusual species included American Tree Sparrow because of the late capture date. The ten most abundant species banded were Magnolia Warbler (227), Gray Catbird (197), Yellow Warbler (173), White-throated Sparrow (112), American Redstart (107), Western Palm Warbler (100), Common Yellowthroat (93), Myrtle Warbler (79), and Nashville Warbler (63).

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 50 days during spring 2021. One hundred and thirty-five species and 12,351 individuals were recorded (Table 3). Canada Goose, Red-winged Blackbird, Common Grackle, and Tree Swallow were observed each count day. The most abundant species recorded was Blue Jay (2,123) followed by Red-winged Blackbird (1,861), Common Grackle (864), Tree Swallow (820), and Canada Goose (564). The first ever Evening Grosbeak for the project was recorded on the point count this spring.

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 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 65 days for 6,636.0 net hours during fall migration. Five thousand, nine hundred and thirty-eight birds were banded with a total of 7,370 birds handled including recaptures (Table 4). This was the 31st fall season in which an extensive netting effort had

been conducted on a daily basis. The capture rate for 2021 was 89.5 new birds/100 net hours and total birds at 111.1 birds/100 net hours. A total of 90 species were banded during fall 2021 (Table 5). The ten most abundant species banded were Blackpoll Warbler (982), Swainson's Thrush (801), Gray Catbird (432), Golden-crowned Kinglet (404), White-throated Sparrow (341), Tennessee Warbler (198), American Robin (197), Myrtle Warbler (180), Gray-cheeked Thrush (173), and Hermit Thrush (148). Several surprises were captured during the fall season and included Eastern Screech-Owl, American Woodcock, Chipping Sparrow, Field Sparrow, Blue-winged Warbler, Yellow-breasted Chat, Hooded Warbler, and Marsh Wren.

Fall point counts were conducted on 64 days during fall 2021. A total of 14,023 individuals of 122 species were recorded (Table 6). Northern Cardinal was counted on every day. The most abundant species were Red-winged Blackbird (3,884), Common Grackle (1,612), European Starling (1,579), American Robin (647), Canada Goose (451), Gray Catbird (388), White-throated Sparrow (348), Blackpoll Warbler (297), Northern Cardinal (266), and Swainson's Thrush (248). An above average species total was recorded in 2021. The first Cave Swallow for the project was reported in October.

SUMMARY BANDINGS

Total combined bandings for passerine migration 2021 for the Navarre Station is in Table 7. The ten most abundant species banded at Navarre were Blackpoll Warbler (993), Swainson's Thrush (850), Gray Catbird (629), White-throated Sparrow (453), Golden-crowned Kinglet (404), Magnolia Warbler (392), Myrtle Warbler (259), Tennessee Warbler (238), Common Yellowthroat (211), and American Redstart (201). A combined total of 100 species made up of 8,080 individuals (105.9 birds/100 net hrs) were banded. While these numbers summarize 2021 they are not comparable to long-term data due to the altered spring banding protocols.

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 2021, 73 birds of 18 species were captured as returning birds at the Navarre site (Table 8). This total includes 8 Yellow Warbler with the oldest being banded in 2014, 8 Prothonotary Warbler (oldest from 2014), 14 Gray Catbird (oldest from 2015), 8 Red-winged Blackbird (oldest from 2015), 8 Northern Cardinal, 4 House Wren, 4 Warbling Vireo (oldest from 2016), and 5 Baltimore Oriole (oldest from 2014). 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. Total return captures for 2021 were below normal and can be attributed to no banding being conducted in 2020 and the reduced spring effort in 2021.

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 41 years. Annual variation in migrational monitoring numbers makes drawing conclusions about populations very risky, even with long-term datasets. 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 the 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 effect 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 2021, project personnel were not able to conduct in person educational programming due to Covid protocols. In addition, five presentations were made to 300 people on avian ecology and migration through zoom remote programs.

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 overriding 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, 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 2021.

