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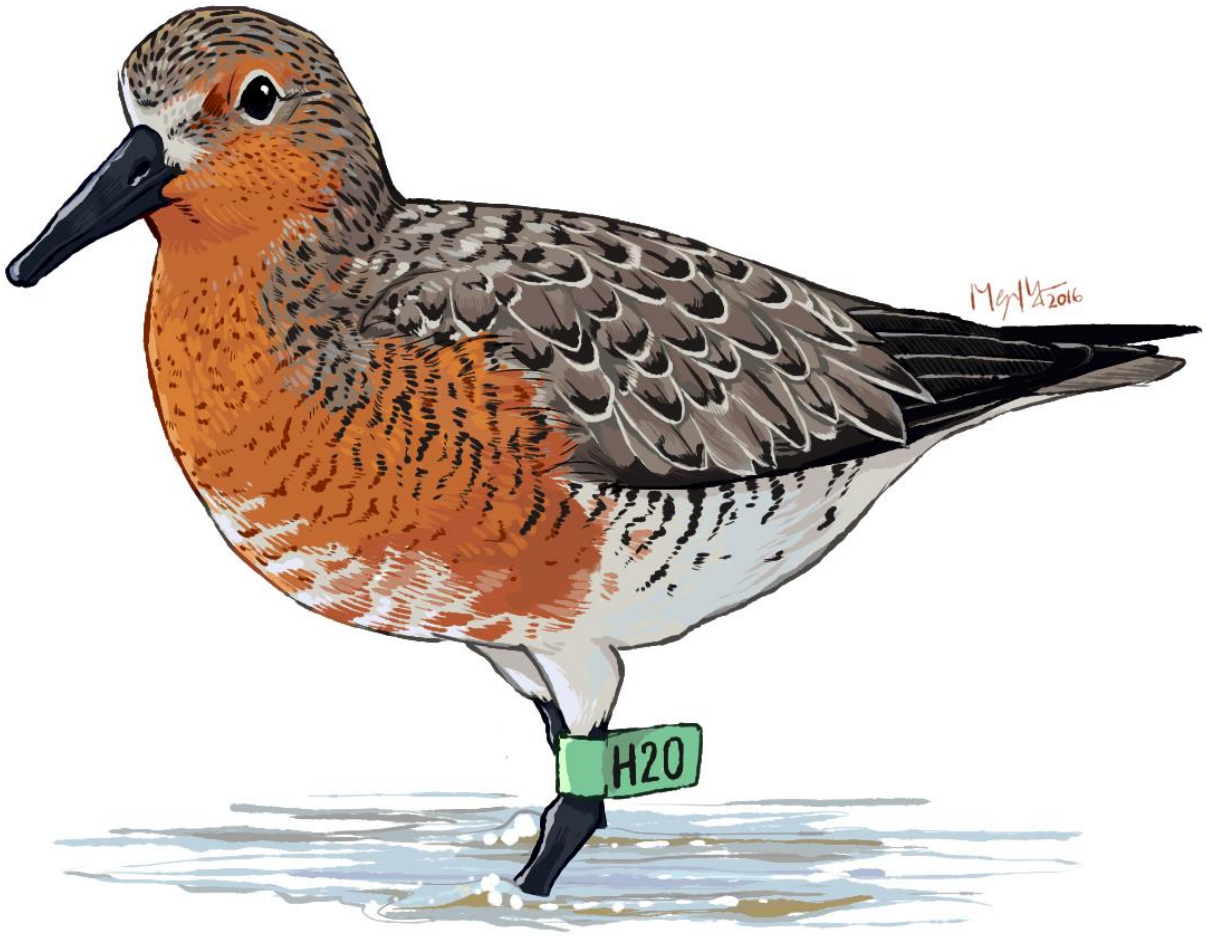

INVESTIGATING RED KNOT MIGRATION ECOLOGY ALONG THE GEORGIA COAST: FALL 2015 SEASON AND SPRING 2013, 2015-16 SEASON SUMMARIES

Investigating Red Knot Migration Ecology along the Georgia Coast: Fall 2015 and Spring 2013, 2015-16 Season Summaries

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Project Partners:
US Fish and Wildlife Service
US Geological Survey
Georgia Department of Natural Resources Non-game Section
Manomet Center for Conservation Sciences
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Cover artwork of flagged Red Knot "H20" provided by Megan Massa.

