AMERICAN WOODCOCK (*SCOLOPAX MINOR*) MIGRATION ECOLOGY IN EASTERN NORTH AMERICA

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The Eastern Woodcock Migratory Research Cooperative is a collaborative group partnered to better-understand the ecology of American woodcock migration in eastern North America. This project would not be possible without significant support from multiple state and federal agencies, universities, non-profit organizations. *This document contains draft information that has not yet been subject to peer review. As such any results or information reported herein should be cited as unpublished dat. We anticipate interpretation may change as additional years of data are collected and we learn more about eastern woodcock and their migration.*

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EXECUTIVE SUMMARY

Declining populations of migrant animals worldwide has prompted a renewed interested in understanding migration ecology. Migrating birds are particularly vulnerable as habitat loss, anthropogenic structures, and novel predators are widely believed to contribute to population declines. The American Woodcock (*Scolopax minor)* is a migratory forest bird that has experienced population declines of 1.1 percent per year for the past five decades. Considerable knowledge gaps remain with respect to woodcock migration, so, we initiated the Eastern Woodcock Migration Research Cooperative in 2017 to describe migration phenology, stopover ecology, and determine survival during migration of woodcock in the Eastern Management Region. From October 2018 – March 2019, we deployed 121 satellite GPS transmitters on woodcock captured in 9 states and 2 Canadian provinces throughout eastern North America. We obtained movement data during spring and fall migration from 113 of these woodcock, and collected at least one full migration path from 83 birds. Mean migration distance between capture locations and residency site (wintering or breeding area) was 1,392 km in fall, and 1,245 km in spring, and mean single night fight distance was 252 km in fall and 177 km in spring. For fall migration, the mean initiation date was 7 November and mean termination date was 5 December. On average it took woodcock 25 days to complete fall migration, using an average of 4.4 stopover sites each and remaining at each site for an average of 5.4 days before continuing migration. During spring migration, the mean initiation data was 10 March and termination date 7 April. On average, it took 29.3 days to complete spring migration, with woodcock using 4.8 stopover sites and remaining at each site for an average of 7.4 days before continuing migration. In general, spring migration was longer in duration and woodcock stopped over at sites for greater lengths of time than during fall migration. We observed a number of individuals

captured and marked in the Eastern Management Region migrating into the Central Management Region during both spring and fall, including a number of birds that overwintered along the Atlantic Coast and migrated to breeding areas in the western Great Lakes region. During the upcoming fall and winter we will continue to mark birds and expand project coverage throughout eastern North America.

INTRODUCTION

Across temperate regions of North America, animals must contend with seasonally influenced thermal extremes, changing food abundance, and stochastic weather events. Some species cope with these dynamic conditions by traveling between seasonally suitable habitats in predictable movements termed migrations (Dingle 2014). Migratory ecology remains an understudied portion of the annual lifecycle for many species (Faaborg et al. 2010). Migrating individuals must continually locate suitable areas, termed stopover locations, to rest and rebuild energy reserves needed to continue migration (Rodewald and Brittingham 2004, Taylor et al. 2011). At the same time, animals must also contend with hazards such as anthropogenic structures (e.g., cell towers, buildings, wind turbines; Loss et al. 2014, Graff et al. 2016, Zimmerling and Francis 2016) and unpredictable weather (Newton 2007). For some species mortality peaks during migration (Sillett and Holmes 2002, Klassen et al. 2014), and navigating these difficulties may contribute to the observed declines of migratory species and possibly limit population viability (Frick et al. 2017).

The American Woodcock (*Scolopax minor*; woodcock hereafter) is a migratory forest bird that has experienced population wide long-term declines of 1.1% per year over the past 50 years (Seamans and Rau 2018). Woodcock are distributed throughout eastern North America; primarily breeding in the northern United States and Southern Canada, and overwintering in the southern United States. The species is managed as two discrete populations associated with the Central and the Eastern Management Regions, which loosely correspond with the portions of woodcock range that occur west and east of the Appalachian Mountains, respectively (Figure 1). Previous research suggests woodcock migrate south between October-December and north between January-April (Krementz et al. 1994, Butler 2003, Meunier et al. 2008, Moore 2016). These prior studies are principally derived from observations of local changes in woodcock abundance (e.g. arrival of spring migrants) and radio-tracking studies at breeding, wintering, and stopover sites. While this information is useful, it is inherently limited in scope and cannot be applied broadly across the species' range. This knowledge gap prompted The Association of Fish and Wildlife Agencies to identify migratory ecology as one of the woodcock's greatest research needs (Case and Associates 2010).

Tracking woodcock throughout migration represents numerous challenges, as individuals must be continually relocated over vast distances, almost always spanning numerous states and often multiple countries (Myatt and Krementz 2007, Klassen et al. 2014). Recent advances in transmitter tracking technologies allow for woodcock to be tracked using satellite transmitters (Moore 2016). Satellite transmitters can now simultaneously collect global positioning system (GPS) location data and remotely transmit locations to a central database via satellite or cellular networks. Between 2014 and 2016, Moore (2016) used satellite transmitters to track migrating woodcock in the Central Management Region, but only tracked a few woodcock that migrated into the eastern half of the range. We were interested in using satellite transmitters in the Eastern Management Region to improve range-wide understanding of woodcock migration. To that end, we created the Eastern Woodcock Migration Research Cooperative, with the goal of describing the migratory phenology and survival of American woodcock in the eastern extent of their range.

Our specific objectives are to 1) describe departure and arrival phenology for migrating woodcock, 2) describe stopover ecology including distance between stopover sites, number of stopover events, and location of stopover events, 3) evaluate migratory connectivity for woodcock, including movements between the Central and Eastern Management Regions via migration, and 4) quantify the survival of migrating woodcock. This report documents results obtained during the project's first two years of data collection, and will focus on what we have learned so far with respect to objectives 1, 2, and 3, with future work to focus on objective 4.

METHODS

Study Area

The Eastern Woodcock Migration Research Cooperative study area is primarily comprised of the Eastern Woodcock Management Region, the spatial unit at which the United States Fish and Wildlife Service and Environment and Climate Change Canada manages the eastern-more population of woodcock (Figure 1). We completed a pilot field season during 2017-2018 (Fish et al. 2018) that was focused on marking birds in Maine, and initiated our first full-scale field season in Fall 2018. For this report we will include data from all years of the project. During the fall (September-October) we focused capture efforts in NY, PA, RI, VA and ME, as well as Ontario and Quebec. During winter (December-February) we focused captures in VA, NJ, MD, SC, and NC. We generally relied on knowledge of local biologists to identify areas suitable for woodcock capture within states and provinces, and we deployed transmitters on a wide variety of land ownership types, including state, federal, non-governmental organization, and private. As woodcock departed for spring and fall migration, they left capture locations and migrated either north or south, respectively, traversing multiple states and provinces throughout the eastern United States and Canada. We anticipated a subset of woodcock would leave the

Eastern Management Region and enter the Central Management Region during both spring and fall migration (Moore 2016; Figure 1).

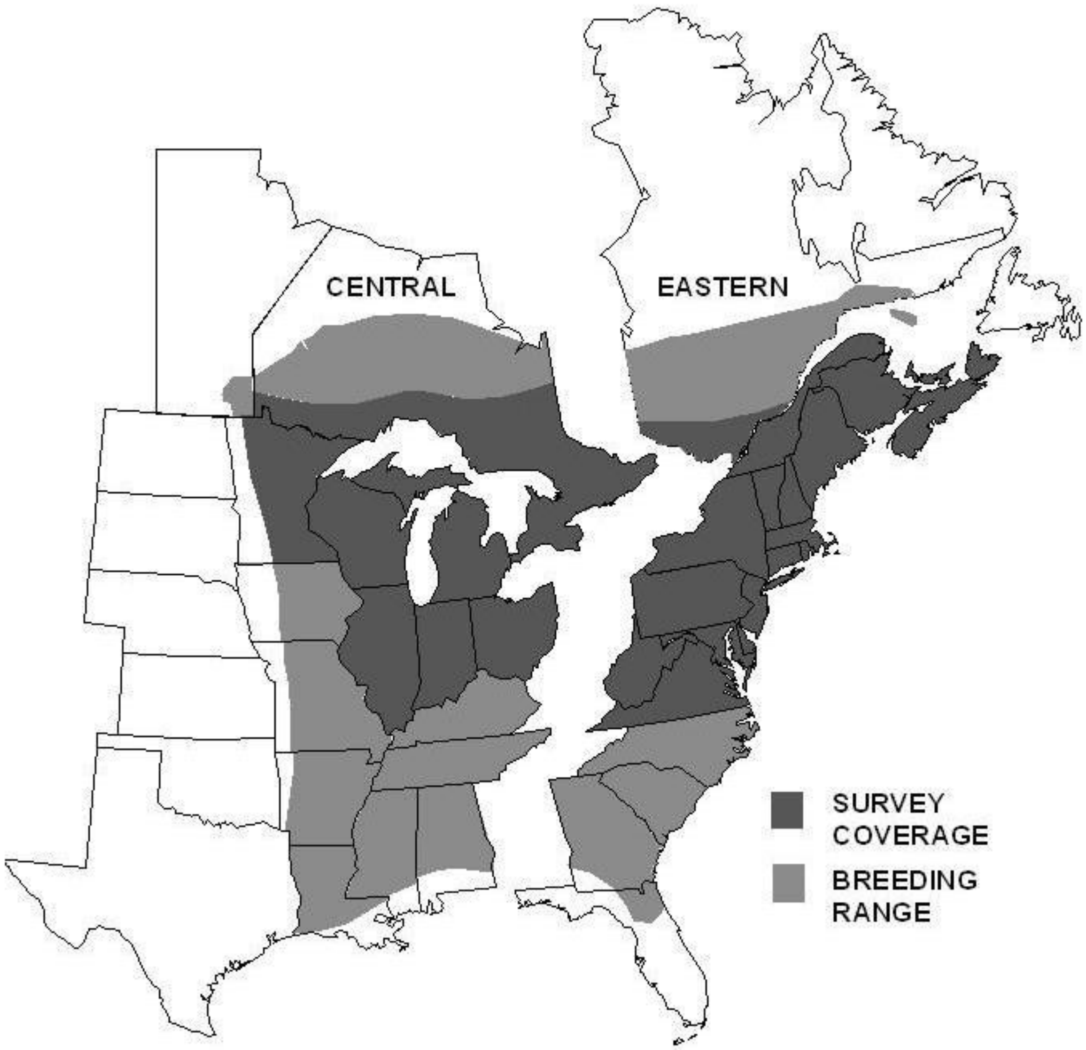

Figure 1 – American Woodcock Central and Eastern Management Regions, with distribution of breeding season survey coverage (figure from Seamans and Rau 2018).

Capture Methods

Woodcock were captured using mist nets during crepuscular flights (Sheldon 1960) and by spot-lighting roosting birds (Rienffenberger and Kletzly 1967, McAuley et al. 1993). We set-mist net arrays near roosting fields, travel corridors, and forested wetlands to capture birds as they left diurnal use areas and flew to night roosts. Additionally, we used spotlights to locate woodcock roosting in fallow fields and captured using handheld nets. Once captured, we aged woodcock to two ages classes (adult [after hatch year or after second year] or immature [hatch year or second year]), using wing plumage characteristics, and sexed (male or female), using a combination of wing plumage, and bill length (Mendell and Aldous 1943, Martin 1964). Woodcock were fitted with a Lotek PinPoint 75 or 150 ARGOS-compatible satellite transmitter, attached with a leg-loop style harness (Moore 2016). The GPS collected locations at pre-programmed dates and times, and transmitted data to a central database using the ARGOS satellite system. We stopped receiving locations when birds either dropped their transmitter or the bird died, thereby causing the transmitter to rest on the ground and attenuate the signal, or if the transmitter's battery died or otherwise failed. We are working on methods to differentiate tags loss/failure from mortality in order to estimate survival from the GPS location data, but those methods are still under development.

Transmitters were manually programmed using LOTEK PinPoint Host software (LOTEK Wireless Inc., Newmarket, Ontario, CA), which allowed us to specify the exact date and time locations were collected. Transmitters had limited battery life and were expected to collect a maximum of 75 and 125 locations for the PinPoint 75 and 150 tags, respectively, before losing power. We created three location collection schedules; frequent (one location per day), infrequent (one location every few days), and hybrid (combinations of frequent and infrequent periods) to maximize the amount of data we collected for each woodcock. Hybrid schedules contained a frequent collection period (~30 days) during the peak of migration, and infrequent collection periods before and after the frequent period. Frequent and infrequent schedules are used on both sexes during both fall and spring migration, with hybrid schedules used during spring migration as the potential migration periods exceeds the expected number of GPS locations possible under a frequent schedule. Frequent schedules are useful to evaluate fine scale movement and provide the finest resolution (i.e. 1-day) to document stopover (resting periods during migration) ecology. Infrequent schedules allowed for woodcock to be tracked for longer periods of time, thus possibly providing data on both spring and fall migration for an individual bird. Infrequent schedules also increased the probability of receiving future data transmissions when individuals used stopover sites with poor satellite signal and failed to upload locations (e.g., mountainous areas with a steep slope). We randomly assigned a transmitter schedule to each captured woodcock, while attempting to control for equal sex and age ratios between programming treatments and capture locations. Location data was transmitted to a remote database after every third GPS location was collected using the ARGOS satellite system. We manually downloaded woodcock locations every 1 to 5 days, and used Movebank (Movebank Project, accessed 6 June 2019) to store all location data.

Preliminary Data Summary

In program R we used the unique date and time signature for each location to determine when woodcock initiated and terminated migration, and to determine how many stopover locations were used, the number of days they spent at each stopover site, and the total duration (days) of migration. We conducted this separately for both spring and fall migration, with some small differences (described below) to accommodate the unique nature of each migratory direction. Migration initiation was determined by using the first known day a bird traveled greater than 16 kilometers from its pre-migratory capture location, or wintering range for birds marked prior to fall migration and followed north during the following spring. Termination was assumed when birds became stationary for more than 7 days in the wintering range following fall migration, or when a woodcock became stationary for greater than 20 days following spring migration. We used a greater number of days for termination of spring migration because woodcock have been documented breeding throughout eastern North America, and cold spring weather may cause extended stopover events that may mimic breeding residency. Therefore, in the spring we wanted to increase our certainty that we were correctly identifying the termination of migration, rather than a prolonged stopover event. We censored woodcock marked in New Jersey during December from our assessment of fall migration initiation, and a subset of birds captured in Virginia from our assessment of spring initiation, as these birds were likely marked during stopover after already beginning migration. We calculated the number of days individuals spent at each stopover location by subtracting the first known departure date from the previous site from the first known arrival date at the current site, and we used a minimum distance of 16 km to delineate migration to a subsequent stopover from local movement at a single stopover. We additionally determined the cumulative distance migrated at each stopover by summing the distances (straight line [Euclidean] distance) between pre-migration location and each subsequent stopover site up to that point. When birds transmitted data for a full migration, we calculated the total distance travelled between pre- and post-migration locations. In each case, the total distance represented the sum of individual migratory paths recorded for each individual bird. We also recorded the state or province where woodcock established post-migration residency.

Because not all transmitters provided daily locations for every bird, we couldn't always assign departure and arrival dates with full certainty, so it is possible that we over-estimated time spent at each stopover and the number of days required for migration. However, we were as likely to over-estimate dates of arrival as we were to under-estimate dates of departure, so this limitation should result in random noise with respect to estimates of migration timing, rather than bias per se. However, it is also certain that we missed some stopover locations completely, which introduced a positive bias into the mean and maximum distances we observed between recorded stopovers, and thus over-estimated the distance woodcock traveled during a single migratory flight and underestimated their total number of stopovers. Thus, our summary of these values for the total dataset should be viewed conservatively, and we provide information on mean and maximum flight distances for birds known to make a flight during a single night (i.e. 1 day between departure and arrival dates) as a secondary assessment of flight distances. In the future we plan to employ more formal analysis methods to deal with this source of uncertainty directly. Finally, we qualitatively evaluated connectivity between breeding and wintering areas, and migratory movements between the Eastern and Central Management Regions, by visually inspecting maps of all woodcock migration paths.

PRELIMINARY RESULTS AND DISCUSSION

Capture: We captured and attached transmitters to 121 woodcock to date; 6 woodcock in October 2017, 60 woodcock from September to October 2018, and 55 woodcock from December 2018 to March 2019. Of the 121 woodcock marked with GPS tags, 32 woodcock were adult males, 34 immature males, 27 adult females, and 28 immature females (Table 1). Captures occurred in Maine, Maryland, New Jersey, New York, North Carolina, Ontario, Pennsylvania, Quebec, Rhode Island, South Carolina, and Virginia (Table 1). A total of 6 woodcock in fall 2017, 52 in fall 2018 and 55 in spring 2019 initiated migration, and 3 woodcock in fall 2017, 38 in fall 2018, and 42 in spring 2019 completed migration (Table 2). Thirty woodcock lacked complete migration tracks because of signal loss before establishing post-migration residency, likely due to a combination of mortality, dropped transmitters, or transmitter malfunction. We were unable to determine exact cause of signal loss for most transmitters, however, two woodcock were harvest by hunters, one in Rhode Island and one in New Jersey, where transmitters had stopped transmitting post-harvest. In both cases, woodcock were harvested prior to leaving the state of capture.

Phenology: Woodcock initiated fall migration between 12 October and 1 January (mean = 7 November), and arrived on the wintering ground between 28 October and 3 February (mean = 5 December). Spring migration was initiated between 26 January and 29 March (mean = 10 March) and terminated between 6 February and 15 May (mean = 7 April). The average number of days each bird spent at a stopover location throughout migration ranged from 1.5 to 15 for fall migrants (mean = 5.4 days), and 2 to 36.5 for spring migrants (mean = 7.4 days; Appendix A), and the number of stopover locations used by individual woodcock ranged from 0 to 10 during the fall (mean = 4.4) and 1 to 11 during the spring (mean = 4.8). The total duration of migration for individual birds was highly variable, ranging from 4 to 72 days in fall (mean = 25 days), and 2 to 73 days in the spring (mean = 29.3 days).