Date	Net Hour	Banded	Banded/ 100 net hr	Returns	Recaptures	Total birds	Total bird/ 100 net hr
426	28.16	18	63.92	2	0	20	71.02
427	26.25	32	121.90	0	0	32	121.90
428	37.08	43	115.97	0	0	43	115.97
430	15.74	15	95.30	1	2	18	114.36
501	37.34	36	96.41	1	0	37	99.09
502	27.92	50	179.08	0	1	51	182.66
504	44.73	127	283.93	1	1	129	288.40
505	35.24	100	283.77	3	3	106	300.79
506	44.17	160	362.24	4	15	179	405.25
507	43.91	75	170.80	4	10	89	202.69
508	40.75	38	93.25	3	8	49	120.25
510	48.55	63	129.76	6	14	83	170.96
511	38.96	37	94.97	2	12	51	130.90
512	53.61	25	46.63	2	3	30	55.96
513	55.50	89	160.36	1	11	101	181.98
514	60.02	145	241.59	4	10	159	264.91
515	58.74	196	333.67	1	10	207	352.40
516	65.88	164	248.94	4	26	194	294.48
517	64.49	151	234.14	5	23	179	277.56
518	60.22	69	114.58	2	11	82	136.17
519	41.41	269	649.60	2	6	277	668.92
520	25.08	68	271.13	1	8	77	307.02
521	36.14	172	475.93	4	9	185	511.90
TOTAL	989.89	2142	216.39	53	183	2378	240.23

Missing dates were weather events.

Table 2. Spring banding totals, Navarre, 2021.

Species	Banded	Species	Banded	Species	Banded
Mourning Dove	1	Rose-breasted Grosbeak	5	Blackpoll Warbler	11
Sharp-shinned Hawk	3	Indigo Bunting	15	Blackburnian Warbler	20
Downy Woodpecker	4	Scarlet Tanager	1	Black-th. Green Warbler	22
Red-bellied Woodpecker	1	Tree Swallow	14	Western Palm Warbler	100
Yellow-shafted Flicker	1	Red-eyed Vireo	41	Ovenbird	38
Ruby-th. Hummingbird	13	Philadelphia Vireo	2	Northern Waterthrush	45
Eastern Kingbird	1	Warbling Vireo	17	Connecticut Warbler	1
Great- Crested Flycatcher	7	Yellow-throated Vireo	1	Mourning Warbler	28
Eastern Wood Pewee	6	Blue-headed Vireo	10	Common Yellowthroat	93
Yellow-bellied Flycatcher	11	White-eyed Vireo	5	Hooded Warbler	2
Acadian Flycatcher	2	Black-and-white Warbler	30	Wilson's Warbler	24
Trail's Flycatcher	24	Prothonotary Warbler	16	Canada Warbler	31
Least Flycatcher	33	Blue-winged Warbler	3	American Redstart	107
Blue Jay	11	Golden-winged Warbler	1	Gray Catbird	197
Brown-headed Cowbird	5	Nashville Warbler	63	Brown Thrasher	2
Red-winged Blackbird	24	Orange-crowned Warbler	3	Carolina Wren	3
Baltimore Oriole	15	Tennessee Warbler	40	Red-breasted Nuthatch	9
Common Grackle	9	Northern Parula	18	Ruby-crowned Kinglet	30
American Goldfinch	2	Cape May Warbler	3	Blue-gray Gnatcatcher	4
White-crowned Sparrow	4	Yellow Warbler	173	Wood Thrush	1
White-throated Sparrow	112	Black-th. Blue Warbler	24	Veery	18
American Tree Sparrow	1	Myrtle Warbler	79	Gray-cheeked Thrush	7
Song Sparrow	6	Magnolia Warbler	227	Swainson's Thrush	49
Lincoln's Sparrow	22	Chestnut-sided Warbler	47	Hermit Thrush	13
Swamp Sparrow	24	Bay-breasted Warbler	42	American Robin	3
Northern Cardinal	11				

Table 3. Number of days observed and totals of individuals seen on point counts, Navarre spring 2021.