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The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

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EXECUTIVE SUMMARY

The *rufa* subspecies of the Red Knot (*Calidris canutus*) has declined significantly in the past 35 years, leading to federal listing (US Fish and Wildlife Service Federal Register Vol. 79 No. 238, 2014a) under the Endangered Species Act in the United States (16 U.S.C. 1531 *et. seq*) and Canada (COSEWIC 2007, SARA 2007). The determination of regional population estimates and identification of major stopover sites are considered to be the highest priority for the Georgia Department of Natural Resources State Wildlife Action Plan (2015), the Atlantic Flyway Shorebird Business Strategy (Winn et al. 2013), the US Shorebird Plan (Brown et al. 2001), the USFWS Red Knot Spotlight Species Action Plan (2010), and the Western Hemisphere Shorebird Reserve Network (WHSRN) Red Knot Conservation Plan for the Western Hemisphere (Niles et al. 2010a). The Georgia Department of Natural Resources State Wildlife Action Plan ranks the Red Knot as a high priority species (with state status of "Rare") and ranks research of the Red Knot as one of the primary conservation actions needed within the state.

A large percentage (3-6%) of Red Knots have been previously captured and tagged with unique 2 to 3 digits alpha-numeric bands. This marked population allows for mark-resight studies of migratory populations of Red Knots with no capturing involved. We detected a total of 43,686 Red Knots during daily surveys in spring 2016 along the Georgia Coast; of those, 10,029 were scanned for flags, and 1,255 individually banded Red Knots were resighted within the spring migrant population. A total of 158 marked to unmarked ratios were recorded during the field season, with an average of 3.8% of Red Knots individually marked over the course of the spring. The estimated superpopulation size for the spring 2016 season is 11,948 Red Knots (95% credible interval: 9,821 – 16,405). The mean Minimum-length-of-stay (MINLOS) for Red Knots staging in Georgia was 9.8day±11.1SD. A total of 3,805 Red Knots were detected on daily surveys during fall migration 2015; of those, 2,231 individuals were scanned for flags, and 140 individually banded Red Knots were resighted within that group. A total of 78 marked to unmarked ratios were recorded during the field season, with an average 3.4% of Red Knots banded. A total of 68 individuals were identified during the fall season, which was not enough data to analyze the population migrating through the Georgia Coast in fall 2015. We determined relative use along the Georgia Coast in spring and fall migration through a combination of aerial and ground based surveys. We created a GIS database of all encounters of Red Knots along the barrier Island chain, totaling 299 locations and 98,155 Red Knots mapped.

The Georgia Coast is a major stopover area annually for *rufa* Red Knots in spring migration and in certain years in fall migration. The superpopulation utilizing the coast in fall migration can exceed 23,000 birds (Lyons et al. 2017 *in press*) and the estimates of spring migration superpopulation from this study ranges between 8,000 and 14,000 birds. The total estimated population of *rufa* Red Knots is 42,000 birds (Andres et al. 2012), suggesting that a high percentage of *rufa* knots are using the Georgia Coast in spring and in some years fall migration. There appears to be less variation in spring migration superpopulations between years than in fall migration, suggesting a more stable (but less abundant) food source for spring migrants.

BACKGROUND

Context

The *rufa* subspecies of the Red Knot (*Calidris canutus*) has declined significantly in the past 35 years, leading to federal listing (US Fish and Wildlife Service Federal Register Vol. 79 No. 238, 2014a) under the Endangered Species Act in the United States (16 U.S.C. 1531 *et. seq*) and Canada (COSEWIC 2007, SARA 2007). Evidence for the decline is seen in long-term surveys of a major spring staging site (Dunne et al. 1982, Clark et al. 1993, Niles et al. 2008) and on wintering grounds (Morrison et al. 2004, Dey et. al 2011, Andres et al. 2012). In only 30 years, the estimated population has declined from 100,000-150,000 to below 30,000 (Niles et al. 2007), leading some researchers to suggest the *rufa* population is highly vulnerable to extinction (Baker et al. 2004).