Differences in timing of migration are at least partially driven by spatial variation across woodcock range; clearly woodcock migrating from Virginia have a shorter distance to reach the wintering range compared to, for example, those migrating from Ontario and Quebec. Indeed, we saw that birds captured at more northern latitudes departed generally earlier on fall migration than more southern birds, but there was also considerable variation, where birds marked at the same location often exhibited very different departure timing (Fig. 2). There was some indication that birds departing earlier ultimately migrated a greater total distance, however, this also was highly variable (Fig. 3). Timing of departure during the fall was also at least partially associated with woodcock age, with immature woodcock departing earlier than adult birds (Fig. 4); there was not as clear an association between age and onset of spring migration, although some adult females departed later than all other age/sex classes (Fig. 5).

Length of migration: The distances woodcock traveled between recorded stopover sites was highly variable, ranging from 16 to 1,143 km; however, this maximum distance almost certainly includes missed stopover locations and does not reflect maximum single flight distance. For flights of known distance (i.e., starting and ending points obtained 1 day apart), the maximum single flight distance we recorded was 797 km, and the mean flight distance was 252 km in the fall and 177 km in the spring. The majority of birds traveled distances under 400 km between successive stopovers; approximately 71% of fall and 80% of spring point-to-point distances fell under 400 km (Table 3). Most stopover sites that were separated by greater distances likely occurred when multiple days of uncertainty existed on either the arrival or departure date at the stopover site. Generally, birds exhibited more short-distance (<100 km) movements during spring migration, while longer distance flights were more common during fall migration, although both were highly variable (Table 3). Total distance traveled during migration was also variable, ranging from 360 to 2,446 km for fall migrants (mean = 1,392 km) and 467 to 2,427 km (mean = 1,243 km) for spring migrants. In Appendix A we provide a bird-by-bird summary of all metrics mentioned above.

The longest migration track we documented (2,446 km) was from a woodcock marked at Moosehorn National Wildlife Refuge in Maine during 2017 that overwintered 3 km north of the Alabama/Florida state border. The shortest migratory distance we observed was a woodcock that spent the summer in Rhode Island and over-wintered in New Jersey (360 km). During fall migration, as birds increased their total migratory distance, they generally increased the total number of days invested in migration. While this relationship is seemingly intuitive, as with timing of departure there was considerable variation among individual birds (Fig. 3). Birds that traveled the greatest distances during fall migration (>2000 km) ranged from an average of 3 to 15 days per stopover, and took between 19 and 72 days to complete fall migration (Fig. 3). Interestingly, immature birds seemed to migrate greater distances than adults during both fall (Fig. 4) and spring migration (Fig. 5). At this point our sample of young birds is relatively robust, but not comprehensive across all sites and conditions, so more years of data are needed to see if these represent true age-specific differences in migration distance, rather than a sampling artifact. With additional data and more formal analysis, we plan to explore mechanisms for variation in migration behaviors in the future.

Migratory connectivity: Maps of woodcock migration paths for fall and spring in aggregate, as well as for birds captured in individual states/provinces, are provided in Figures 6 through 26. Based on the 83 individuals with complete migration paths, we found that 35% of fall-migrating woodcock and 20% of spring migrating woodcock crossed management region boundaries during migration. During fall most cross-regional movements were associated with woodcock marked on the western side of the Eastern Management Region (e.g. Quebec, PA, NY; Fig. 7, 10, 11, 12, 13), and a few woodcock marked in New England that overwintered in the Central Management Region along the Gulf of Mexico, primarily in Louisiana (e.g. Fig. 6, 14). During spring (Fig. 17), we observed 4 of 9 woodcock marked in southeastern South Carolina migrating into the Central Management Region (Fig. 25), as well as additional birds marked in Virginia (Fig. 26) and Maryland (Fig. 17). Woodcock moving from the Eastern to Central Management Region during spring terminated their migration in Kentucky, Michigan, Minnesota, Ohio, Ontario, and Wisconsin. While cross-regional movements by woodcock have been previously documented (e.g. Moore 2016), the information we collected during the spring 2019 migration providing detailed information on movements from eastern wintering areas to the central breeding range is relatively unprecedented. This illustrates at least some population connectivity between wintering areas in the mid-Atlantic and southeastern U.S., and breeding areas in the western Great Lakes.

FUTURE DIRECTIONS

We anticipate that as the project continues to grow and additional tags are deployed throughout the eastern United States and Canada, we will refine the information presented in this report, increase our ability to document migration, and further test mechanisms for migratory patterns. We have been incredibly impressed with the data collected so far, and are continually working to adopt robust methods to more formally analyze woodcock movement data, interpret the results, and translate our findings into conclusions that are relevant to woodcock management. Specifically, we plan to develop a more formal approach to classify migration corridors and to identify regionally-important stopover areas using dynamic Brownian bridge movement models. These should also allow us to more systematically differentiate migratory behaviors, such as migration flights vs stopover, or local movements during breeding and wintering from migratory movements, based on the underlying distribution of data rather than an arbitrary rule set. This will enable us to more-accurately classify woodcock movements and describe aspects of woodcock migration in greater detail, and should provide a more rigorous framework for dealing with information gaps and missing data. More broadly, the movement models will help us to better-understand the dynamics of short-distant migration and investigate how environmental and biological covariates influence these dynamics.

Our project has continued to gather support from an ever-growing group of stakeholders. With this growing interest, we will repeat sampling in the same states and provinces that we worked in during 2018/19, and we also plan to deploy transmitters in new locations. During fall of 2019, we anticipate adding sites in eastern Quebec, Nova Scotia, and West Virginia, and during winter 2020 we will expand deployments to sites in Alabama, Florida, and Georgia.

PROJECT PARTNERS

Alabama Department of Conservation and Natural Resources
American Woodcock Society
Canaan Valley National Wildlife Refuge
Environment and Climate Change Canada
Florida Fish and Wildlife Conservation Commission
Friends of the 500th
Georgia Department of Natural Resources
Maine Department of Inland Fisheries and Wildlife
Maryland Department of Natural Resources
Moosehorn National Wildlife Refuge
New Jersey Department of Environmental Protection
New York Department of Environmental Conservation
North Carolina Wildlife Resources Commission
Pennsylvania Game Commission
Rhode Island Dept. of Environmental Management
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PROJECT WEBSITE

Please visit www.woodcockmigration.org for weekly updates during migration and for more information on the Eastern Woodcock Migration Research Cooperative.

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TABLES AND FIGURES

Table 1. Capture summary for American woodcock marked with GPS transmitters as part of the Eastern Woodcock Migratory Research Cooperative.

		Male		**Female**		
Capture Location	**Year**	**Immature**	**Adult**	**Immature**	**Adult**	**GPS TOTALS**
Maine	*2017*	4			2	6
Maine	*2018*	1	1	3	2	7
Maryland	*2019*		3	5	2	10
New Jersey	*2018*	7		8		15
New York	*2018*	4	1	1	3	9
North Carolina	*2019*	2	2		2	6
Ontario	*2018*		1		1	2
Pennsylvania	*2018*	2	4	2	4	12
Quebec	*2018*	2		2	1	5
Rhode Island	*2018*		12		3	15
South Carolina	*2019*	2	1	4	2	9
Virginia	*2018*		6	3	1	10
Virginia	*2019*	10	1		4	15
TOTAL		**34**	**32**	**28**	**27**	**121**

Table 2. Total net migration distance for GPS-marked woodcock during fall and spring migratory periods that completed one full migration. We only included woodcock marked prior to migration, and censored woodcock marked in New Jersey during fall migration and some woodcock marked in Virginia during spring migration because we assumed these were captured after the onset of migration. New Jersey-captured woodcock were included in spring migration assessments.

	Total Migration		**Percent of Total**		**Sum Percent**	
Bin[a]	**Fall[b]**	**Spring[c]**	**Fall**	**Spring**	**Fall**	**Spring**
0-200	0	0	0.00%	0.00%	0.00%	0.00%
200-400	1	1	2.40%	2.40%	2.40%	2.40%
400-600	0	3	0.00%	7.10%	2.40%	9.50%
600-800	2	3	4.90%	7.10%	7.30%	16.60%
800-1000	5	8	12.20%	19.00%	19.50%	35.60%
1000-1200	4	3	9.80%	7.1%	29.30%	42.70%
1200-1400	4	1	9.80%	2.40%	39.10%	45.10%
1400-1600	3	6	7.30%	14.30%	46.40%	59.40%
1600-1800	10	8	24.40%	19.00%	70.80%	78.40%
1800-2000	3	4	7.30%	9.50%	78.10%	87.90%
2000-2200	4	3	9.80%	7.10%	87.90%	95.00%
2200-2400	2	1	4.90%	2.40%	92.80%	97.50%
2400-2600	3	1	7.30%	2.40%	100.00%	100.00%
Total	**41**	**42**	**100.00%**	**100.00%**	-	-

[a]distances in kilometers

[b]1 October 2017 to 31 January 2018, and 1 September 2018 to 31 January 2019

[c]1 February 2019 to 30 May 2019 to spring

Table 3. Distribution of all migratory movement [step] distances between successive pre-migration, stopover, and post-migration locations for spring and fall migrating woodcock. For some individuals, locations are greater than one day apart, resulting in some stopover locations not being recorded and step events likely overestimating single day migratory movements.

	Step Events		Percent of Total		Sum Percent	
Bin[a]	**Fall[b]**	**Spring[c]**	**Fall**	**Spring**	**Fall**	**Spring**
0-100	64	90	26.80%	32.60%	26.80%	32.60%
100-200	47	61	19.70%	22.10%	46.50%	54.70%
200-300	32	44	13.40%	15.90%	59.90%	70.60%
300-400	28	28	11.70%	10.10%	71.60%	80.70%
400-500	21	23	8.80%	8.30%	80.40%	89.00%
500-600	20	14	8.40%	5.10%	88.80%	94.10%
600-700	17	6	7.10%	2.20%	95.90%	96.30%
700-800	6	3	2.50%	1.10%	98.40%	97.40%
800-900	1	2	0.40%	0.70%	98.80%	98.10%
900-1000	2	3	0.80%	1.10%	99.60%	99.20%
1000-1100	0	0	0.00%	0.00%	99.60%	99.20%
1100-1200	0	2	0.00%	0.70%	99.60%	100.00%
1200-1300	1	0	0.40%	0.00%	100.00%	100.00%
Total	**239**	**276**	**100%**	**100%**	-	-

[a]distances in kilometers

[b]1 October 2017 to 31 January 2018, and 1 September 2018 to 31 January 2019

[c]1 February 2019 to 30 May 2019 to spring

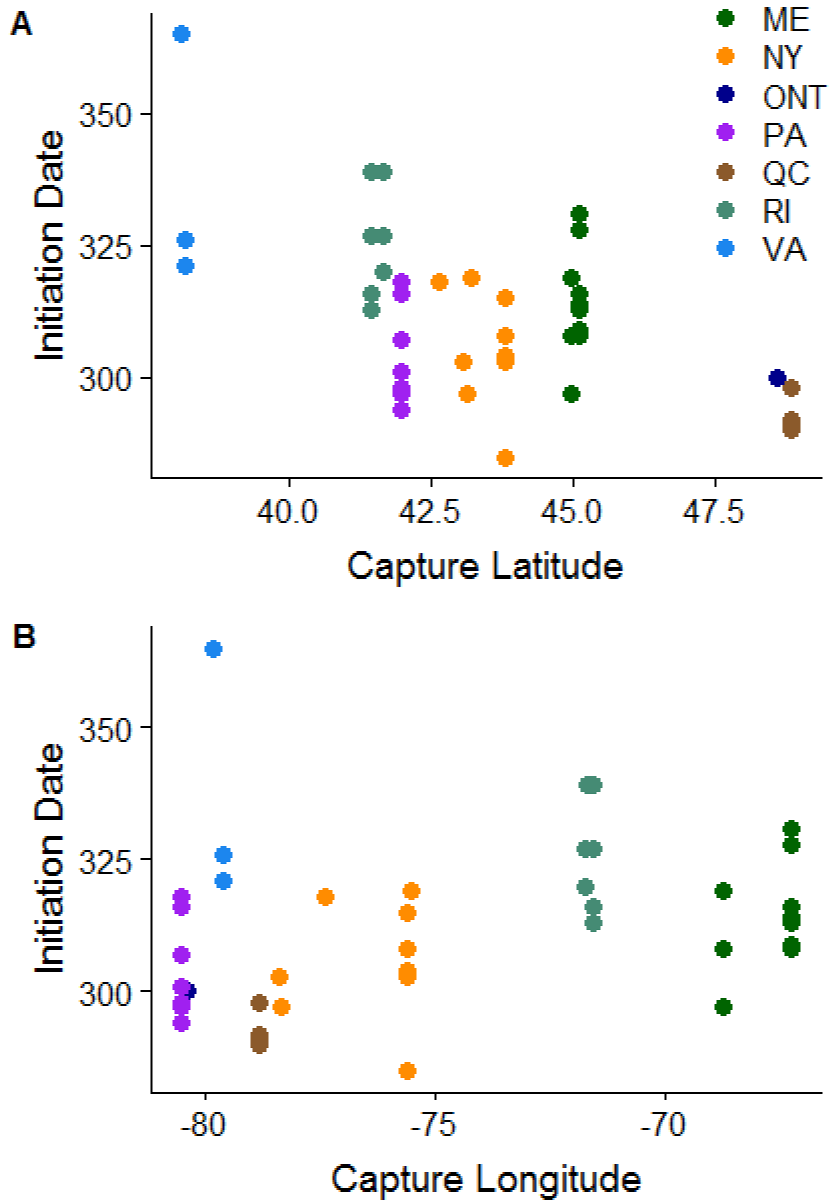

Figure 2. Ordinal date of initiation for fall migration by GPS-marked American woodcock as a function of latitude (A) and longitude (B) of capture. Day 300 = October 26th. Point colors indicate state of capture, as shown in the figure legend.

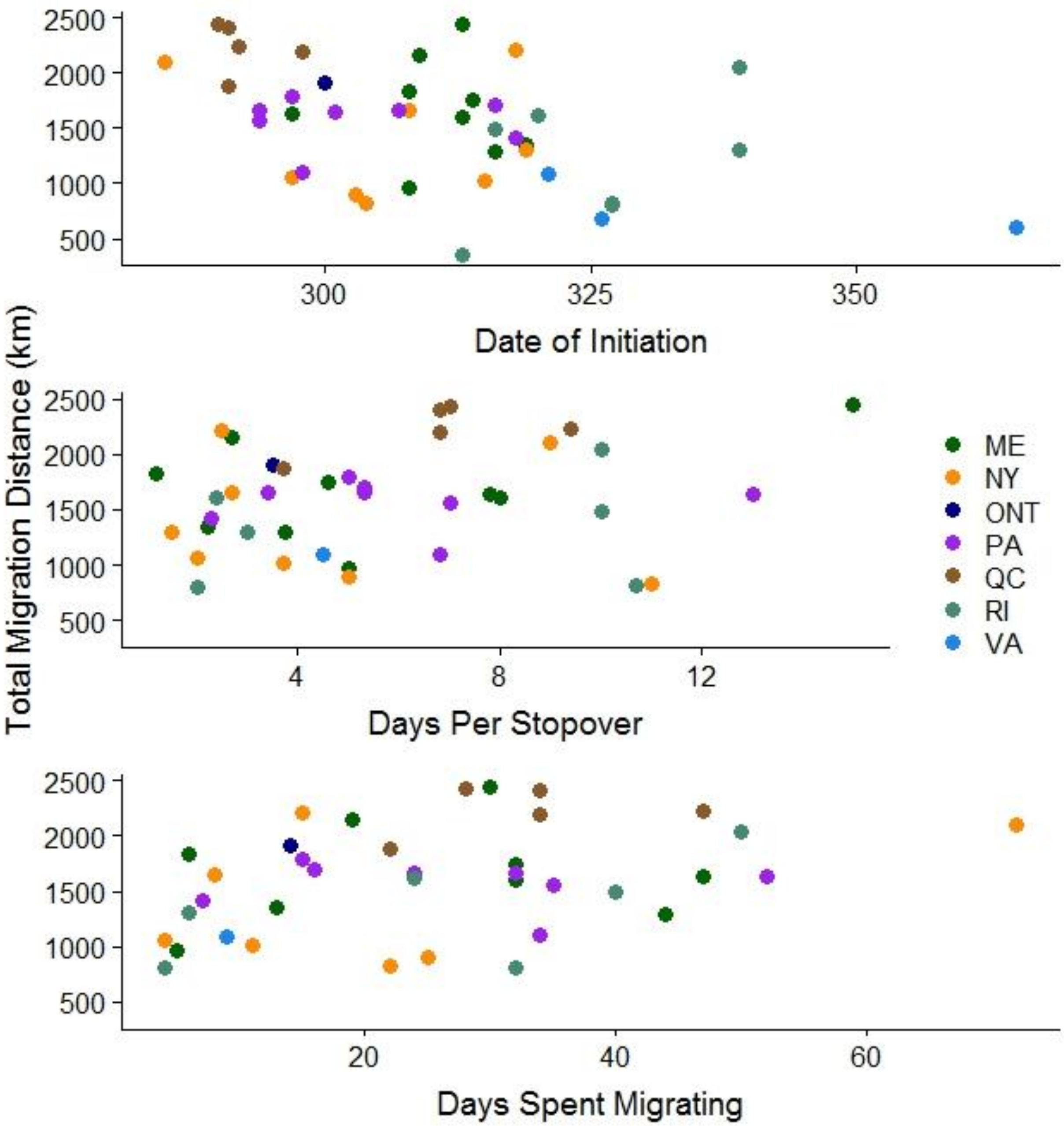

Figure 3. Total distance migrated by GPS-marked American woodcock during fall migration as a function of initiation date (top), mean number of days spent at each stopover (middle), and total number of days in migration (bottom). Day 300 = October 26th. Point colors indicate state of capture, as shown in the figure legend. Only woodcock with complete migration tracks during fall migration (n=41) were included in these figures.