Species	# days	#Observed	Species	# days	#Observed	Species	# days	#Observed
Pied-billed Grebe	11	14	Yellow-bel. Flycatcher	4	5	Cape May Warbler	7	14
Herring Gull	23	37	Acadian Flycatcher	1	1	Yellow Warbler	30	329
Ring-billed Gull	21	36	Alder Flycatcher	6	11	Black-th.-Blue Warbler	15	36
Bonaparte's Gull	7	32	Willow Flycatcher	3	4	Myrtle Warbler	28	80
Caspian Tern	7	12	Traill's Flycatcher	2	2	Magnolia Warbler	18	33
Dou.-cr. Cormorant	25	201	Least Flycatcher	9	14	Chestnut-sided Warbler	18	28
Am. White Pelican	2	2	Blue Jay	42	2123	Bay-breasted Warbler	8	37
Mallard	17	59	European Starling	49	344	Blackpoll Warbler	10	22
Gadwall	5	30	Brown-headed Cowbird	48	333	Blackburnian Warbler	20	53
Blue-winged Teal	2	12	Red-winged Blackbird	50	1861	Black-th. Green Warbler	18	36
No. Shoveler	1	1	Orchard Oriole	2	2	Pine Warbler	3	3
Wood Duck	29	112	Baltimore Oriole	24	107	W. Palm Warbler	17	44
Lesser Scaup	4	19	Rusty Blackbird	23	108	Ovenbird	10	18
Canada Goose	50	564	Common Grackle	50	846	No. Waterthrush	12	22
Trumpeter Swan	39	104	Evening Grosbeak	1	1	Connecticut Warbler	2	2
Gr. Blue Heron	46	176	Purple Finch	1	1	Mourning Warbler	6	8
Great Egret	26	53	House Finch	1	1	Com. Yellowthroat	22	64
Green Heron	7	10	Am. Goldfinch	19	70	Hooded Warbler	1	1
Black-cr. N. Heron	1	3	Pine Siskin	3	5	Wilson's Warbler	8	19
Sandhill Crane	18	39	White-th. Sparrow	29	230	Canada Warbler	3	4
Virginia Rail	1	1	Am. Tree Sparrow	5	15	American Redstart	21	98
Sora	3	3	Chipping Sparrow	2	2	Gray Catbird	28	270
Lesser Yellowlegs	1	5	Slate-colored Junco	2	2	Brown Thrasher	12	14
Killdeer	4	5	Song Sparrow	47	172	Carolina Wren	36	50
Mourning Dove	48	154	Swamp Sparrow	20	43	House Wren	43	158
Turkey Vulture	1	1	Fox Sparrow	5	26	Winter Wren	4	6
Sharp-shinned. Hawk	1	1	Eastern Towhee	3	3	Marsh Wren	9	12
Red-tailed Hawk	23	30	No. Cardinal	49	319	Brown Creeper	2	2
Bald Eagle	30	60	Rose-br. Grosbeak	12	20	White-breasted Nuthatch	22	31
Osprey	1	1	Indigo Bunting	7	10	Red-breasted Nuthatch	5	6
Eastern Screech-Owl	2	4	Scarlet Tanager	5	5	Tufted Titmouse	1	1
Great Horned Owl	1	1	Purple Martin	12	32	Black-capped Chickadee	9	11
Yellow-billed Cuckoo	7	14	Barn Swallow	11	30	Golden-crowned Kinglet	13	66
Black-billed Cuckoo	3	4	Tree Swallow	50	820	Ruby-crowned Kinglet	30	118
Belted Kingfisher	1	1	Cedar Waxwing	10	181	Blue-gray Gnatcatcher	14	30
Hairy Woodpecker	6	8	Red-eyed Vireo	11	57	Wood Thrush	7	9
Downy Woodpecker	38	84	Philadelphia Vireo	4	4	Veery	4	4
Yellow-bellied Sap.	4	5	Warbling Vireo	27	114	Gray-checked Thrush	5	6
Red-h Woodpecker	4	5	Yellow-throated Vireo	1	1	Swainson's Thrush	10	17
Red-b. Woodpecker	20	28	Blue-headed Vireo	3	3	Hermit Thrush	5	9
Yellow-shafted Flicker	28	56	Black-and-white Warbler	13	16	American Robin	49	247
Chimney Swift	9	12	Prothonotary Warbler	23	53	Unk. Blackbird	3	76
Ruby-th. Humming.	2	2	Golden-winged Warbler	2	2	Unk. Duck	3	7
Eastern Kingbird	11	19	Nashville Warbler	17	57	Unk. Flycatcher	1	4
Great- Cr. Flycatcher	6	8	Orange-cr. Warbler	1	1	Unk. Shorebird	1	1
Eastern Phoebe	3	3	Tennessee Warbler	13	47	Unk. Warbler	10	41
E. Wood Pewee	7	16	Northern Parula	13	57			