Most research exploring the population decline has focused on studying the foraging conditions within the Delaware Bay (Atkinson et al. 2003, Baker et al. 2004, Haramis et al. 2007, McGowan et al. 2011). The Delaware Bay is a terminal spring staging site on the mid-Atlantic seacoast where birds refuel before moving north to their breeding grounds in the high arctic (Harrington and Flowers 1996, Harrington 2001) and was the first site recognized for its hemispheric importance under the Western Hemisphere Shorebird Reserve Network (WHSRN) program (Delaware Bay WHSRN Partners 1986). Red Knots staging within the Delaware Bay feed nearly exclusively on the eggs of the horseshoe crab (*Limulus polyphemus*) (Tsipoura and Burger 1999) and horseshoe crab egg densities have been related to spatial distribution (Karpanty et al. 2006), foraging rates (Atkinson et al. 2003, Gillings et al. 2007), rates of mass gain (Robinson et al. 2003, Atkinson et al. 2007, Gillings et al. 2009) and the associated ability of birds to reach threshold leaving weights (Baker et al. 2001, Niles et al. 2008, Morrison 2012). Leaving weights have been suggested to influence adult survivorship, indicating a link between conditions within the Delaware Bay and recent population declines (Baker et al. 2004). Horseshoe crabs have been harvested commercially in the Delaware Bay for decades, and the rapid emergence of the conch industry has dramatically increased harvest pressures in recent years (Walls et al. 2002). Increased harvest rates of horseshoe crabs may impact the magnitude of spawning events, resulting in egg densities well below those required by staging Red Knots and other shorebirds, and harvest of crabs has led to conflicts between the fishing industry and conservation groups (Odell et al. 2005).

A Red Knot band resight program was initiated by Manomet Center for Conservation Sciences, US Fish and Wildlife Service, and Georgia Department of Natural Resources Nongame Section in the Altamaha River basin during the fall of 2011. Prior to the 2011 study, no systematic resighting of migratory Red Knots had been conducted in Georgia in any season. The patterns observed suggest that Red Knots are using the Georgia Coast during fall migrations in large numbers when forage is abundant (Lyons et al. 2017 *in press*). Fall coastal habitats

in Georgia are used primarily by Red Knots wintering in southeastern states, coastal Texas, and into northeast Brazil, though long-distance migrant (wintering in Argentina and Chile) Red Knots refuel there as well (Lyons et al. 2017 *in press*). Although movement and settlement "decisions" are likely influenced by foraging conditions throughout the network, and investigations into the factors driving movement during migration is necessary to better understand Red Knot migration ecology. There is an essential need for developing appropriate stopover models and adaptive management tools for land managers to better conserve the resource. Systematic resighting of individually tagged Red Knots along the Georgia Coast during spring and fall migrations fills a crucial knowledge gap in the life history of Red Knots.

The Center for Conservation Biology, US Fish and Wildlife Service, and Georgia Department of Natural Resources Nongame Section initiated a Red Knot band resight program along the Atlantic Coast of Georgia during the spring of 2013. This was the first systematic resight study of Red Knots in spring migration in Georgia. Previous population estimates of Red Knots along the South Atlantic coast focused on aerial or ground based surveys and while these methods are useful for counting peak numbers, they are less than ideal for estimating accumulated numbers of the overall population of Red Knots cycling through a stopover site. McGowan et al. (2011) strongly recommend moving away from aerial or ground counts to methods that use mark-recapture and allow for estimation of variance from the data. Estimates of spring migration survival rates, stopover duration, and between-year fidelity rates to Georgia are impossible to calculate without a dedicated systematic mark-recapture program.

The determination of regional population estimates and identification of major stopover sites are considered to be the highest priority as outlined in the Georgia Department of Natural Resources State Wildlife Action Plan (2015), the Atlantic Flyway Shorebird Business Strategy (Winn et al. 2013), the US Shorebird Plan (Brown et al. 2001), the USFWS Red Knot Spotlight Species Action Plan (2010), and the WHSRN Red Knot Conservation Plan for the Western Hemisphere (Niles et al. 2010a). The Georgia Department of Natural Resources State Wildlife Action Plan (2015) ranks the Red Knot as a high priority species (with state status of "Rare") and ranks research of the Red Knot as one of the primary conservation actions needed within the state.