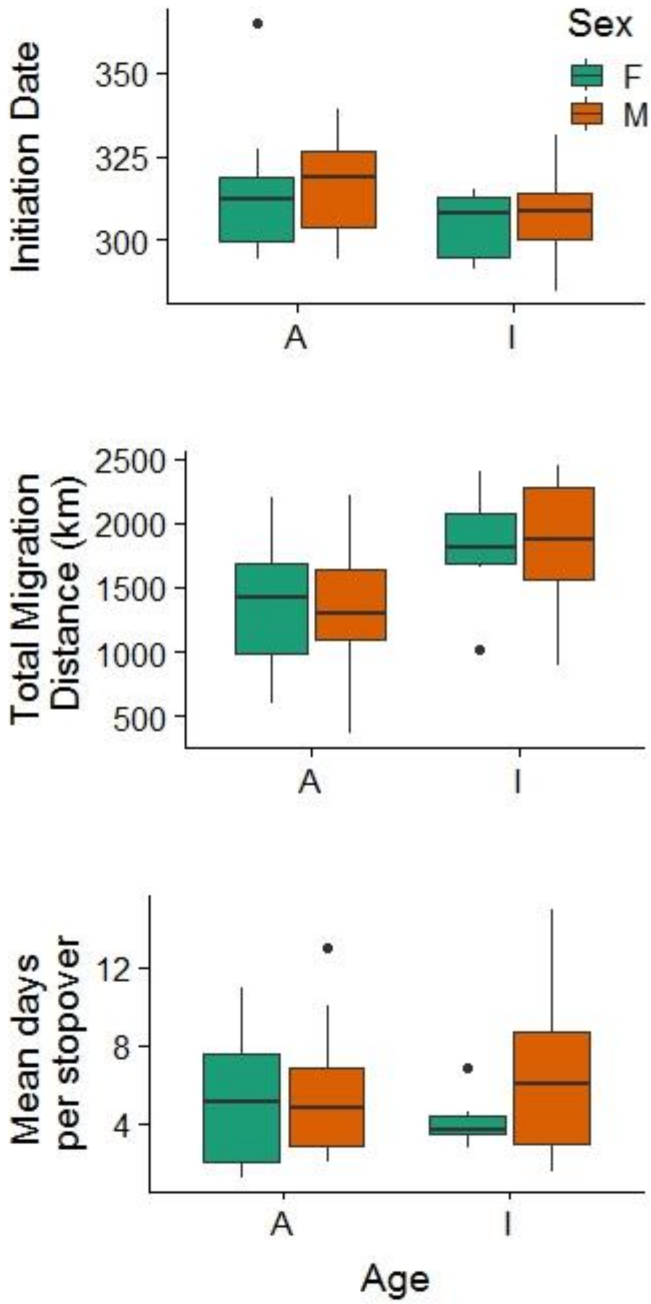

Figure 4. Distribution of ordinal initiation date (top), total migration distance (middle), and number of days per stopover (bottom), by age and sex class, for GPS-marked American woodcock during fall migration. Day 300 = October 26th. A = Adult/After Hatch Year, I = Immature/Hatch Year. F = Female, M = Male. For total migration distance, we only used birds that completed a full fall migration (n=41).

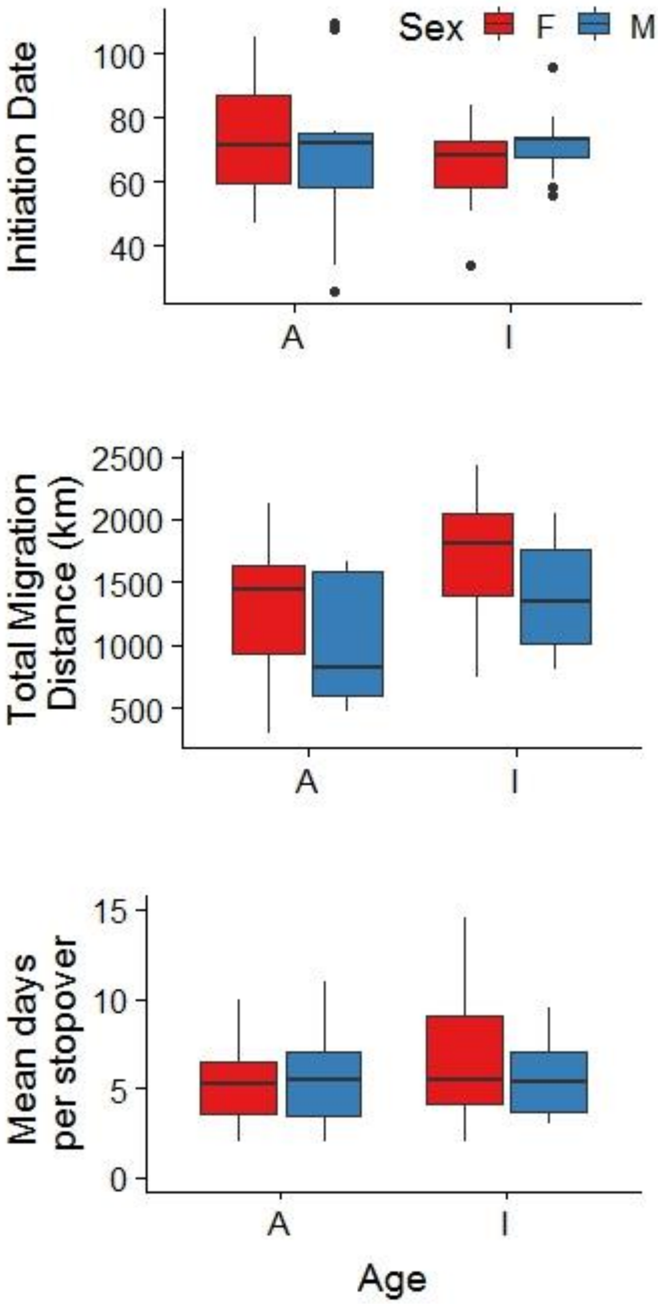

Figure 5. Distribution of ordinal initiation date (top), total migration distance (middle), and number of days per stopover (bottom), by age and sex class, for GPS-marked American woodcock during spring migration. Day 60 = March 1. A = Adult/After Hatch Year, I = Immature/Hatch Year. F = Female, M = Male. For total migration distance, we only used birds that completed a full spring migration (n=45).

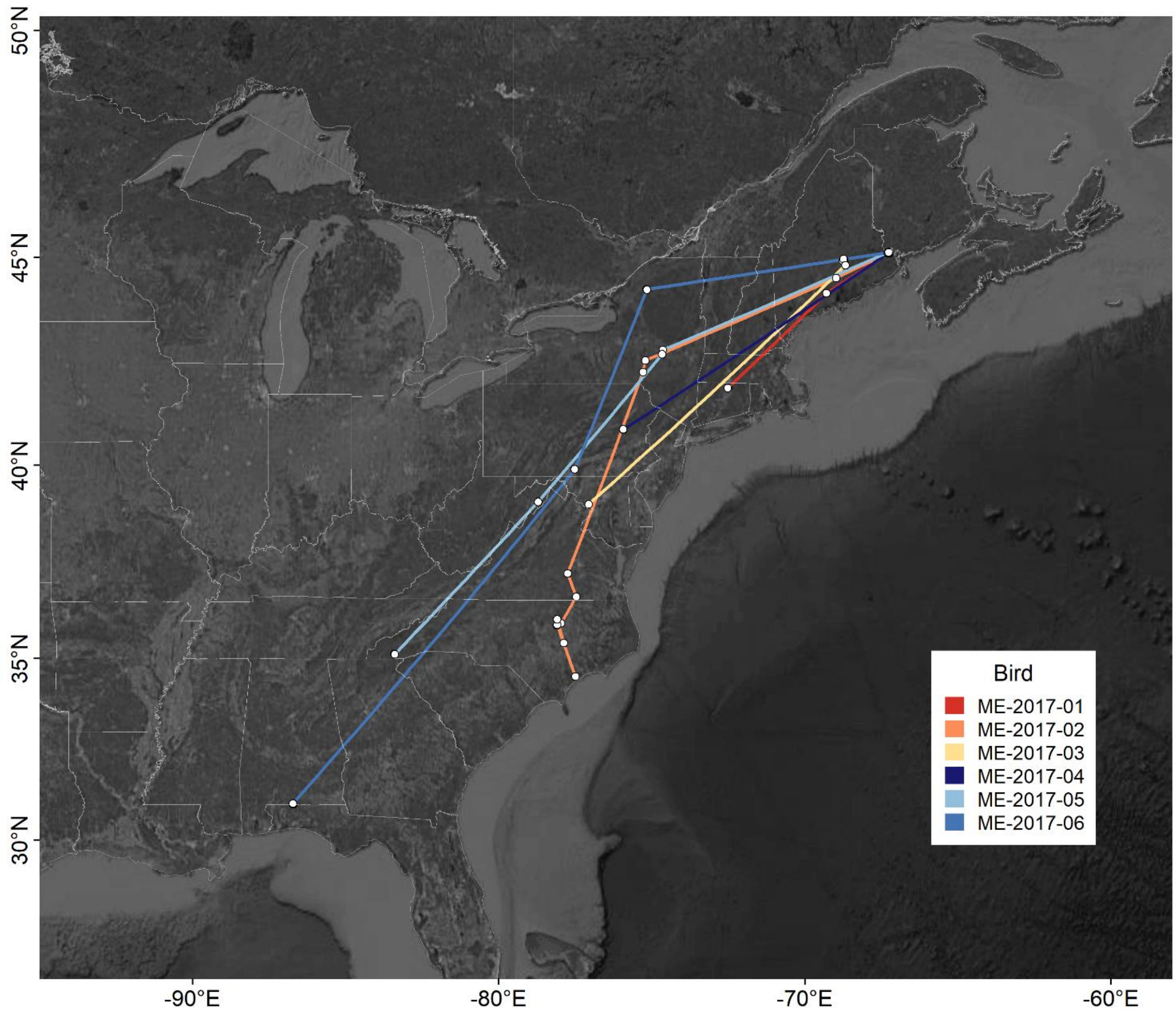

Figure 6. Fall migration routes for 6 American woodcock (*Scolopax minor*) marked with satellite transmitters in central and eastern Maine, October 2017-January 2018.

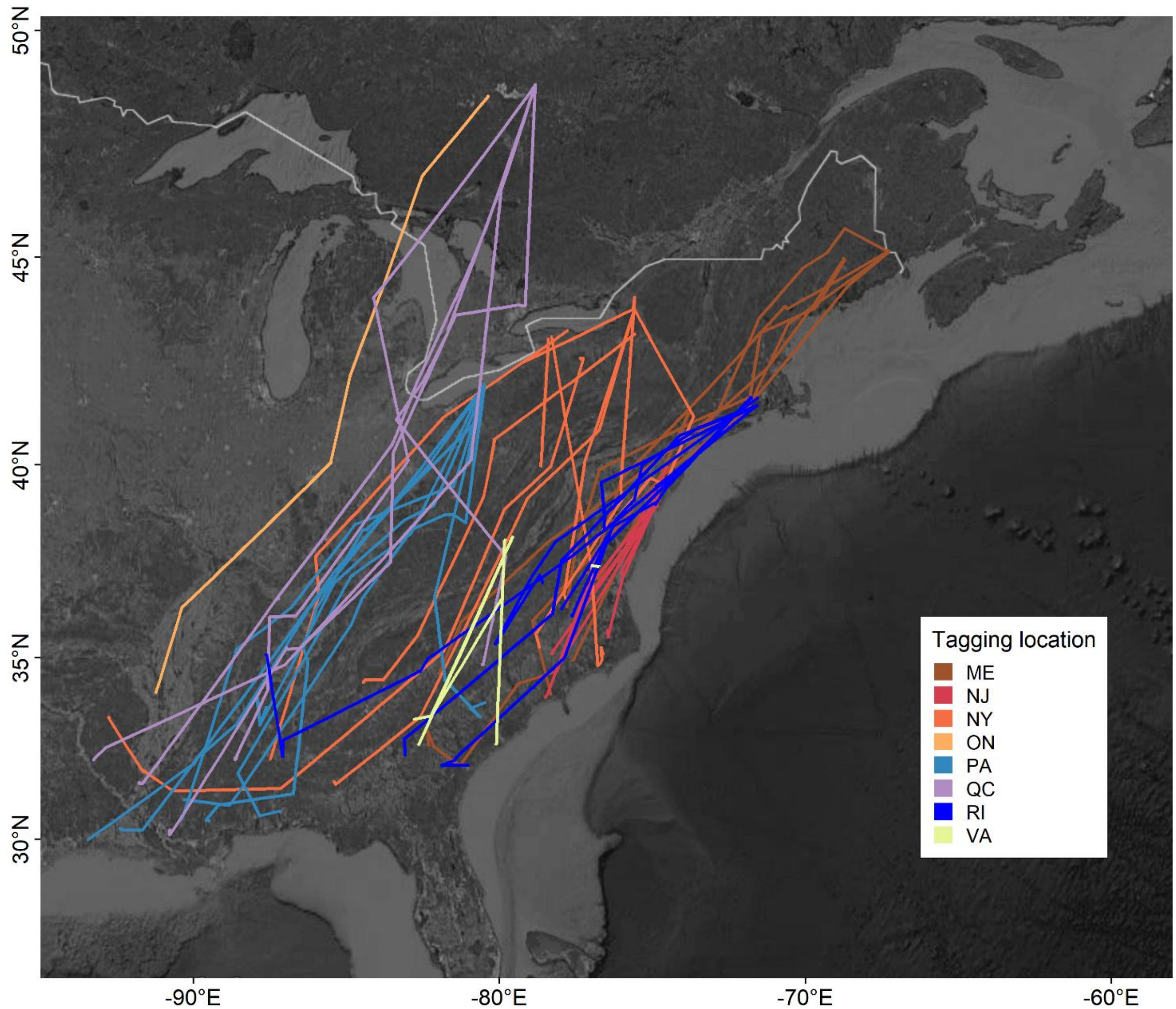

Figure 7. Fall migration routes for American woodcock (*Scolopax minor*) marked with satellite transmitters in Eastern North America, October 2018-December 2018. Generally, Woodcock marked further east were more likely to remain in the Eastern Management Region, and woodcock marked further west were more likely to migrate into the Central Management Region.

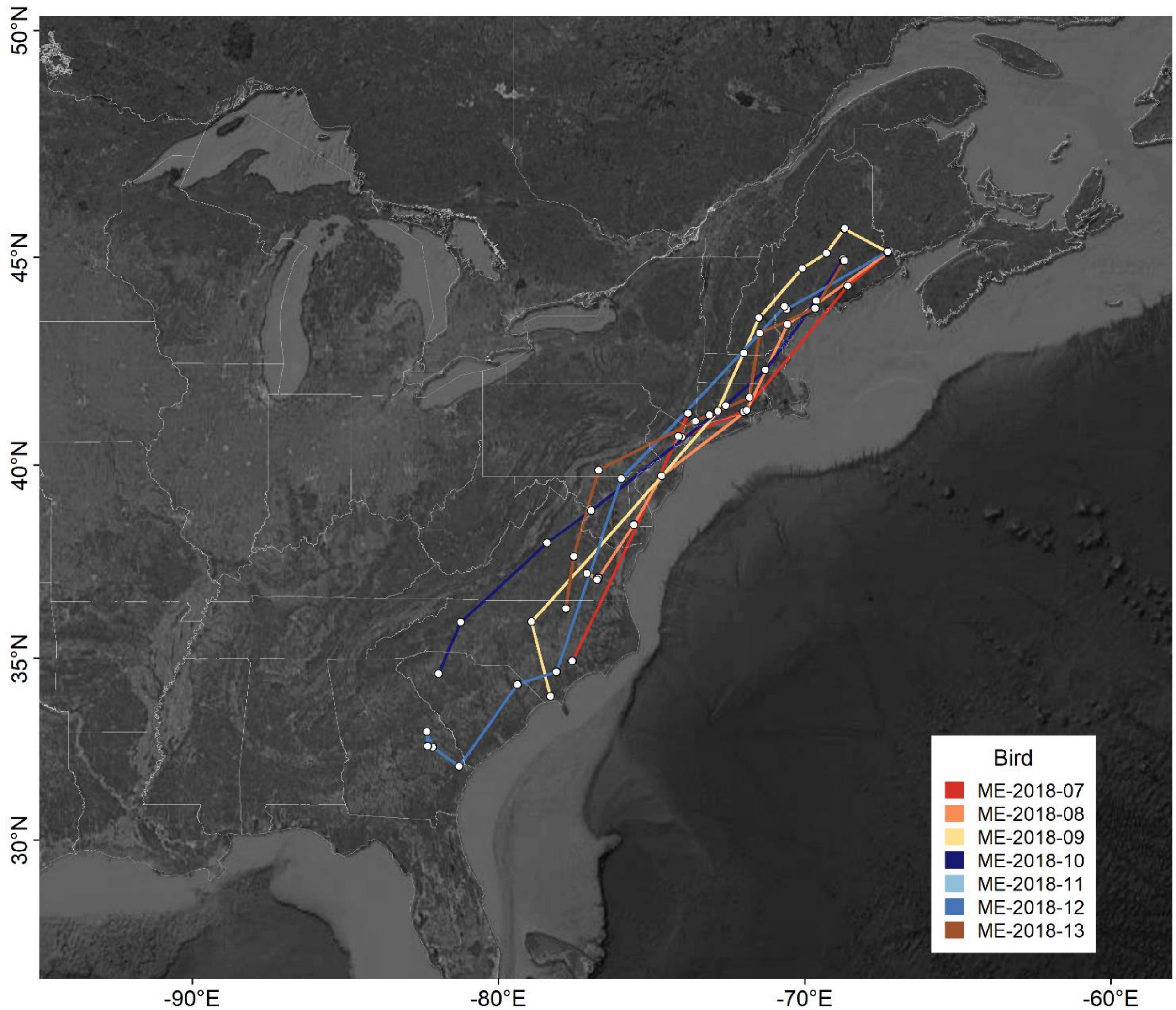

Figure 8. Fall migration routes of American Woodcock marked in Maine during October 2018.