Table 4. Daily banding totals for Navarre, fall 2021. (* missing dates were weather events)

Date *	Net Hour	Banded	Banded/100 net hr	Returns	Recaptures	Total birds	Total bird/ 100 net hr
817	109.25	58	53.09	2	2	62	56.75
818	109.25	26	23.80	2	6	34	31.12
819	109.25	38	34.78	1	1	40	36.61
820	111.09	62	55.82	0	8	70	63.02
821	115.00	40	34.78	1	10	51	44.35
822	115.00	29	25.22	1	3	33	28.70
823	107.18	41	38.25	0	4	45	41.99
824	103.50	38	36.71	1	6	45	43.48
825	17.25	4	23.19	0	2	6	34.78
827	113.16	49	43.30	0	11	60	53.02
828	109.25	53	48.51	0	9	62	56.75
829	111.09	25	22.50	1	5	31	27.91
830	113.16	47	41.53	0	7	54	47.72
831	105.34	32	30.37	0	7	39	37.01
902	103.50	61	58.94	0	7	68	65.70
903	103.50	36	34.78	0	13	49	47.34
904	109.25	32	29.29	0	10	42	38.44
905	111.09	41	36.91	0	10	51	45.91
906	113.46	130	114.88	0	19	149	131.67
907	111.09	138	124.22	0	10	148	133.23
908	111.09	133	119.72	0	15	148	133.23
909	115.00	122	106.09	0	17	139	120.87
910	105.34	114	108.22	1	23	138	131.00
911	111.09	102	91.82	2	15	119	107.12
912	101.66	103	101.32	1	23	127	124.93
913	124.66	195	156.43	0	36	231	185.30
914	115.00	73	63.48	0	20	93	80.87
915	101.66	210	206.57	0	14	224	220.34
916	107.18	114	106.36	0	25	139	129.69
917	103.50	83	80.19	1	21	105	101.45
918	103.50	57	55.07	0	23	80	77.29
919	103.50	72	69.57	1	12	85	82.13
920	99.59	81	81.33	0	20	101	101.42
921	82.34	39	47.36	0	12	51	61.94
924	99.59	323	324.33	1	31	355	356.46
925	47.84	135	282.19	0	24	159	332.36
926	122.59	358	292.03	1	53	412	336.08
927	78.66	141	179.25	0	53	194	246.63
928	107.18	128	119.43	1	71	200	186.60
929	103.50	119	114.98	0	44	163	157.49
930	107.18	100	93.30	0	37	137	127.82
1001	103.50	94	90.82	0	53	147	142.03
1002	113.16	107	94.56	0	60	167	147.58
1003	103.50	72	69.57	0	48	120	114.94
1004	103.50	67	64.73	0	34	101	97.58
1005	105.34	35	33.23	0	20	55	52.21
1006	95.68	30	31.35	0	14	44	45.97
1007	92.00	84	91.30	0	16	100	108.70
1008	120.75	110	91.10	0	32	142	117.60
1009	85.68	116	121.24	0	19	135	141.10
1010	69.00	87	126.09	0	25	112	162.32
1011	115.00	134	116.52	0	51	185	160.87
1012	103.50	103	99.52	1	55	159	153.62
1013	107.18	97	90.50	0	25	122	113.83
1014	97.75	70	71.61	0	11	81	82.86
1016	111.09	128	115.22	0	12	140	126.02
1017	92.00	137	148.91	0	27	164	178.26
1018	97.75	120	122.76	0	26	146	149.36
1019	90.16	68	75.42	1	17	86	95.39
1020	93.84	58	61.81	0	18	76	80.99
1022	113.39	126	111.12	1	31	158	139.34
1023	92.00	133	144.57	0	28	161	175.00
1024	88.09	98	111.25	0	28	126	143.04
1027	92.00	28	30.43	1	12	41	44.57
1031	88.09	54	61.30	0	9	63	71.52
TOTAL	6635.97	5938	89.48	22	1410	7370	111.06

Table 5. Fall banding totals, Navarre 2021.