ACTIVITIES and OBJECTIVES

The Center for Conservation Biology, Manomet Center for Conservation Sciences, Georgia Department of Natural Resources Nongame Section, US Geological Survey, and the US Fish and Wildlife Service objectives for the Red Knot project in Coastal Georgia are to:

1) Resight individually tagged Red Knots (*Calidris canutus rufa*) in previously identified stopover locations (>200 Red Knots) within the study area (Camden, Glynn, McIntosh, Liberty, Bryan, and Chatham counties, Georgia) in fall (2015) and spring (2016) migration. Prior fall migration studies have shown considerable use of coastal sites (Lyons et al. *2017 in press*), as have previous spring studies (Smith et al. 2014). Expanding the Red Knot resight program to include other important staging areas along the Atlantic Coast is a stated priority of the USFWS Red Knot Spotlight Species Action Plan (2010). A deliverable associated with this objective is to upload all resighting data to the Georgia resighting portal in Bandedbirds.org, contributing this data set to studies looking at range-wide demographics of the species.

2) Utilize peer reviewed mark-recapture methodology to analyze Red Knot resight data to estimate the population of Red Knots utilizing the Georgia Coast in spring (2015 and 2016) and fall (2015) migration. Regional population estimates and identification of major stopover sites are considered to be the highest priority for the Georgia State Wildlife Action Plan, the Atlantic Flyway Shorebird Initiative Business Strategy (Winn et al. 2013), the US Shorebird Plan (Brown et al 2001), the USFWS Spotlight Species Action Plan (2010) and the WHSRN Red Knot Conservation Plan for the Western Hemisphere (Niles et al 2010a). Providing a population estimate for various staging areas is a stated goal of the WHSRN Red Knot Conservation Plan for the Western Hemisphere (Niles et al 2010a), the Atlantic Flyway Shorebird Business Strategy (Winn et al. 2013), and the USFWS Red Knot Spotlight Species Action Plan (2010). The Georgia State Wildlife Action Plan (2015) ranks the Red Knot as a high priority species and ranks research of the Red Knot as one primary conservation actions needed within the state.

3) Determine which locations are primary stopover sites in Georgia and provide information to local, regional, and nationwide land and resource managers. We propose to disseminate all information gathered to resource managers that have input on habitat use in the area. These include land managers and staff at the US Fish and Wildlife Service Savannah Coastal Refuges, Georgia Department of Natural Resources owned properties, Cumberland Island National Seashore, and staff on privately owned islands such as Little St. Simons and St. Catherines Islands.

4) Solicit and train volunteers to resight Red Knots and collect data in a standard way throughout the region. We propose to continue training and improve our volunteer base. We have been able to train over 20 local biologist (federal, state, private in origin) to collect Red Knot resight data based on standardized protocols (F. Smith 2013).

5) Increase public awareness of the conservation issues surrounding the Red Knot and other shorebirds in Georgia through all publicly available media and social media avenues. Project partners have been effective in communicating the story of birds of conservation concern (see http://www.youtube.com/watch?v=wlbCZG-wGuY which reached 8 million people, also see http://www.ccbbirds.org/2013/09/09/machi-goshens-conservation-legacy/ , a story that was followed by tens of thousands of people worldwide (and translated into at least 7 languages) and helped initiate a 3 year moratorium on Whimbrel hunting in Guadeloupe, and was a direct catalyst to creation of the Shorebird Hunting Working Group that is currently focusing efforts on reducing or eliminating non-sustainable harvesting of migratory shorebirds throughout the flyway.

METHODS

Study Area

The primary study area is the Georgia Coast barrier island chain in Camden, Glynn, McIntosh, Liberty, Bryan, and Chatham Counties (Figure 1). Study sites were determined based on Red Knot concentrations in prior years, and were comprised of a mixture of federal, state, and private lands. The primary study sites in the fall of 2015 were Little Egg Island Bar, Wolf Island, and Wolf Bar (Figure 2). A total of 7 barrier islands were selected for intensive resighting efforts during the 2016 spring season: Gould's Inlet, Pelican Spit, Rainbow Beach (LSSI), Cabretta/S. Blackbeard Island, Ogeechee/Raccoon Key Bar, Beach Hammock, and Tybee Bar (Figure 3). Several ground based surveys were conducted on other islands to document Red Knot numbers outside of the main study area: St Catherines Island, St. Catherines Bar, and Ossabaw Island. Late March/early April surveys of Cumberland Island were conducted by project partners. Spring study areas initially covered the islands with highest Red Knot use during the 2013 and 2015 seasons; some were subsequently repositioned to cover areas with high Red Knot use in spring 2016.