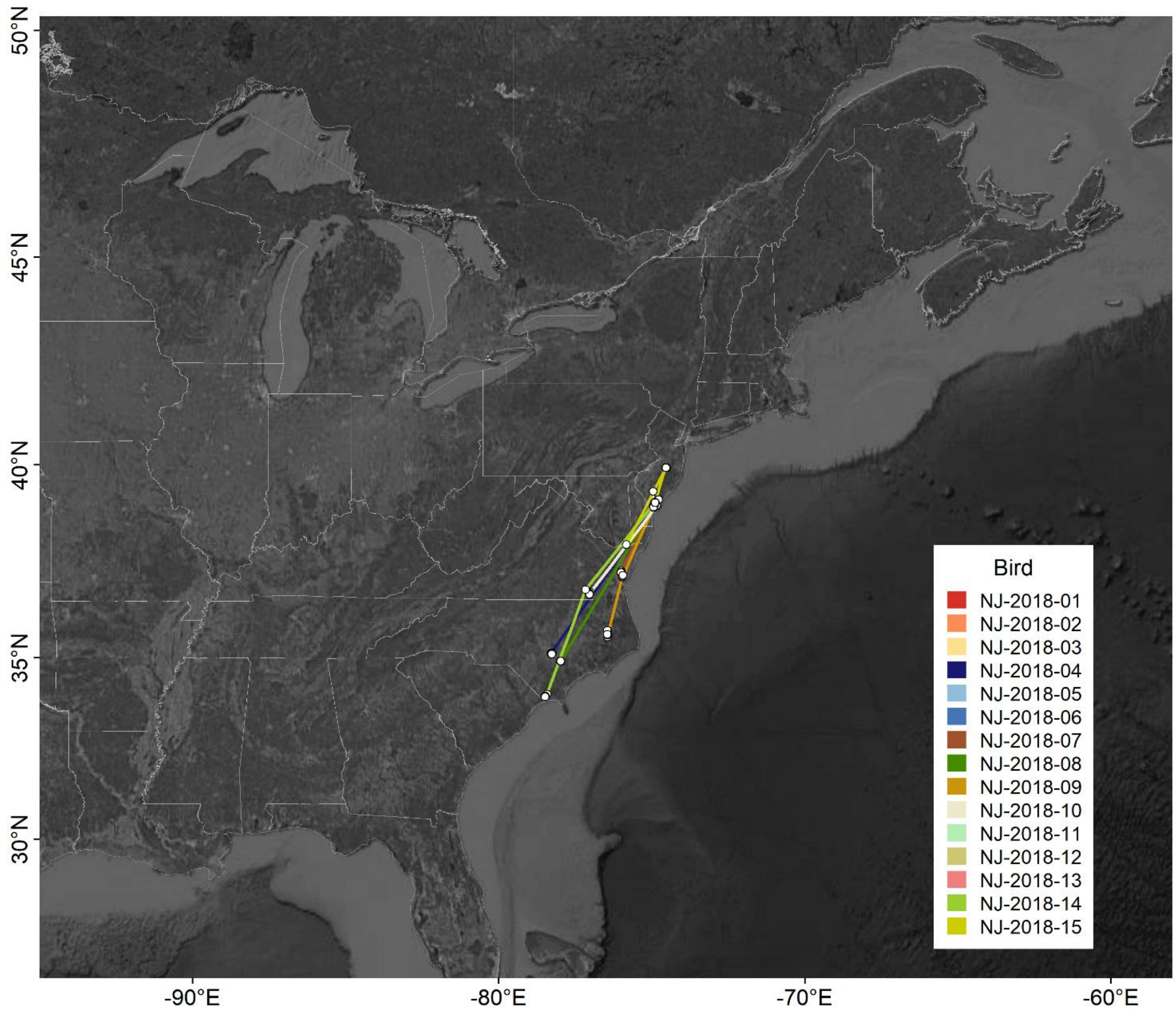

Figure 9. Fall migration routes of American Woodcock marked on Cape May in New Jersey during migration December 2018. A subset of the woodcock remained in New Jersey throughout the winter, but a second subset of woodcock continued migrating south before establishing winter residencies.

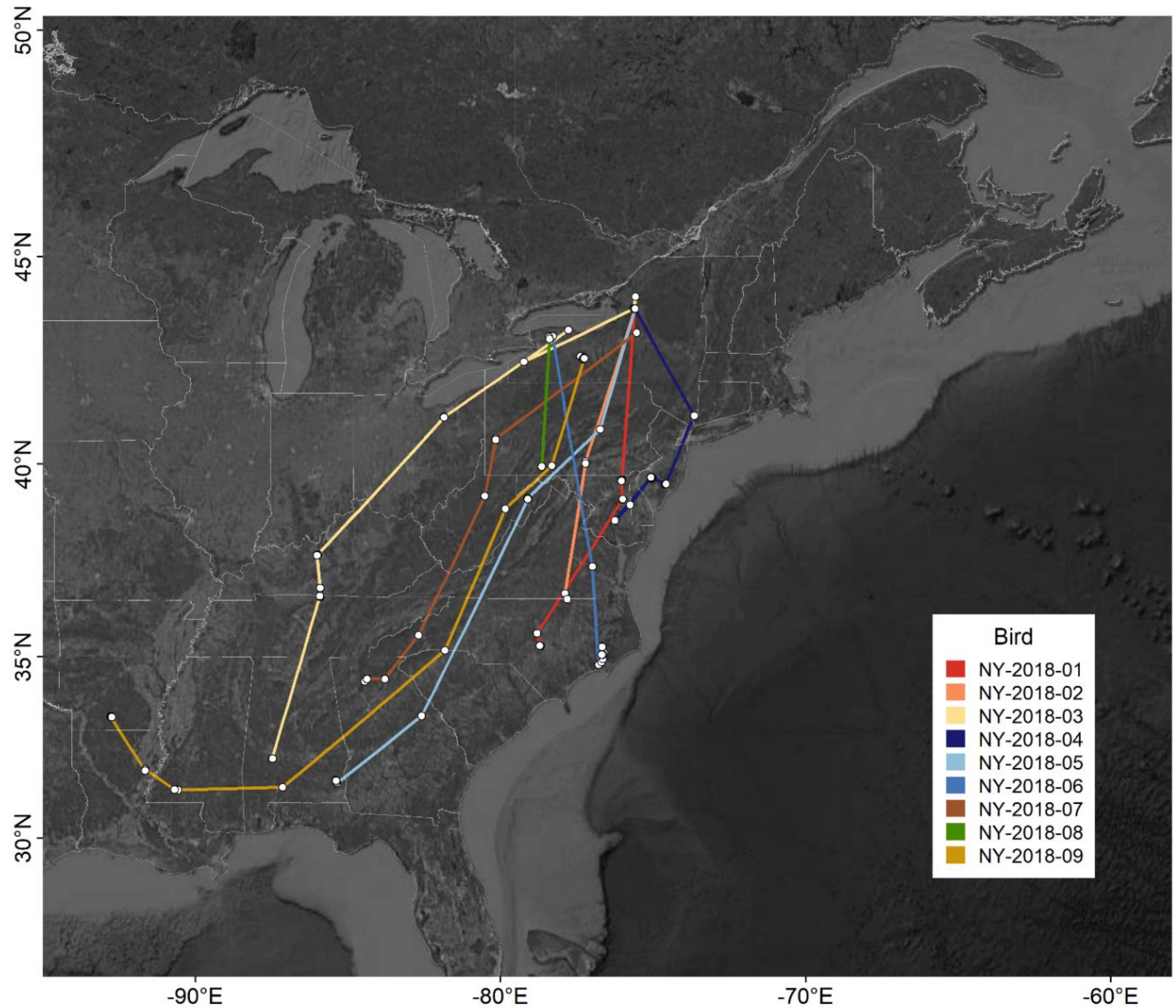

Figure 10. Fall migration routes of American Woodcock marked in New York during September - October 2018. New York likely represents a spatial partition in which woodcock can either migrate east or west of the Appalachian Mountains to the Atlantic Coast or to states boarding the Gulf of Mexico. However, there is high amount of variation, as noted by the highly variable migratory routes woodcock used.

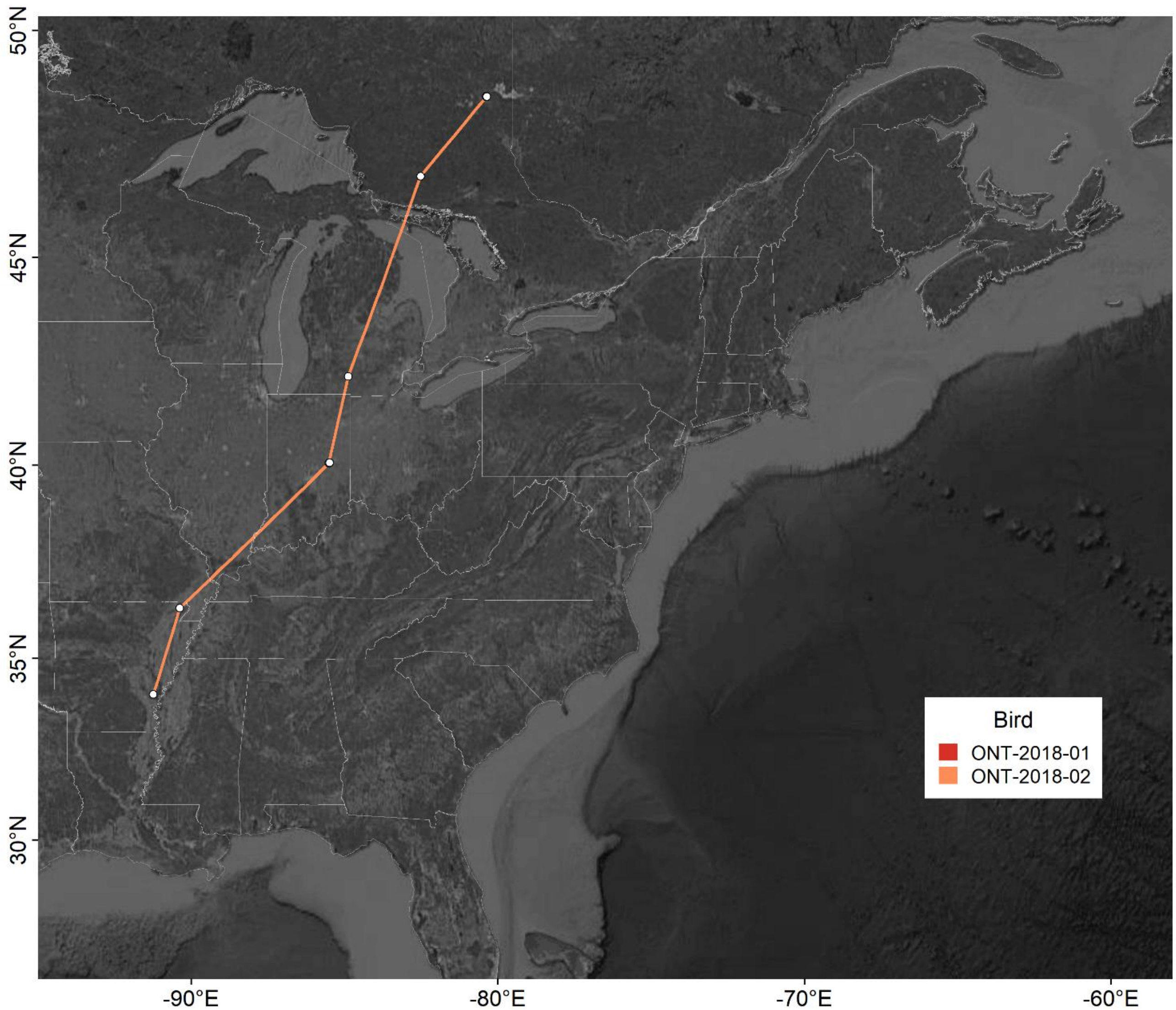

Figure 11. Fall migration route of American Woodcock marked in Ontario during September - October 2018. Only one of two woodcock marked in Ontario initiated migration and established a winter residency in southeastern Arkansas.

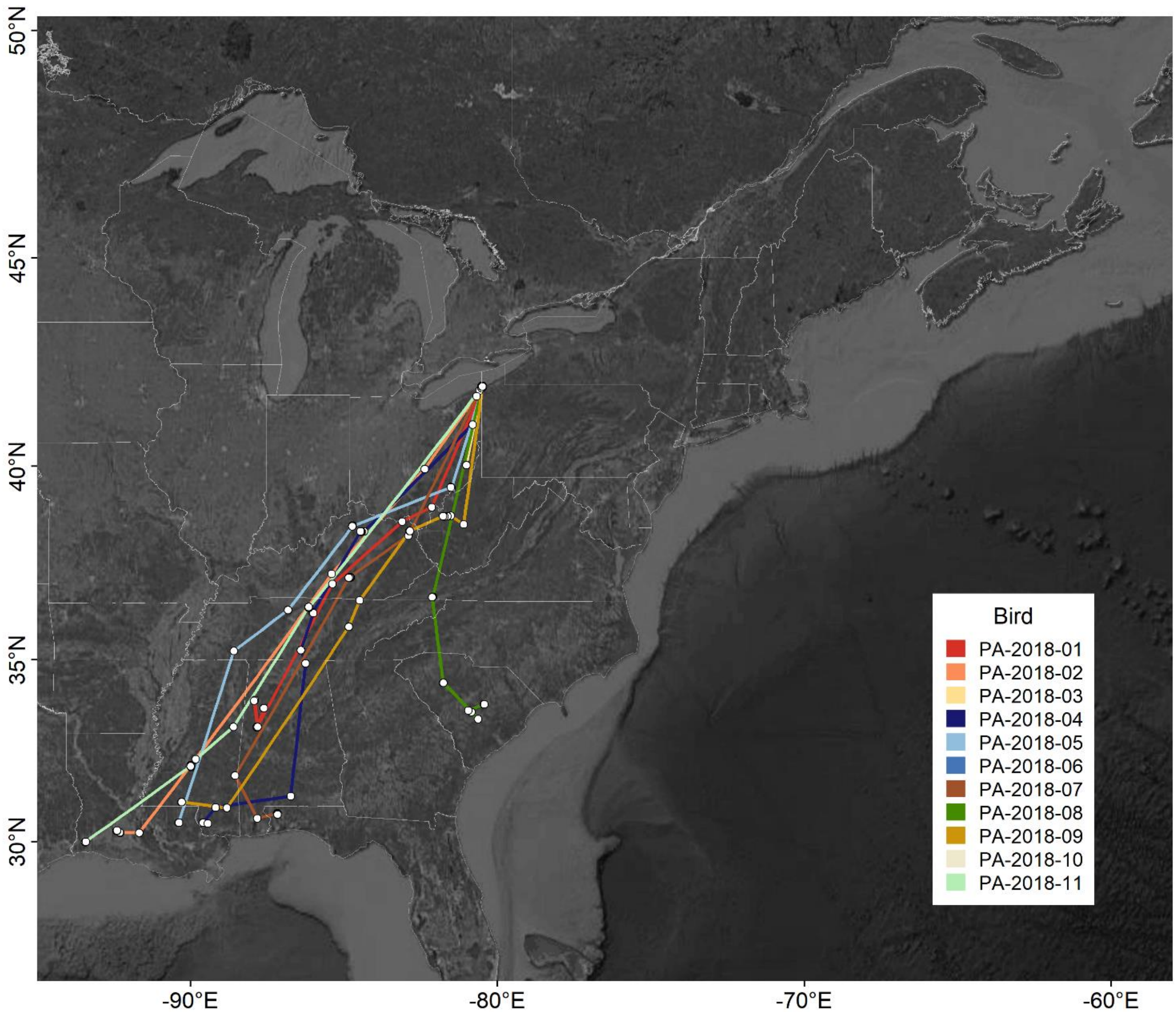

Figure 12. Fall migration routes of American Woodcock marked in Pennsylvania during September 2018. All but one woodcock migrated into the Central Management Region to establish winter residency, with the remaining bird migrating to South Carolina.