Species	Banded	Species	Banded	Species	Banded
American Woodcock	2	Lincoln's Sparrow	5	Western Palm Warbler	1
Eastern Screech Owl	4	Swamp Sparrow	77	Ovenbird	101
Yellow-billed Cuckoo	3	Fox Sparrow	9	Northern Waterthrush	42
Hairy Woodpecker	3	Northern Cardinal	49	Connecticut Warbler	7
Downy Woodpecker	20	Rose-breasted Grosbeak	5	Mourning Warbler	13
Yellow-bellied Sapsucker	3	Indigo Bunting	1	Common Yellowthroat	118
Red-bellied Woodpecker	2	Scarlet Tanager	1	Yellow-breasted Chat	1
Yellow-shafted Flicker	13	Cedar Waxwing	9	Hooded Warbler	1
Ruby-th. Hummingbird	10	Red-eyed Vireo	114	Wilson's Warbler	9
Great-cr. Flycatcher	2	Philadelphia Vireo	18	Canada Warbler	11
Eastern Phoebe	18	Warbling Vireo	28	American Redstart	94
Eastern. Wood Pewee	10	Blue-headed Vireo	9	Gray Catbird	432
Yellow-bellied Flycatcher	31	Black-and-white Warbler	28	Brown Thrasher	6
Trail's Flycatcher	3	Prothonotary Warbler	30	Carolina Wren	14
Least Flycatcher	3	Blue-winged Warbler	1	House Wren	68
Blue Jay	1	Nashville Warbler	37	Winter Wren	46
Brown-headed Cowbird	20	Orange-crowned Warbler	1	Marsh Wren	1
Red-winged Blackbird	35	Tennessee Warbler	198	Brown Creeper	60
Baltimore Oriole	19	Northern Parula	9	White-breasted Nuthatch	4
Rusty Blackbird	3	Cape May Warbler	99	Red-breasted Nuthatch	7
Common Grackle	39	Yellow Warbler	5	Black-capped Chickadee	9
Purple Finch	5	Black-th. Blue Warbler	78	Tufted Titmouse	3
House Finch	4	Myrtle Warbler	180	Golden-crowned Kinglet	404
American Goldfinch	6	Magnolia Warbler	165	Ruby-crowned Kinglet	131
White-crowned Sparrow	3	Chestnut-sided Warbler	17	Wood Thrush	8
White-throated Sparrow	341	Bay-breasted Warbler	132	Veery	28
Chipping Sparrow	6	Blackpoll Warbler	982	Gray-cheeked Thrush	173
Field Sparrow	2	Blackburnian Warbler	10	Swainson's Thrush	801
Slate-colored Junco	23	Black-th. Green Warbler	8	Hermit Thrush	148
Song Sparrow	59	Pine Warbler	2	American Robin	197

Table 6. Number of days observed and totals of individuals seen on point counts, Navarre fall 2021.