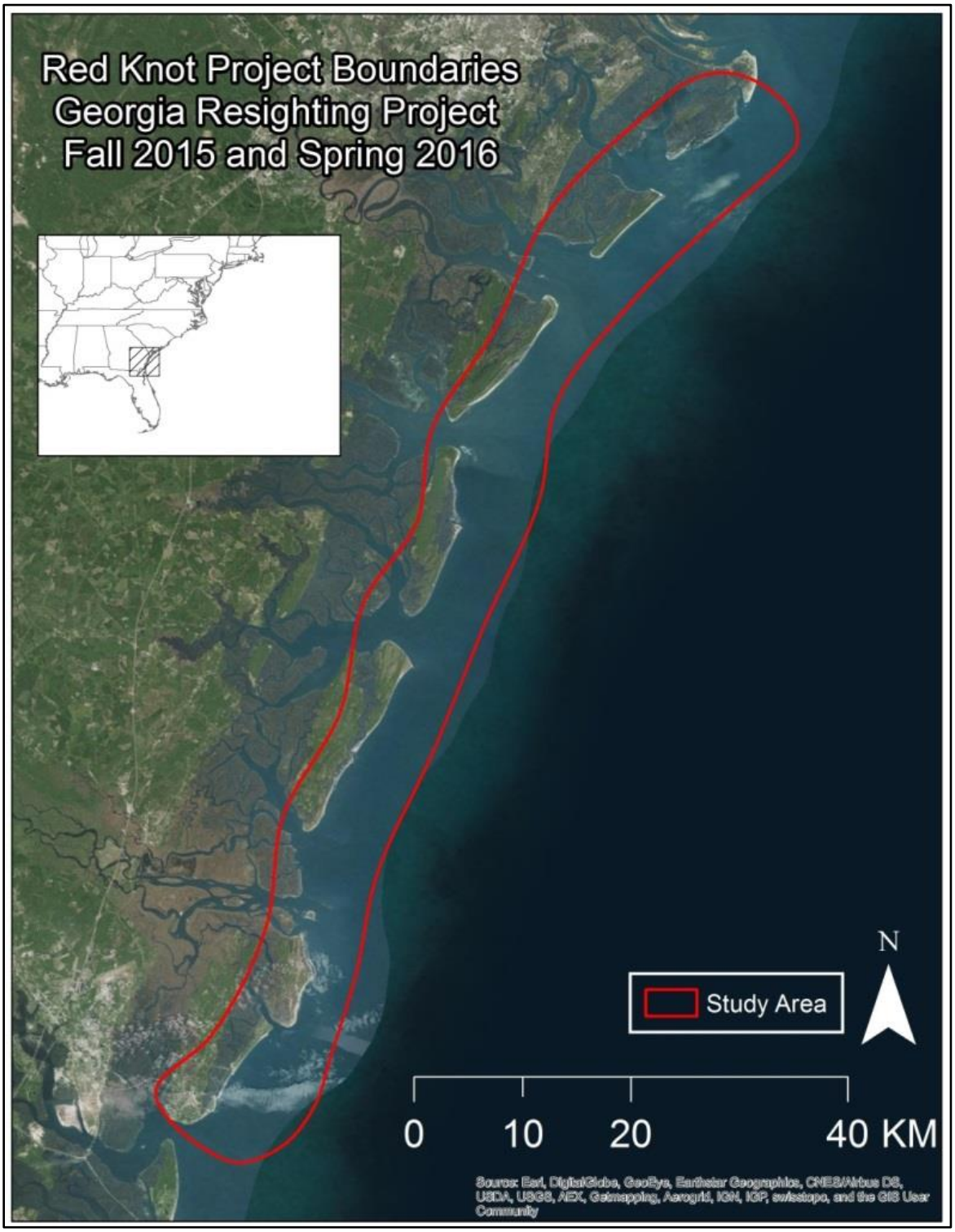

Figure 1. Project boundaries for the fall 2015 and spring 2016 Red Knot resighting field seasons.