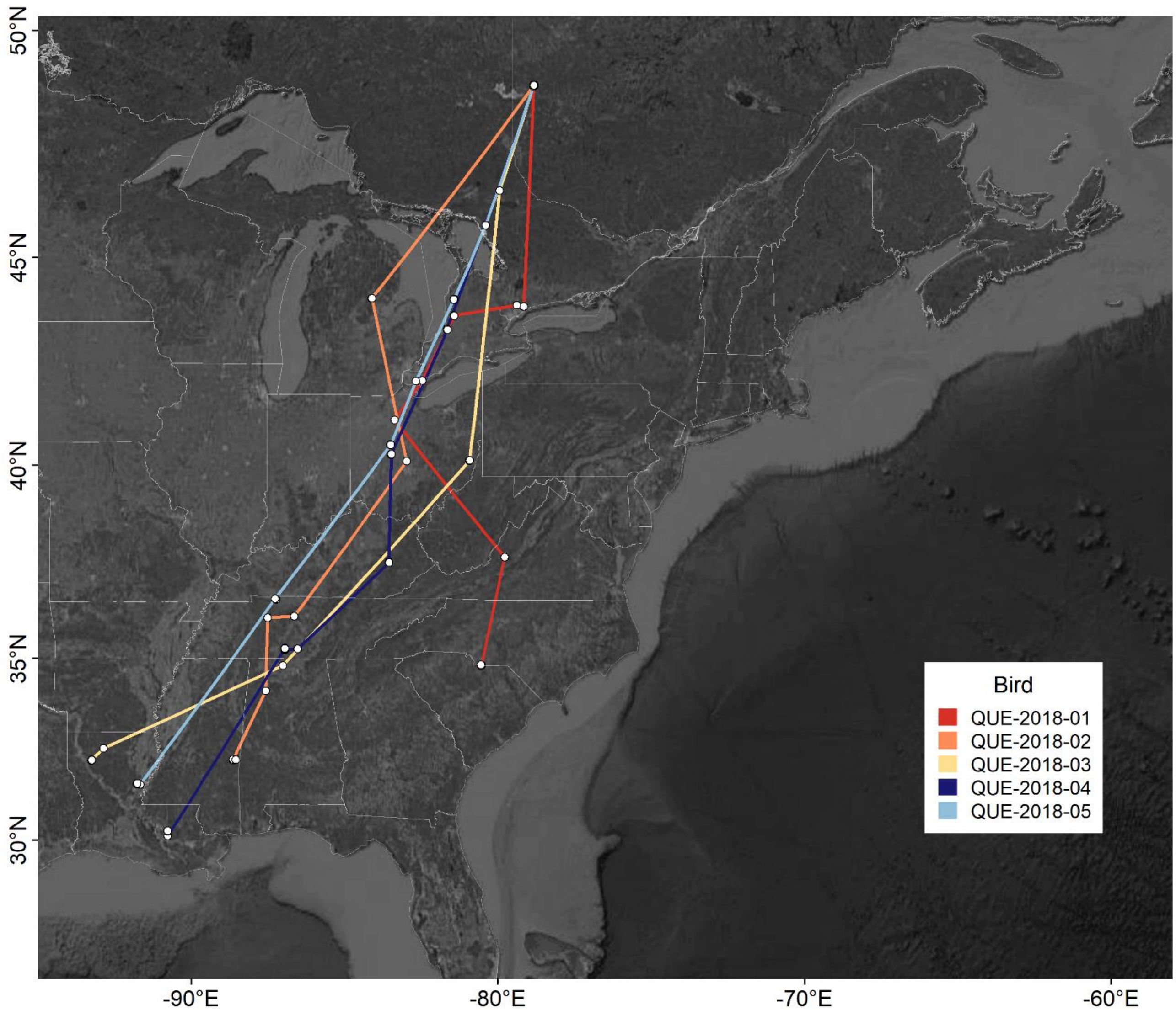

Figure 13. Fall migration routes of American Woodcock marked in Quebec during September 2018. Woodcock primarily funneled between the Great Lakes through Ontario, but one bird likely crossed Lake Michigan. All but one woodcock migrated into the Central Management Region to establish winter residency.

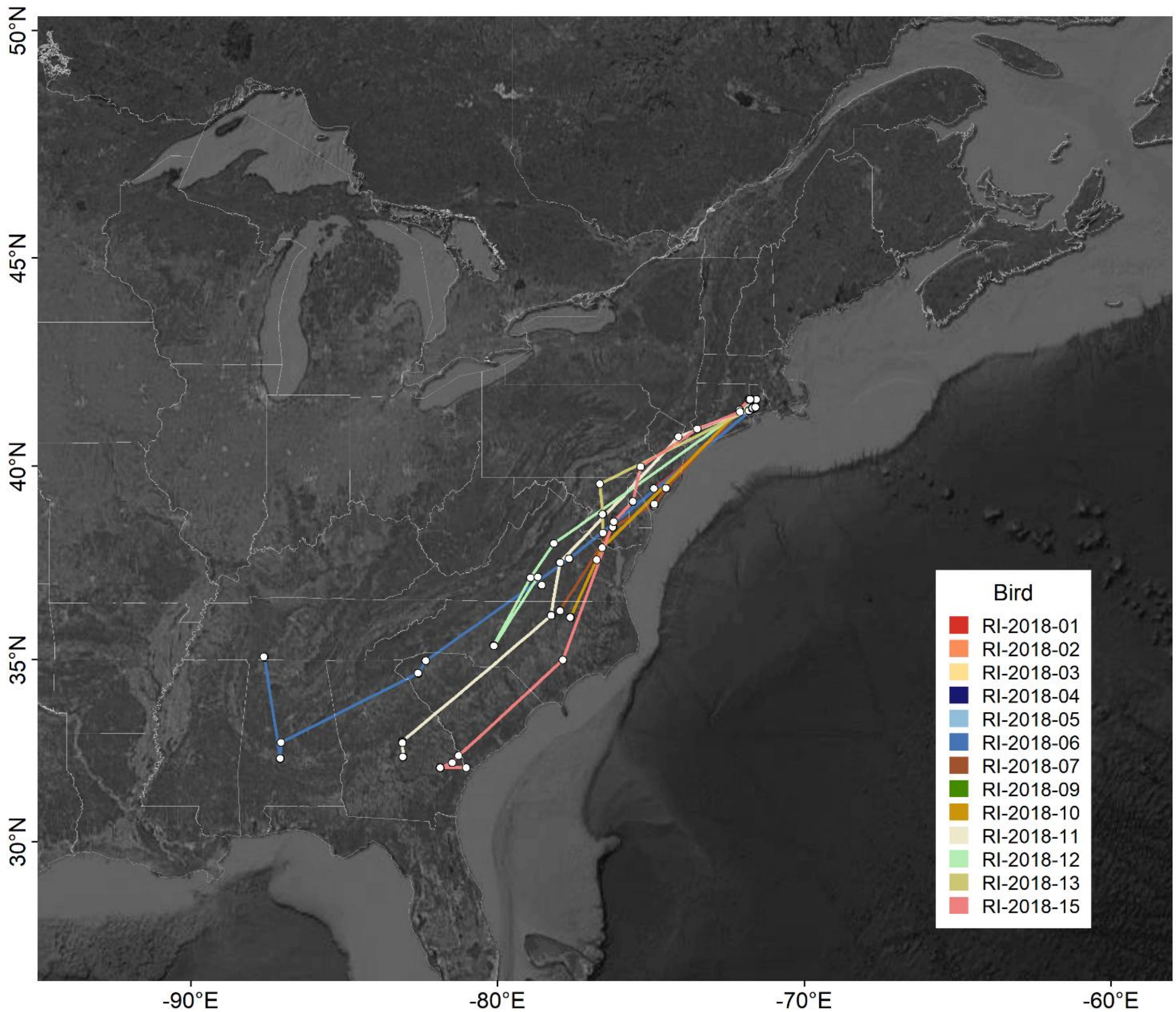

Figure 14. Fall migration routes of American Woodcock marked in Rhode Island during September to October 2018. The majority of woodcock remained in the Eastern Management Region, however one woodcock migrated into the Central Management Region.

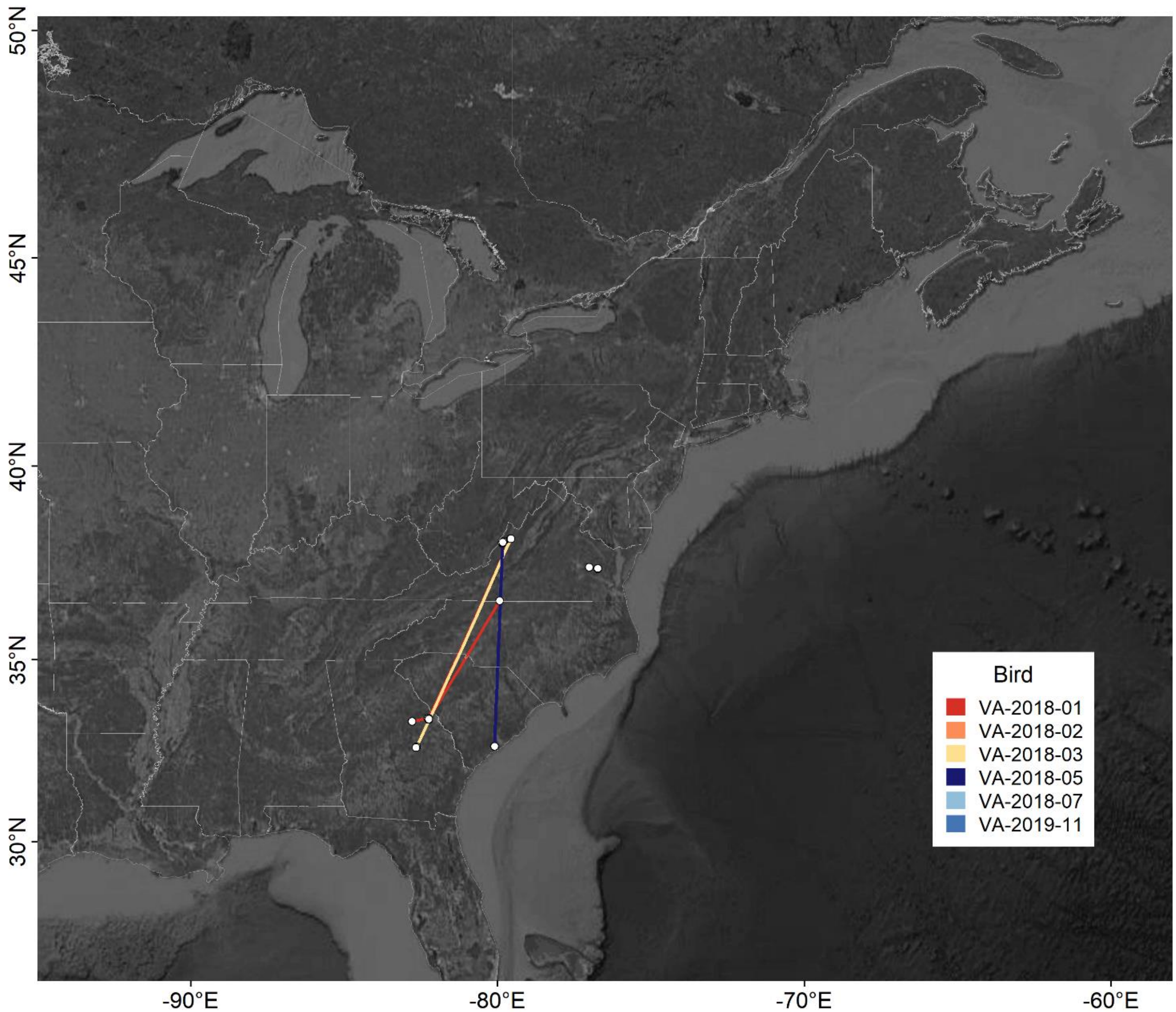

Figure 15. Fall migration routes of American Woodcock marked in Virginia during April - October 2018. Woodcock primarily completed migration in one long distance flight, then ranged around local area before settling into a winter residency.

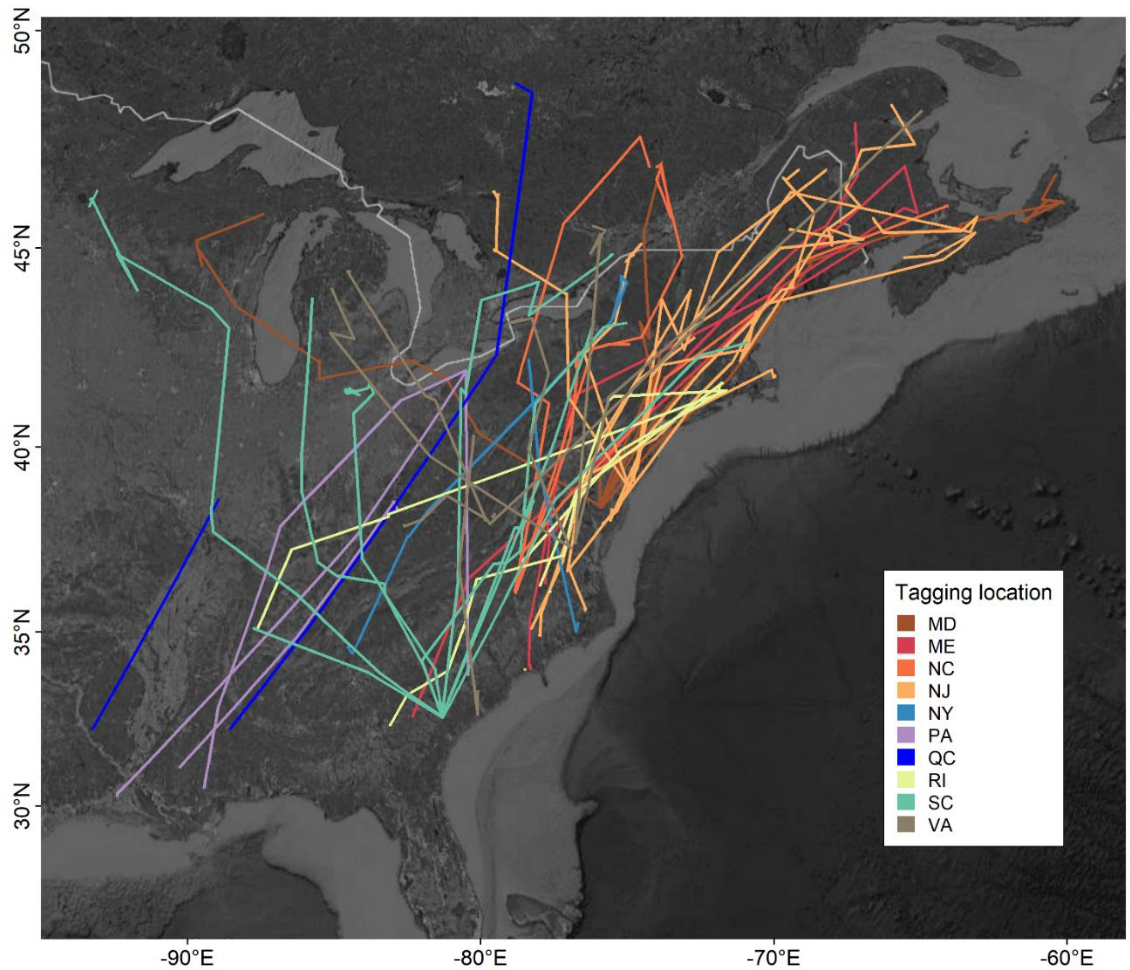

Figure 16. Spring migration routes for American woodcock marked with satellite transmitters in Eastern North America, October 2018-April 2019, and followed during spring migration. We observed 8 woodcock marked in the southeastern United States migrating northwest into the Central Management Region. A subset of woodcock marked fall 2018 continued to upload migratory locations for part of all of spring migration. Woodcock marked fall 2018 are identified by their initial capture location.

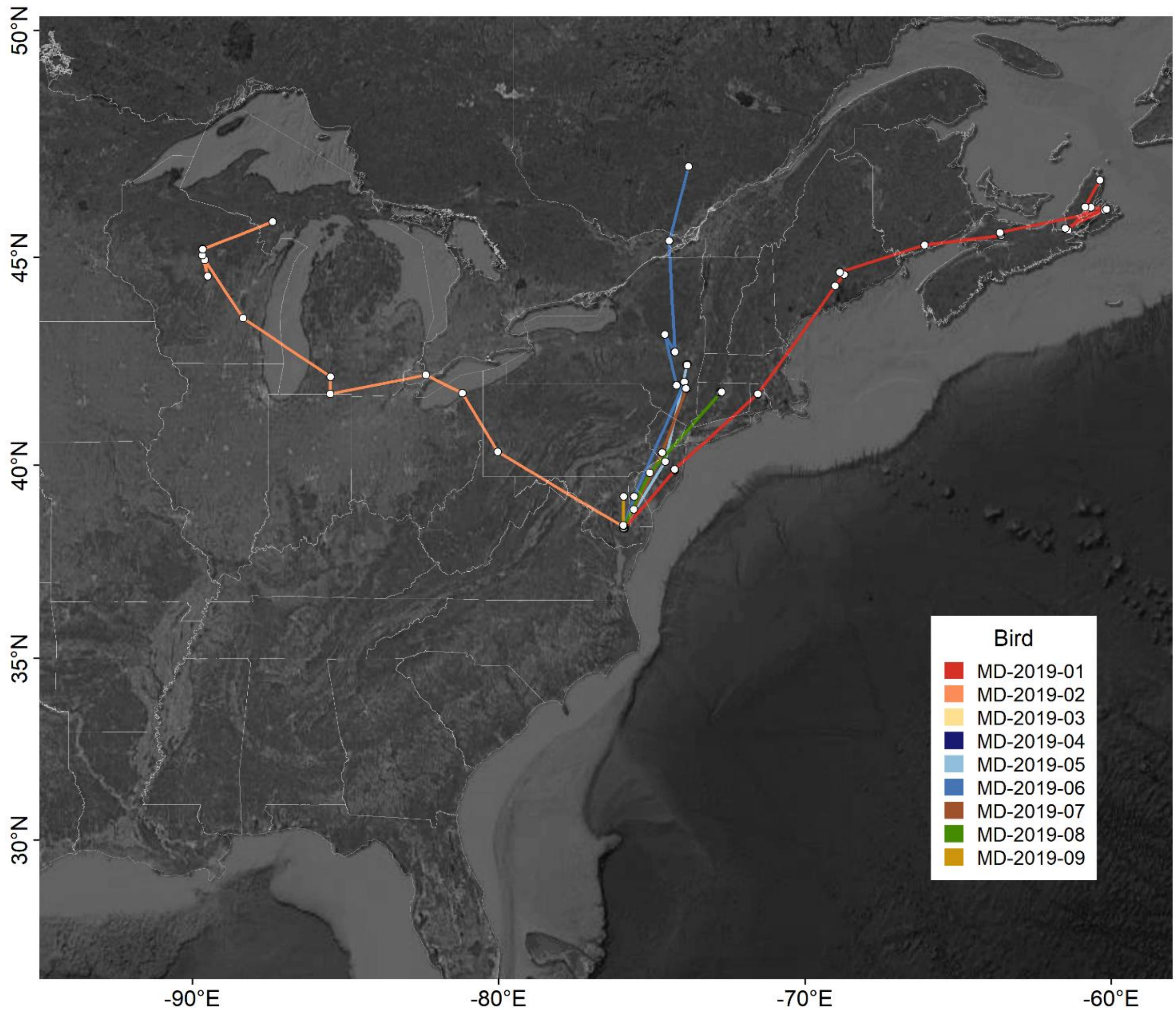

Figure 17. Spring migration routes of American Woodcock marked in Maryland during February 2019. The majority of woodcock remained in the Eastern management Region, however one woodcock migrated into the Upper Peninsula of Michigan.