Species	# days	#Observed	Species	# days	#Observed	Species	# days	#Observed
Pied-billed Grebe	2	3	Great- Cr. Flycatcher	1	1	Cape May Warbler	10	23
Herring Gull	23	79	Eastern Phoebe	3	3	Yellow Warbler	5	7
Ring-billed Gull	44	219	Olive-sided Flycatcher	1	1	Bl.-th. Blue Warbler	7	7
Caspian Tern	11	11	Eastern Wood Pewee	4	4	Myrtle Warbler	18	90
D-c. Cormorant	16	178	Yellow-bel. Flycatcher	4	5	Magnolia Warbler	9	17
Am White Pelican	1	47	Least Flycatcher	1	1	Chestnut-sided Warb	2	2
Mallard	32	203	Blue Jay	55	134	Bay-breasted Warbler	9	14
American Black Duck	6	16	American Crow	1	1	Blackpoll Warbler	37	297
Gadwall	11	81	European Starling	64	1579	Blackburnian Warbler	5	6
American Wigeon	4	26	Brown-headed Cowbird	18	66	Blk.-th. Green Warbler	5	6
Blue-winged Teal	1	1	Red-winged Blackbird	63	3884	Ovenbird	5	5
Northern Shoveler	1	1	Baltimore Oriole	21	92	Northern Waterthrush	5	5
Northern Pintail	5	27	Rusty Blackbird	17	234	Connecticut Warbler	1	1
Wood Duck	35	95	Common Grackle	63	1612	Common Yellowthroat	8	9
Canada Goose	60	451	Purple Finch	1	1	Wilson's Warbler	2	2
Trumpeter Swan	15	30	House Finch	13	18	Canada Warbler	1	1
Least Bittern	1	1	American Goldfinch	24	40	American Redstart	13	26
Great- Blue Heron	38	68	Pine Siskin	6	13	House Sparrow	1	1
Great Egret	8	17	White-th. Sparrow	28	348	Gray Catbird	53	388
Green Heron	6	8	Slate-colored Junco	1	1	Brown Thrasher	8	10
Sandhill Crane	5	15	Song Sparrow	21	45	Carolina Wren	62	138
Lesser Yellowlegs	2	2	Swamp Sparrow	5	13	House Wren	20	26
Killdeer	8	9	Fox Sparrow	2	2	Winter Wren	18	23
Mourning Dove	20	55	Northern Cardinal	64	266	Brown Creeper	3	3
Cooper Hawk	2	2	Rose-br. Grosbeak	8	9	White-br. Nuthatch	38	59
Bald Eagle	36	62	Scarlet Tanager	1	1	Red-br. Nuthatch	30	54
American Kestrel	1	1	Purple Martin	25	114	Black.-cap. Chickadee	23	31
Peregrine Falcon	2	2	Cliff Swallow	1	1	Golden-cr. Kinglet	27	167
Merlin	1	1	Cave Swallow	1	2	Ruby-cr. Kinglet	18	141
Eastern Screech Owl	7	9	Barn Swallow	15	109	Blue-gray Gnatcatcher	1	1
Yellow-billed Cuckoo	3	4	Tree Swallow	31	151	Veery	8	10
Black-billed Cuckoo	1	1	Bank Swallow	3	6	Gray-cheeked Thrush	19	47
Belted Kingfisher	2	2	No. Rough-wing Swal.	2	6	Swainson's Thrush	30	248
Hairy Woodpecker	22	24	Cedar Waxwing	42	193	Hermit Thrush	8	10
Downy Woodpecker	60	140	Red-eyed Vireo	26	46	American Robin	60	647
Yellow-bel. Sapsucker	8	11	Philadelphia Vireo	4	4	Eastern Bluebird	2	2
Red-hd. Woodpecker	6	10	Warbling Vireo	23	45	Unknown Blackbird	1	9
Red-bell. Woodpecker	28	38	Blue-headed Vireo	5	5	Unknown Duck	11	164
Yellow-sh. Flicker	25	44	Blk.-and-white Warbler	2	2	Unknown Finch	1	1
Common Nighthawk	3	3	Prothonotary Warbler	2	2	Unknown Shorebird	1	2
Chimney Swift	18	50	Nashville Warbler	3	3	Unknown Swallow	4	8
Ruby-th. Hummingbird	5	5	Tennessee Warbler	6	8	Unknown Warbler	32	171
Eastern Kingbird	11	15	Northern Parula	1	1	Unknown Thrush	3	5

Table 7. Total bandings Navarre Banding Station, passerine migration , 2021.

Species	Banded	Species	Banded	Species	Banded
American Woodcock	2	Song Sparrow	65	Blk.-th. Grn. Warbler	30
Mourning Dove	1	Lincoln's Sparrow	27	Pine Warbler	2
Sharp-shinned Hawk	3	Swamp Sparrow	101	West. Palm Warbler	101
Eastern Screech-Owl	4	Fox Sparrow	9	Ovenbird	139
Yellow-billed Cuckoo	3	Northern Cardinal	60	Northern Waterthrush	87
Hairy Woodpecker	3	Rose-breasted Grosbeak	10	Connecticut Warbler	8
Downy Woodpecker	24	Indigo Bunting	16	Mourning Warbler	41
Yellow-bell. Sapsucker	3	Scarlet Tanager	2	(9) C. Yellowthroat	211
Red-bellied Woodpecker	3	Tree Swallow	14	Yellow-breasted Chat	1
Yellow-shafted Flicker	14	Cedar Waxwing	9	Hooded Warbler	3
Ruby-th. Hummingbird	23	Red-eyed Vireo	155	Wilson's Warbler	33
Eastern Kingbird	1	Philadelphia Vireo	20	Canada Warbler	42
Great-Crested Flycatcher	9	Warbling Vireo	45	(10) Amer. Redstart	201
Eastern Phoebe	18	Yellow-throated Vireo	1	(3) Gray Catbird	629
Eastern Wood-Pewee	16	Blue-headed Vireo	19	Brown Thrasher	8
Yellow-bell. Flycatcher	42	White-eyed Vireo	5	Carolina Wren	17
Acadian Flycatcher	2	Black-and-white Warbler	58	House Wren	68
Trail's Flycatcher	27	Prothonotary Warbler	46	Winter Wren	46
Least Flycatcher	36	Blue-winged Warbler	4	Marsh Wren	1
Blue Jay	12	Golden-winged Warbler	1	Brown Creeper	60
Brown-headed Cowbird	25	Nashville Warbler	100	White-br Nuthatch	4
Red-winged Blackbird	59	Orange-crowned Warbler	4	Red-br. Nuthatch	16
Baltimore Oriole	34	(8) Tennessee Warbler	238	Tufted Titmouse	3
Rusty Blackbird	3	Northern Parula	27	Black-cap. Chickadee	9
Common Grackle	48	Cape May Warbler	52	(5) Gold.-cr. Kinglet	404
Purple Finch	5	Yellow Warbler	178	Ruby-cr Kinglet	161
House Finch	4	Black-th. Blue Warbler	102	Blue-gray Gnatcatch.	4
American Goldfinch	8	(7) Myrtle Warbler	259	Wood Thrush	9
White-cr. Sparrow	7	(6) Magnolia Warbler	392	Veery	46
(4) White-th. Sparrow	453	Chestnut-sided Warbler	64	Gray-cheek Thrush	180
Am. Tree Sparrow	1	Bay-breasted Warbler	174	(2) Swainson's Thrush	850
Chipping Sparrow	6	(1) Blackpoll Warbler	993	Hermit Thrush	161
Field Sparrow	2	Blackburnian Warbler	30	American Robin	200
Slate-colored Junco	23				

() numbers in bold are top ten banded species

Table 8. Banding year of returning birds captured at Navarre study site, 2021.

Species	2020	2019	2018	2017	2016	2015	2014	2013	Total
Eastern Screech-Owl				1					1
Hairy Woodpecker			1						1
Downy Woodpecker					2				2
Blue Jay			1						1
Red-winged Blackbird		5	2			1			8
Baltimore Oriole		1	2	1			1		5
Common Grackle		1							1
Song Sparrow		1		1					2
Northern Cardinal		5	3						8
Tree Swallow		2							2
Warbling Vireo		3			1				4
Prothonotary Warbler		3	3	1			1		8
Yellow Warbler		1	5		1	1			8
Chestnut-sided Warbler			1						1
Gray Catbird		7	2	3	1	1			14
House Wren		4							4
Black-cap. Chickadee		1							1
American Robin		2							2
Total		36	20	7	5	3	2		73

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

Species	Band Number	Band Date	Band Location*	Recovery Date	Recovery Location
Red-winged Blackbird	1412-26836	04-18-19	Navarre	03-21-20	Ohio 413-0830
Prothonotary Warbler	2730-12133	05-16-14	Navarre	05-14-21	Navarre
Yellow Warbler	2300-97600	05-17-13		05-12-17	Ohio 413-0831
Common Yellowthroat	2780-41175	08-24-16	Navarre	05-11-19	Navarre

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