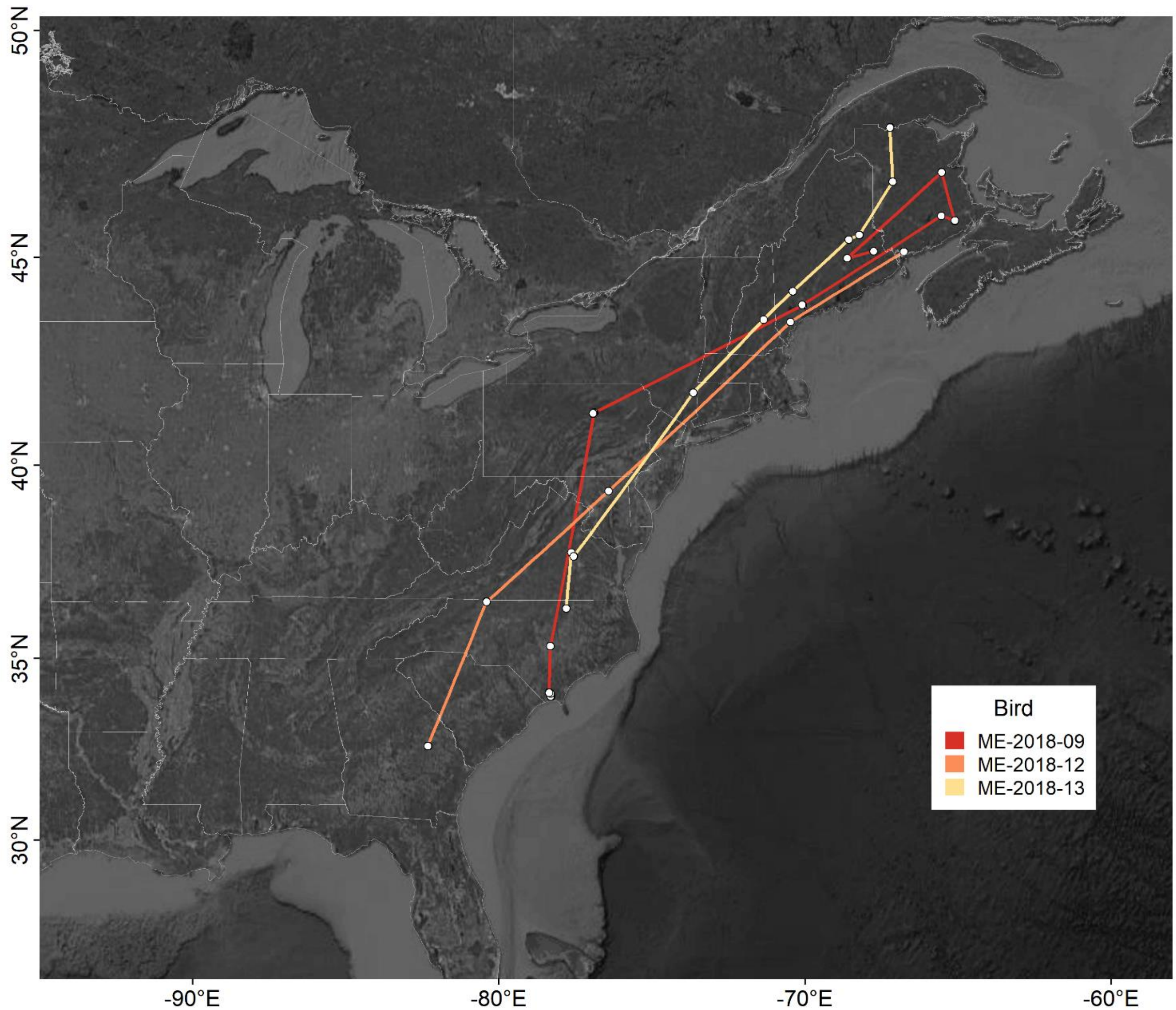

Figure 18. Spring migration routes of American Woodcock marked in Maine during October 2018. Three woodcock continued to transmit locations throughout spring migration and established breeding residency in northeastern New England and maritime Canada.

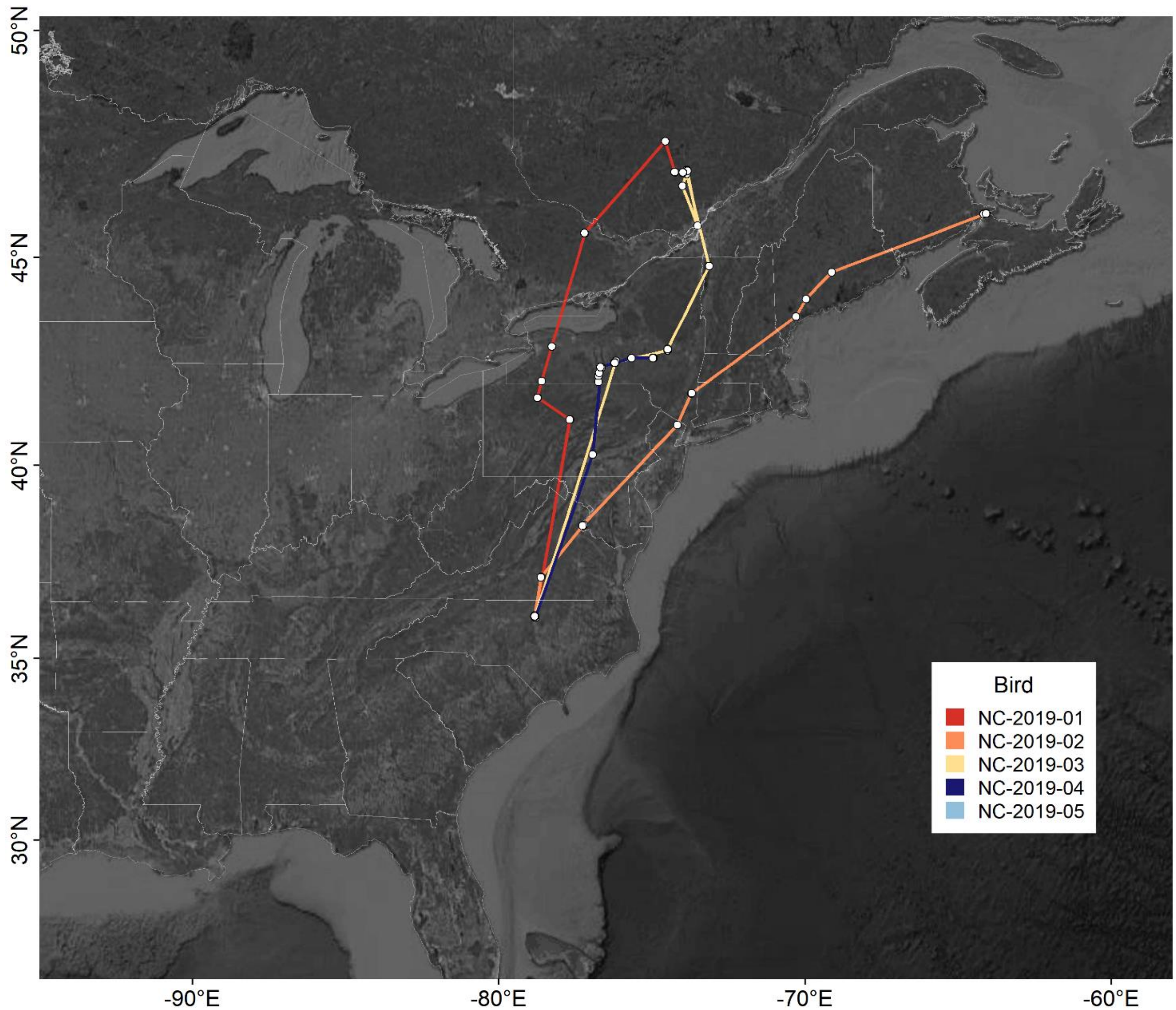

Figure 19. Spring migration routes of American Woodcock marked in North Carolina during February 2019. Four woodcock initiated migration and two of the woodcock established breeding residency 20 km apart in Quebec.

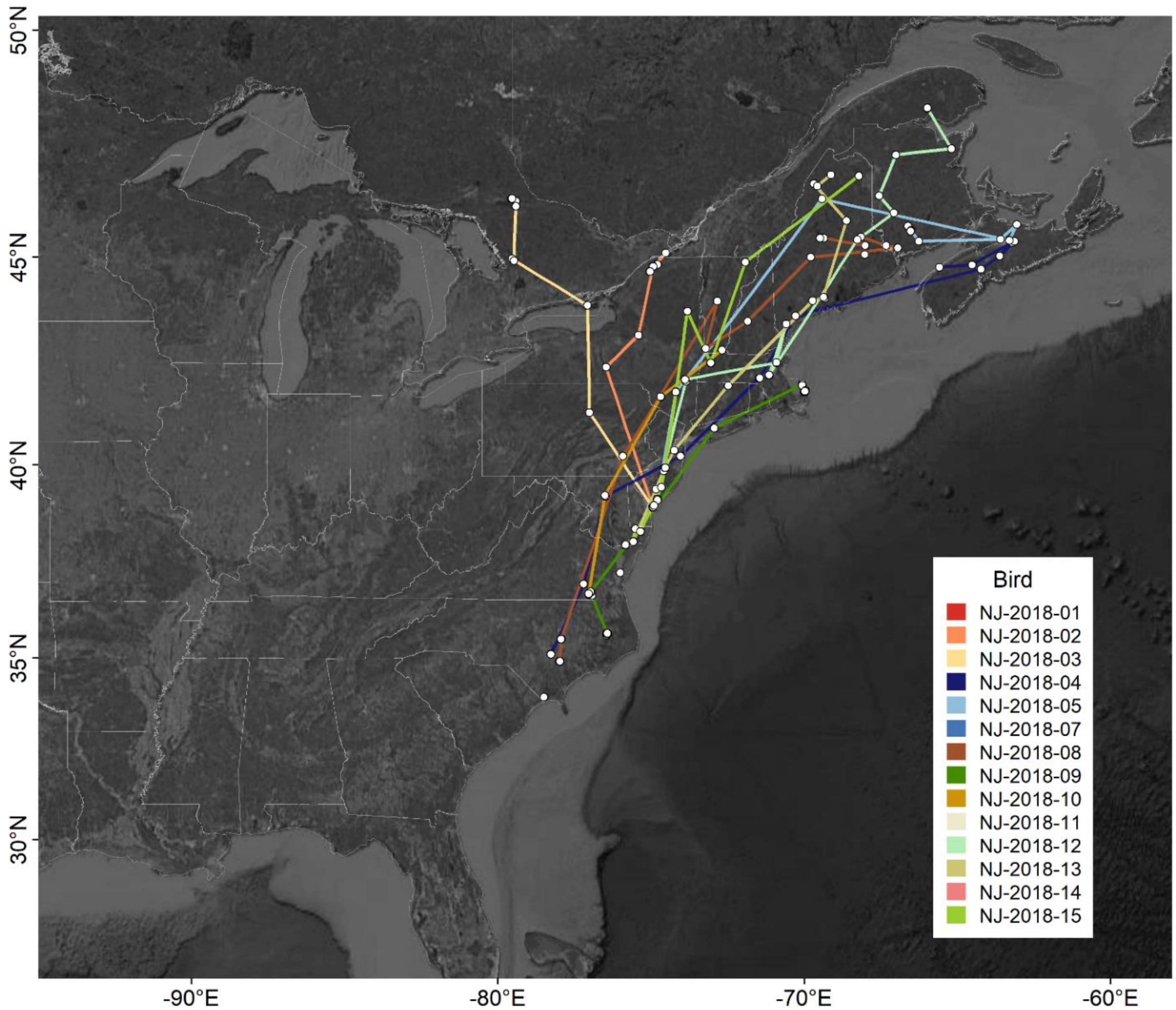

Figure 20. Spring migration routes of American Woodcock marked in New Jersey during December 2018. Woodcock marked in New Jersey primarily remained in the Eastern Management Region, but one woodcock migrated into the Central Management Region and established breeding residency in Ontario.

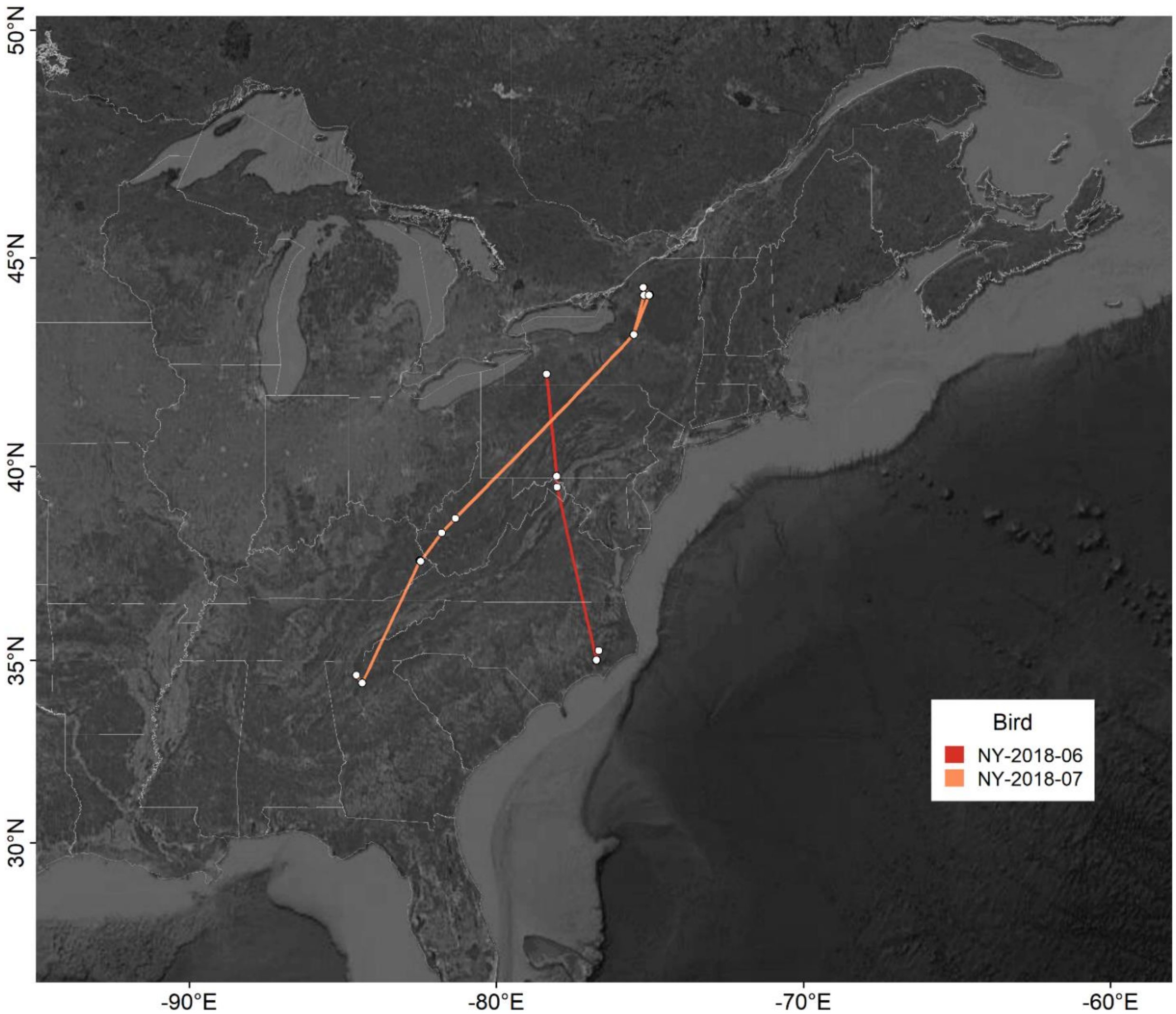

Figure 21. Spring migration routes of American Woodcock marked in New York during September - October 2018. Once woodcock completed migration and we stopped retrieving locations from the other woodcock prior to establishing a breeding territory. NY-2018-07 actually stopped-over on the exact same locations it was captured last fall, before migrating into the Adirondack Mountains in New York.

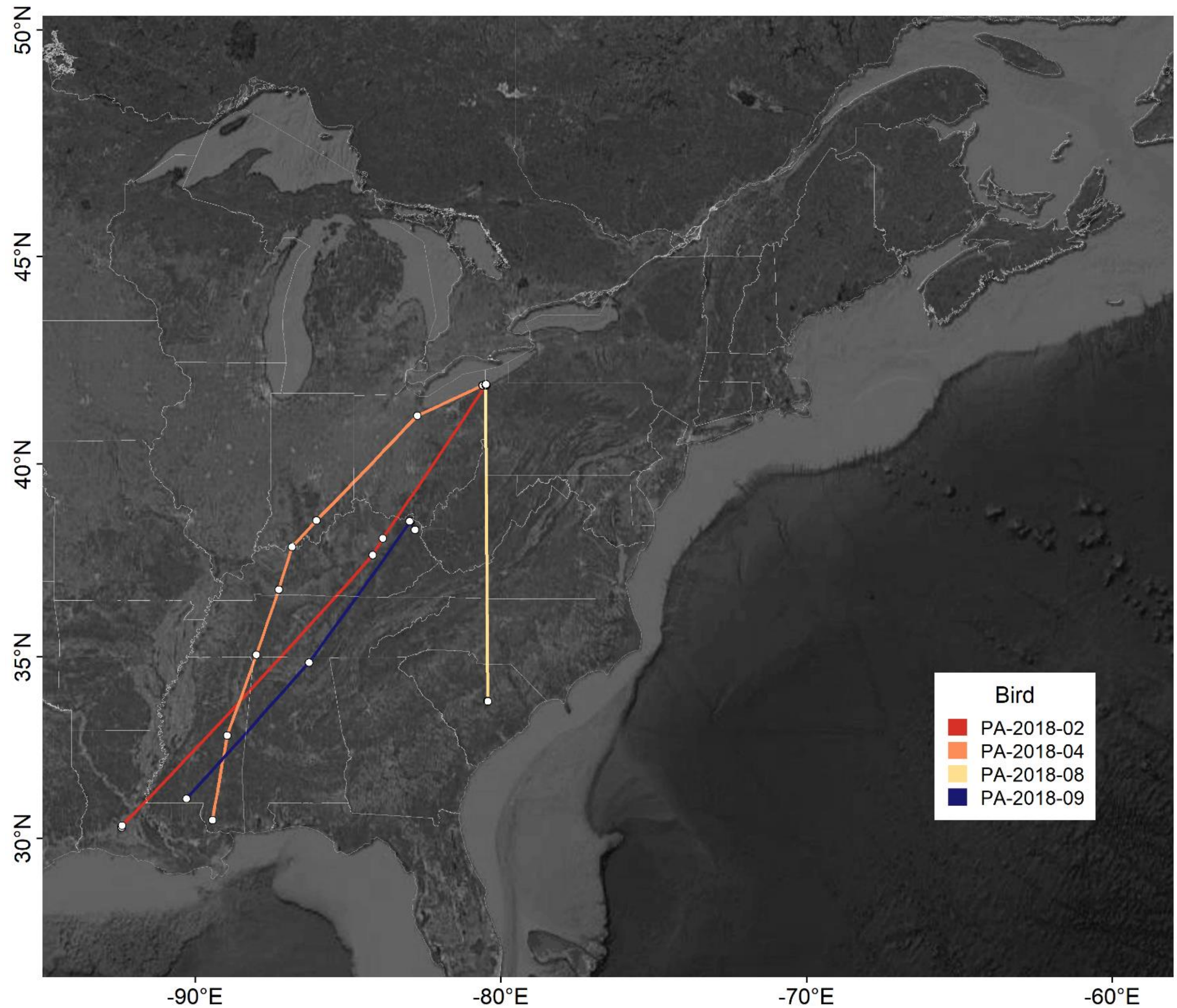

Figure 22. Spring migration routes of American Woodcock marked in Pennsylvania during September 2018. Three woodcock returned to the same capture location and the forth woodcock stopped transmitting data during spring migration.

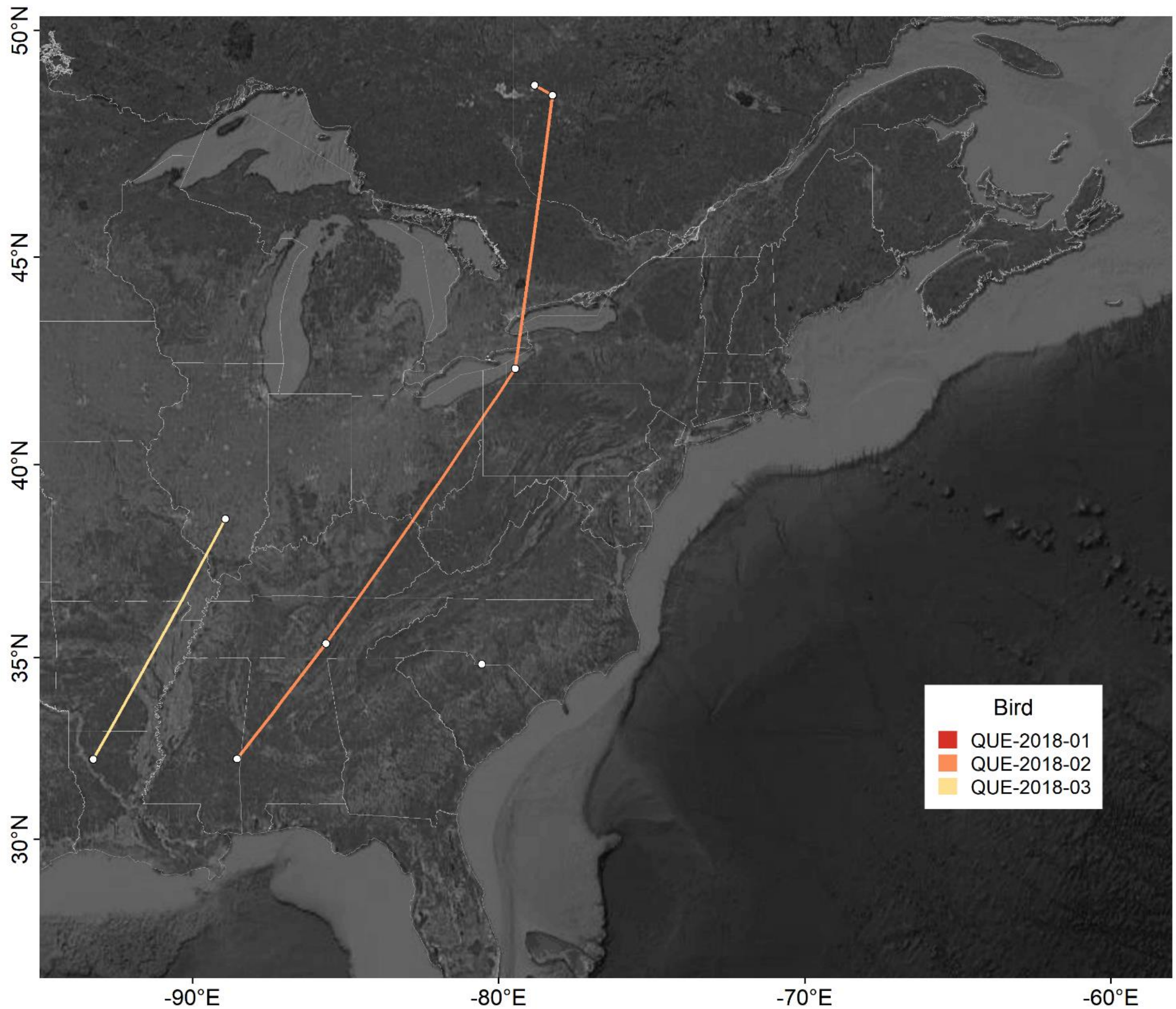

Figure 23. Spring migration routes of American Woodcock marked in Quebec during September 2018. We received one full migration, one partial migration, and one transmitter stopped transmitting data prior to migration. QUE-2018-02 set a project record for number of locations received from a single transmitter and returned to the same capture location from the previous fall.

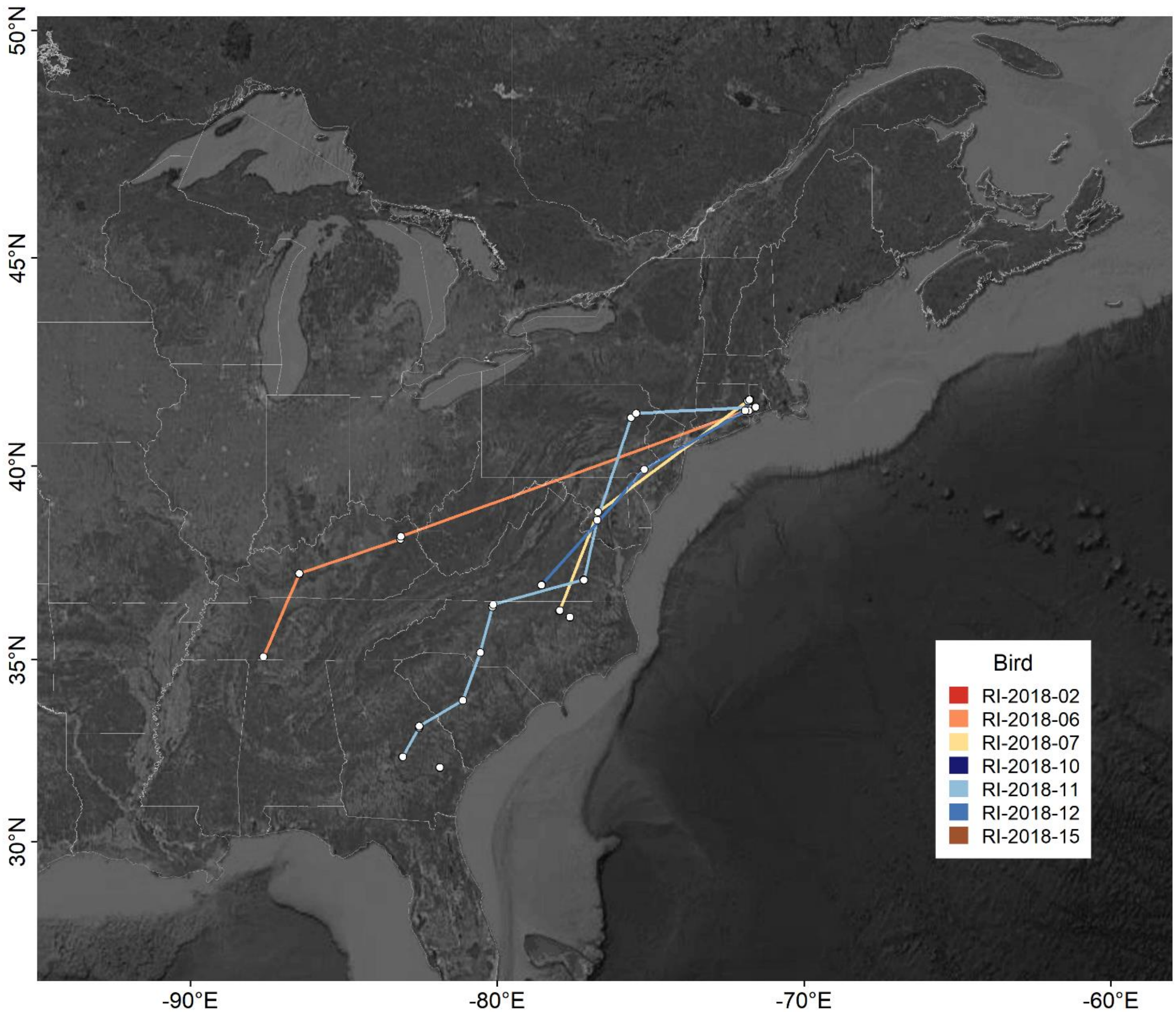

Figure 24. Spring migration routes of American Woodcock marked in Rhode Island during September - October 2018. All woodcock that completed migration returned to the same capture locations as the previous fall. One woodcock was recaptured during spring 2019 for a concurrent breeding season study.

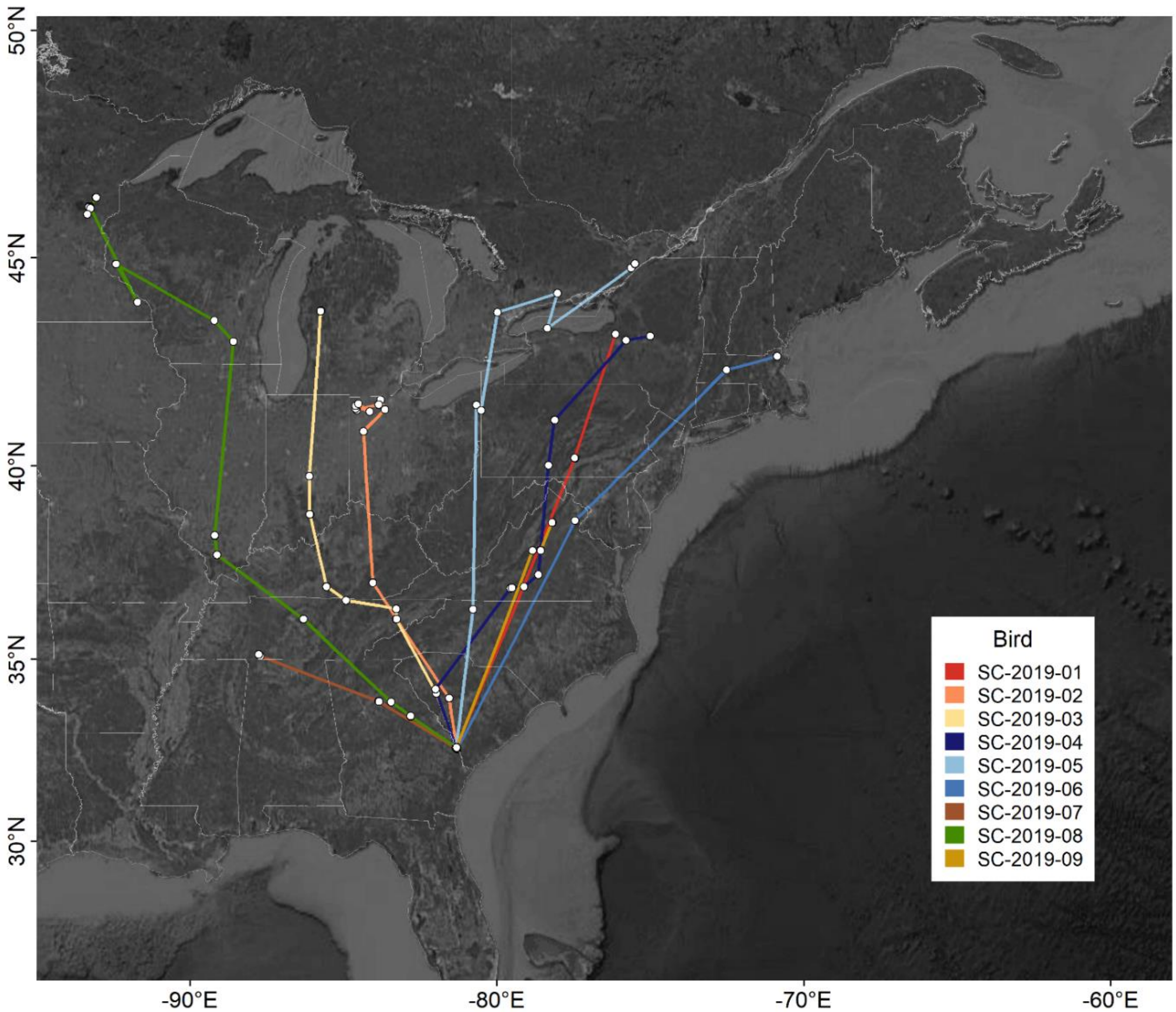

Figure 25. Spring migration routes of American Woodcock marked in South Carolina during February 2019. Approximately one-half of the woodcock marked in South Carolina migrated into the Central Management Region to breed. This northwestern migration has been infrequently documented and as the Easter Woodcock Migration Research Cooperative continues to mark bird in the southeastern United States, we hope to quantify the proportion of woodcock that exhibit this migration path.

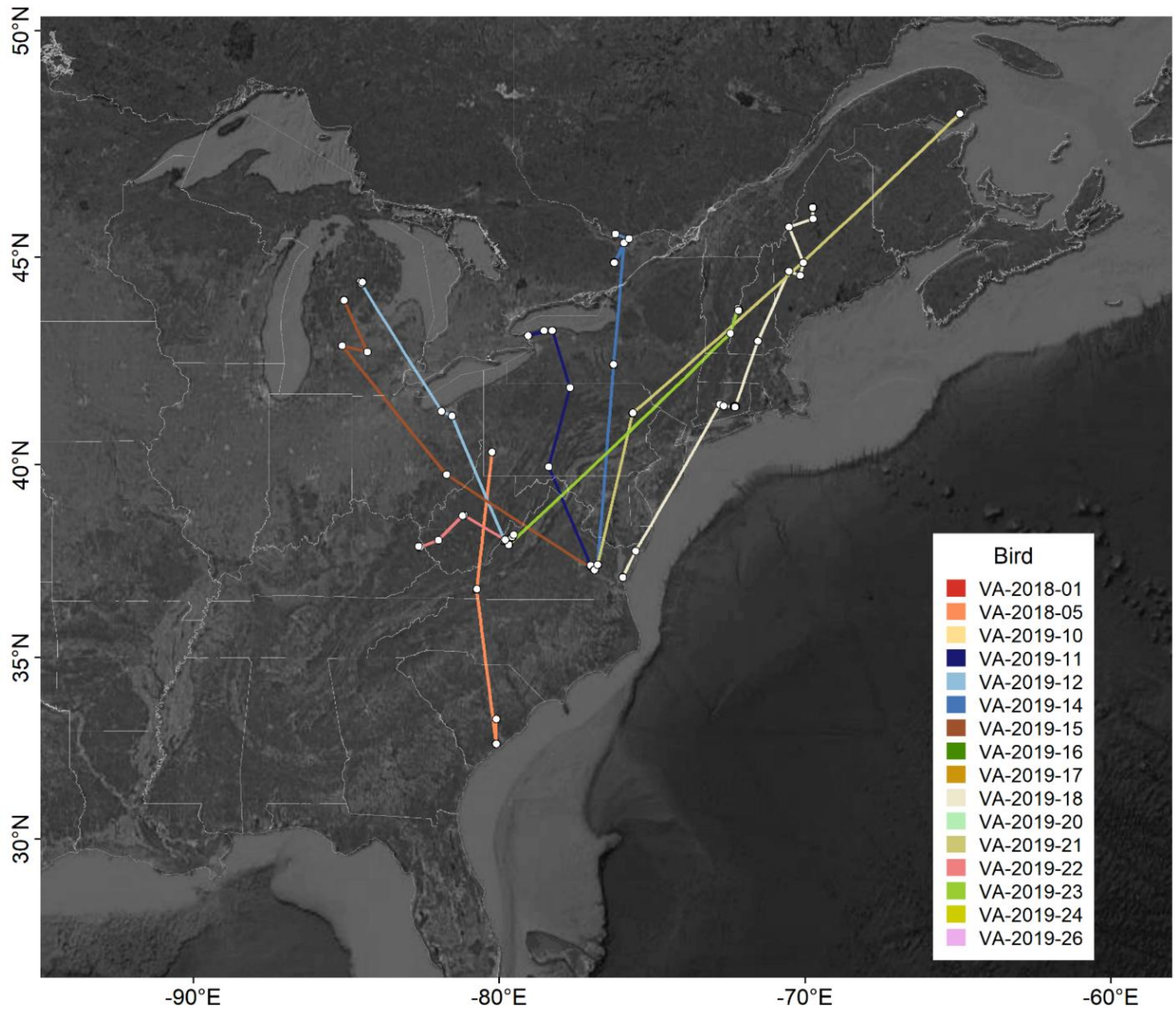

Figure 26. Migration routes of American Woodcock marked in Virginia during September 2018 – April 2019. Woodcock were captured on wintering areas in eastern Virginia and during spring migration in western Virginia. A small number of woodcock marked during fall migration 2018 continued to transmit locations for part of spring migration. Both wintering and woodcock migrating through Virginia migrated into the Central Management Region.

APPENDIX A. Summary of phenology and biological data collected from each woodcock marked with PinPoint GPS satellite-enabled transmitters between October 2017 and February 2019, as part of the Eastern Woodcock Migratory Research Cooperative woodcock migration study. Footnotes as follows: [a]male or female [b]adult or immature [c]number of GPS locations collected for each bird [d]earliest date migration was initiated [e]latest date that migration was completed [f]number of days between migration initiation and migration termination [g]number of stopover sites recorded during migration [h]average number of days spent at each stopover site [i]state or province of initial capture [j]state or province where either winter or breeding residency was established following migration [k]distance traveled in kilometers to last known location, for birds that established residency this reflects total migratory distance [l]data from 01 October 2017 to 31 January 2018 [m]date from 01 September 2019 to 31 January 2019 [n]data from 01 February 2019 to 31 May 2019.

Bird ID	Sex[a]	Age[b]	No. Loc.[c]	Initiation Date[d]	Termination Date[e]	Days Migr[f]	No. Stop[g]	Days Per Stop[h]	Site of Capture[i]	Site of Residency[j]	Distance Migrated[k]
Fall 2017[l]											
Maine											
ME-2017-01	M	I	39	11/27/2017	NA	3	2	1.5	ME	NA	553
ME-2017-02	F	A	93	11/04/2017	11/11/2017	6	5	1.2	ME	NC	1829
ME-2017-03	F	A	14	11/04/2017	11/09/2017	5	1	5	ME	MD	965
ME-2017-04	M	I	15	11/24/2017	NA	1	1	NA	ME	NA	846
ME-2017-05	M	I	27	11/05/2017	NA	7	3	3.5	ME	NA	1780
ME-2017-06	M	I	19	11/09/2017	12/09/2019	30	2	15	ME	AL	2446
Fall 2018[m]											
Maine											
ME-2018-07	M	I	88	11/09/2018	12/11/2018	32	4	8	ME	NC	1601
ME-2018-08	M	A	101	11/12/2018	11/27/2018	44	4	3.75	ME	VA	1290
ME-2018-09	F	I	73	11/10/2018	12/12/2018	32	7	4.6	ME	NC	1747
ME-2018-10	F	A	58	10/24/2018	12/10/2018	47	6	7.8	ME	SC	1636
ME-2018-11	F	I	12	NA	NA	NA	NA	NA	ME	NA	NA
ME-2018-12	F	I	70	11/05/2018	11/24/2018	19	7	2.7	ME	GA	2151
ME-2018-13	F	A	72	11/15/2018	11/28/2018	13	6	2.2	ME	VA	1347
New Jersey											
NJ-2018-01	M	I	22	NA	NA	NA	NA	NA	NJ	NJ	NA
NJ-2018-02	M	I	22	NA	NA	NA	NA	NA	NJ	NJ	NA
NJ-2018-03	M	I	23	01/17/2019	01/23/2019	6	1	6	NJ	NJ	87
NJ-2018-04	M	I	25	12/09/2018	12/09/2018	NA	NA	NA	NJ	NC	518
NJ-2018-05	M	I	22	12/07/2018	12/07/2018	NA	NA	NA	NJ	NJ	22
NJ-2018-06	M	I	16	NA	NA	NA	NA	NA	NJ	NJ	NA
NJ-2018-07	M	I	19	12/23/2018	12/23/2018	NA	NA	NA	NJ	VA	206

Bird ID	Sex[a]	Age[b]	No. Loc.[c]	Initiation Date[d]	Termination Date[e]	Days Migr[f]	No. Stop[g]	Days Per Stop[h]	Site of Capture[i]	Site of Residency[j]	Distance Migrated[k]
New Jersey											
NJ-2018-08	F	I	30	01/12/2019	01/12/2019	NA	NA	NA	NJ	NC	522
NJ-2018-09	F	I	26	12/25/2018	01/08/2019	15	2	7.5	NJ	NC	423
NJ-2018-10	F	I	28	01/02/2019	01/02/2019	NA	NA	NA	NJ	VA	313
NJ-2018-11	F	I	9	NA	NA	NA	NA	NA	NJ	NA	NA
NJ-2018-12	F	I	28	NA	NA	NA	NA	NA	NJ	NJ	NA
NJ-2018-13	F	I	28	02/02/2019	02/03/2019	1	1	1	NJ	MD	115
NJ-2018-14	F	I	26	12/19/2018	12/23/2018	4	1	4	NJ	NC	650
NJ-2018-15	F	I	22	12/21/2018	01/14/2019	24	1	24	NJ	MD	348
New York											
NY-2018-01	F	I	93	11/11/2018	11/22/2018	11	3	3.7	NY	NC	1016
NY-2018-02	F	A	24	10/31/2018	11/22/2018	22	2	11	NY	NC	825
NY-2018-03	M	I	45	10/12/2018	12/23/2018	72	8	9	NY	AL	2100
NY-2018-04	M	I	78	10/30/2018	11/24/2018	25	5	5	NY	NJ	897
NY-2018-05	M	I	68	11/04/2018	11/12/2018	8	3	2.7	NY	AL	1655
NY-2018-06	F	A	70	10/24/2018	10/28/2018	4	2	2	NY	NC	1059
NY-2018-07	F	A	71	11/15/2018	11/21/2018	6	4	1.5	NY	GA	1302
NY-2018-08	M	I	18	10/30/2018	NA	1	1	NA	NY	NA	348
NY-2018-09	M	A	80	11/14/2018	11/29/2018	15	6	2.5	NY	MS	2210
Ontario											
ONT-2018-01	M	A	3	NA	NA	NA	NA	NA	ONT	NA	NA
ONT-2018-02	F	A	24	10/27/2018	11/10/2018	14	4	3.5	ONT	AR	1908
Pennsylvania											
PA-2018-01	M	I	78	11/14/2018	11/21/2018	7	3	2.3	PA	AL	1417
PA-2018-02	F	A	76	11/12/2018	11/28/2018	16	3	5.3	PA	LA	1702
PA-2018-03	F	A	22	11/14/2018	NA	2	1	2	PA	NA	221
PA-2018-04	F	I	67	11/03/2018	11/27/2018	24	7	3.4	PA	MS	1660
PA-2018-05	M	A	60	10/28/2018	12/19/2018	52	4	13	PA	LA	1641
PA-2018-06	F	A	10	NA	NA	NA	NA	NA	PA	NA	NA
PA-2018-07	M	A	90	10/21/2018	11/25/2018	35	5	7	PA	FL	1561
PA-2018-08	M	A	37	10/25/2018	11/28/2018	34	5	6.8	PA	SC	1100

Bird ID	Sex[a]	Age[b]	No. Loc.[c]	Initiation Date[d]	Termination Date[e]	Days Migr[f]	No. Stop[g]	Days Per Stop[h]	Site of Capture[i]	Site of Residency[j]	Distance Migrated[k]
Pennsylvania											
PA-2018-09	F	A	62	10/21/2018	11/22/2018	32	6	5.3	PA	MS	1660
PA-2018-10	F	I	16	NA	NA	NA	NA	NA	PA	NA	NA
PA-2018-11	M	A	54	10/24/2018	11/08/2018	15	3	5	PA	MS	1791
Quebec											
QUE-2018-01	F	I	107	10/18/2018	11/09/2018	22	6	3.7	QC	NC	1877
QUE-2018-02	F	A	41	10/25/2018	11/28/2018	34	5	6.8	QC	MS	2192
QUE-2018-03	M	I	45	10/17/2018	11/14/2018	28	4	7	QC	LA	2431
QUE-2018-04	F	I	67	10/18/2018	11/25/2018	34	5	6.8	QC	LA	2408
QUE-2018-05	M	I	92	10/19/2018	12/05/2018	47	5	9.4	QC	LA	2230
Rhode Island											
RI-2018-01	M	A	30	11/09/2018	11/09/2018	NA	NA	NA	RI	NJ	360
RI-2018-02	F	A	41	11/23/2018	NA	NA	1	NA	RI	NA	20
RI-2018-03	M	A	3	NA	NA	NA	NA	NA	RI	NA	NA
RI-2018-04	M	A	5	NA	NA	NA	NA	NA	RI	NA	NA
RI-2018-05	M	A	5	NA	NA	NA	NA	NA	RI	NA	NA
RI-2018-06	M	A	51	12/05/2018	12/17/2018	50	5	10	RI	AL	2042
RI-2018-07	F	A	64	11/23/2018	12/25/2018	32	3	10.7	RI	NC	815
RI-2018-09	M	A	4	NA	NA	NA	NA	NA	RI	NA	NA
RI-2018-10	M	A	74	11/23/2018	11/27/2018	4	2	2	RI	NC	803
RI-2018-11	F	A	81	11/12/2018	12/22/2018	40	4	10	RI	GA	1490
RI-2018-12	M	A	54	12/05/2018	12/11/2018	6	2	3	RI	NC	1300
RI-2018-13	M	A	32	12/05/2018	NA	18	3	6	RI	NA	610
RI-2018-15	M	A	84	11/16/2018	12/10/2018	24	10	2.4	RI	GA	1614
Virginia											
VA-2018-01	M	A	24	11/17/2018	11/27/2018	9	2	4.5	VA	GA	1088
VA-2018-02	M	A	1	NA	NA	NA	NA	NA	VA	NA	NA
VA-2018-03	M	A	16	11/22/2018	11/22/2018	NA	NA	NA	VA	GA	673
VA-2018-05	F	A	17	01/01/2019	01/01/2019	NA	NA	NA	VA	SC	601
VA-2018-07	F	I	9	NA	NA	NA	NA	NA	VA	NA	NA
VA-2019-11	M	I	7	NA	NA	NA	NA	NA	VA	VA	NA

Bird ID	Sex[a]	Age[b]	No. Loc.[c]	Initiation Date[d]	Termination Date[e]	Days Migr[f]	No. Stop[g]	Days Per Stop[h]	Site of Capture[i]	Site of Residency[j]	Distance Migrated[k]
Spring 2019[n]											
Maryland											
MD-2019-01	F	I	96	03/25/2019	04/25/2019	31	8	3.9	MD	NS	1978
MD-2019-02	F	I	87	03/14/2019	04/17/2019	34	8	4.25	MD	WI	1775
MD-2019-03	F	I	3	NA	NA	NA	NA	NA	MD	NA	NA
MD-2019-04	M	A	17	03/01/2019	NA	2	1	2	MD	NA	59
MD-2019-05	M	A	57	03/13/2019	03/15/2019	2	1	2	MD	NY	491
MD-2019-06	F	A	50	03/14/2019	04/02/2019	19	7	2.7	MD	NY	1135
MD-2019-07	F	I	42	03/19/2019	03/21/2019	2	1	2	MD	NA	422
MD-2019-08	M	A	48	02/25/2019	03/03/2019	6	1	6	MD	CT	467
MD-2019-09	F	A	45	03/31/2019	NA	4	1	4	MD	NA	81
Maine											
ME-2018-09	F	I	50	03/14/2019	04/29/2019	46	5	9.2	ME	NB	2427
ME-2018-12	F	I	31	03/14/2019	04/11/2019	28	3	9.3	ME	NB	1962
ME-2018-13	F	A	53	03/28/2019	05/02/2019	31	6	5.2	ME	QUE	1623
North Carolina											
NC-2019-01	M	I	51	03/15/2019	05/10/2019	57	6	9.5	NC	QUE	1506
NC-2019-02	M	I	57	02/27/2019	04/08/2019	40	7	5.7	NC	NB	1706
NC-2019-03	M	A	60	03/15/2019	04/26/2019	42	6	7	NC	QUE	1657
NC-2019-04	F	A	90	03/29/2019	04/14/2019	16	5	3.2	NC	NY	933
NC-2019-05	M	A	9	NA	NA	NA	NA	NA	NC	NA	NA
New Jersey											
NJ-2018-01	M	I	2	NA	NA	NA	NA	NA	NJ	NA	NA
NJ-2018-02	M	I	41	03/15/2019	03/21/2019	6	2	3	NJ	NY	821
NJ-2018-03	M	I	42	03/11/2019	04/26/2019	46	3	15.3	NJ	ONT	991
NJ-2018-04	M	I	47	02/25/2019	04/06/2019	40	7	5.7	NJ	NS	2040
NJ-2018-05	M	I	46	03/15/2019	04/14/2019	30	6	5	NJ	NB	1775
NJ-2018-07	M	I	20	NA	NA	NA	NA	NA	NJ	NA	NA
NJ-2018-08	F	I	87	02/27/2019	04/23/2019	55	11	5	NJ	ME	2102
NJ-2018-09	F	I	87	02/27/2019	03/19/2019	16	2	8	NJ	MA	986
NJ-2018-10	F	I	60	03/14/2019	NA	35	3	17.5	NJ	NA	805

Bird ID	Sex[a]	Age[b]	No. Loc.[c]	Initiation Date[d]	Termination Date[e]	Days Migr[f]	No. Stop[g]	Days Per Stop[h]	Site of Capture[i]	Site of Residency[j]	Distance Migrated[k]
New Jersey											
NJ-2018-11	F	I	6	NA	NA	NA	NA	NA	NJ	NA	NA
NJ-2018-12	F	I	86	03/15/2019	04/23/2019	39	9	4.3	NJ	QUE	1811
NJ-2018-13	F	I	72	02/03/2019	NA	79	9	9.9	NJ	NA	1270
NJ-2018-14	F	I	35	NA	NA	NA	NA	NA	NJ	NA	NA
NJ-2018-15	F	I	70	02/20/2019	NA	87	7	14.5	NJ	NA	1471
New York											
NY-2018-06	F	A	12	02/22/2019	NA	27	4	9	NY	NA	848
NY-2018-07	F	A	40	03/12/2019	04/15/2019	33	6	5.5	NY	NY	1545
Pennsylvania											
PA-2018-02	F	A	22	03/10/2019	03/02/2019	12	2	6	PA	PA	1681
PA-2018-04	F	I	43	02/22/2019	03/28/2019	33	6	5.5	PA	PA	1560
PA-2018-08	M	A	15	03/17/2019	03/17/2019	NA	NA	NA	PA	PA	907
PA-2018-09	F	A	14	02/16/2019	NA	14	3	7	PA	NA	1095
Quebec											
QUE-2018-01	F	I	7	NA	NA	NA	NA	NA	QUE	NA	NA
QUE-2018-02	F	A	16	02/25/2019	05/06/2019	71	3	23.7	QUE	QUE	2131
QUE-2018-03	M	I	6	03/02/2019	NA	5	1	NA	QUE	NA	809
Rhode Island											
RI-2018-02	F	A	11	NA	NA	NA	NA	NA	RI	NA	NA
RI-2018-06	M	A	17	02/03/2019	04/17/2019	73	2	36.5	RI	RI	1613
RI-2018-07	F	A	43	03/26/2019	04/05/2019	10	1	10	RI	RI	827
RI-2018-10	M	A	3	NA	NA	NA	NA	NA	RI	NA	NA
RI-2018-11	F	A	37	02/22/2019	04/11/2019	48	8	6	RI	RI	1637
RI-2018-12	M	A	20	03/06/2019	03/20/2019	14	2	7	RI	CT	788
RI-2018-15	M	A	9	NA	NA	NA	NA	NA	RI	NA	NA
South Carolina											
SC-2019-01	M	A	24	03/15/2019	NA	5	2	5	SC	NA	1264
SC-2019-02	F	I	97	03/10/2019	03/22/2019	12	4	3	SC	OH	1239
SC-2019-03	F	A	100	03/10/2019	04/02/2019	23	7	2.9	SC	MI	1444
SC-2019-04	F	A	90	03/13/2019	04/13/2019	31	7	4.4	SC	NY	1436

Bird ID	Sex[a]	Age[b]	No. Loc.[c]	Initiation Date[d]	Termination Date[e]	Days Migr[f]	No. Stop[g]	Days Per Stop[h]	Site of Capture[i]	Site of Residency[j]	Distance Migrated[k]
South Carolina											
SC-2019-05	M	I	60	03/15/2019	04/08/2019	24	7	3.4	SC	ONT	1804
SC-2019-06	M	I	38	03/14/2019	NA	7	3	3.5	SC	NA	1486
SC-2019-07	F	I	27	02/27/2019	NA	9	2	9	SC	NA	656
SC-2019-08	F	I	96	03/09/2019	04/08/2019	22	8	2.8	SC	MN	2325
SC-2019-09	F	I	89	02/27/2019	03/11/2019	12	2	6	SC	VA	732
Virginia											
VA-2018-01	M	A	6	01/26/2019	02/06/2019	11	1	11	VA	VA	592
VA-2018-05	F	A	11	03/02/2019	NA	15	2	7.5	VA	NA	1007
VA-2019-10	M	A	18	NA	NA	NA	NA	NA	VA	VA	NA
VA-2019-11	M	I	56	04/06/2019	04/24/2019	30	4	7.5	VA	ONT	798
VA-2019-12	M	A	22	04/18/2019	04/26/2019	8	2	4	VA	MI	814
VA-2019-14	M	I	50	03/21/2019	04/22/2019	32	4	8	VA	QUE	1043
VA-2019-15	M	I	55	03/13/2019	03/25/2019	12	3	4	VA	MI	1174
VA-2019-16	F	I	14	NA	NA	NA	NA	NA	VA	NA	NA
VA-2019-17	F	A	2	NA	NA	NA	NA	NA	VA	NA	NA
VA-2019-20	M	A	3	NA	NA	NA	NA	NA	VA	NA	NA
VA-2019-21	M	A	11	04/20/2019	05/15/2019	25	1	25	VA	QUE	1579
VA-2019-22	F	A	44	04/11/2019	04/15/2019	4	2	2	VA	KY	290
VA-2019-23	F	A	35	04/15/2019	04/24/2019	9	2	4.5	VA	NH	935
VA-2019-24	F	A	157	NA	NA	NA	NA	NA	VA	VA	NA
VA-2019-26	M	A	18	NA	NA	NA	NA	NA	VA	VA	NA