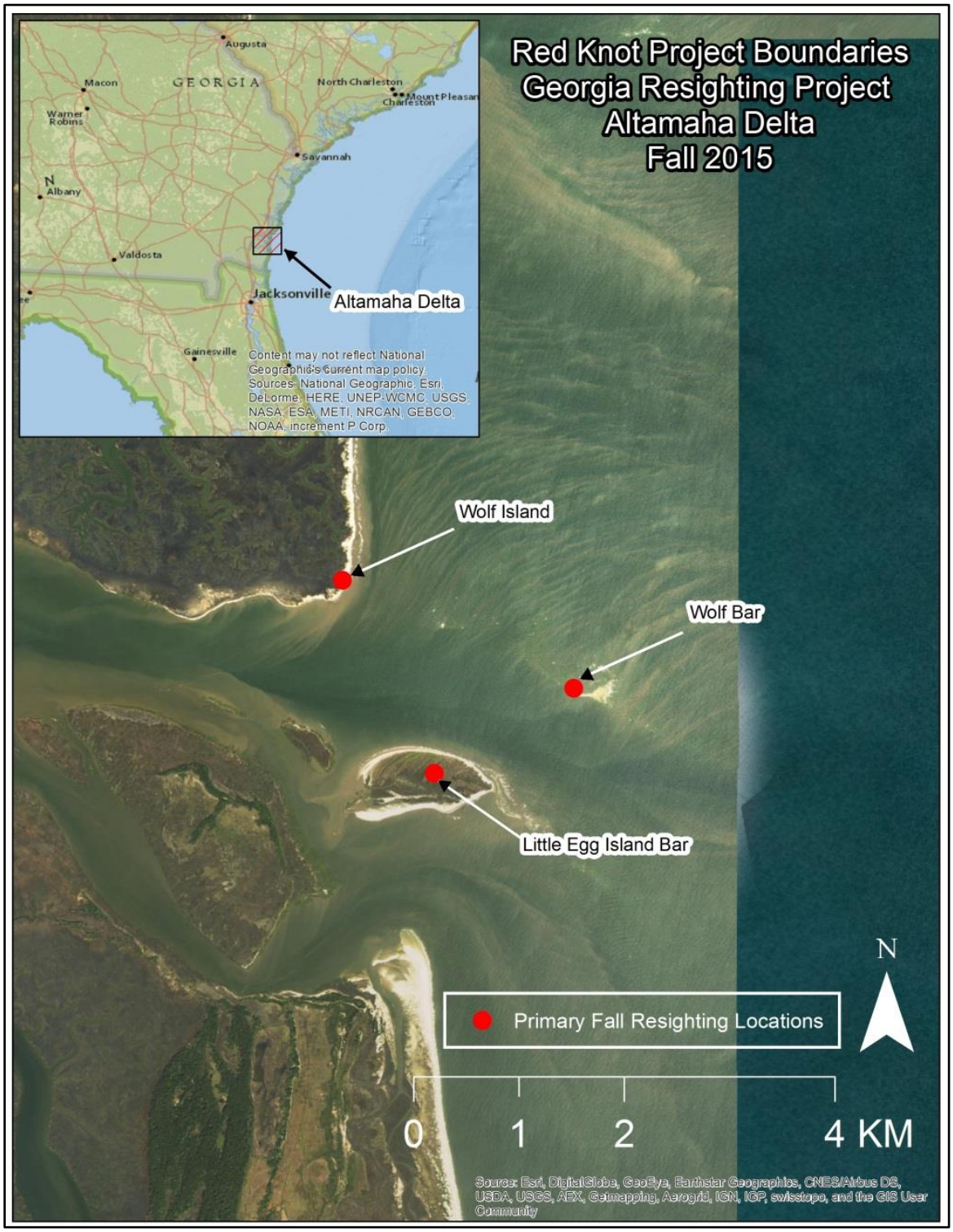

Figure 2. Fall 2015 Red Knot resighting locations within the Altamaha Delta.

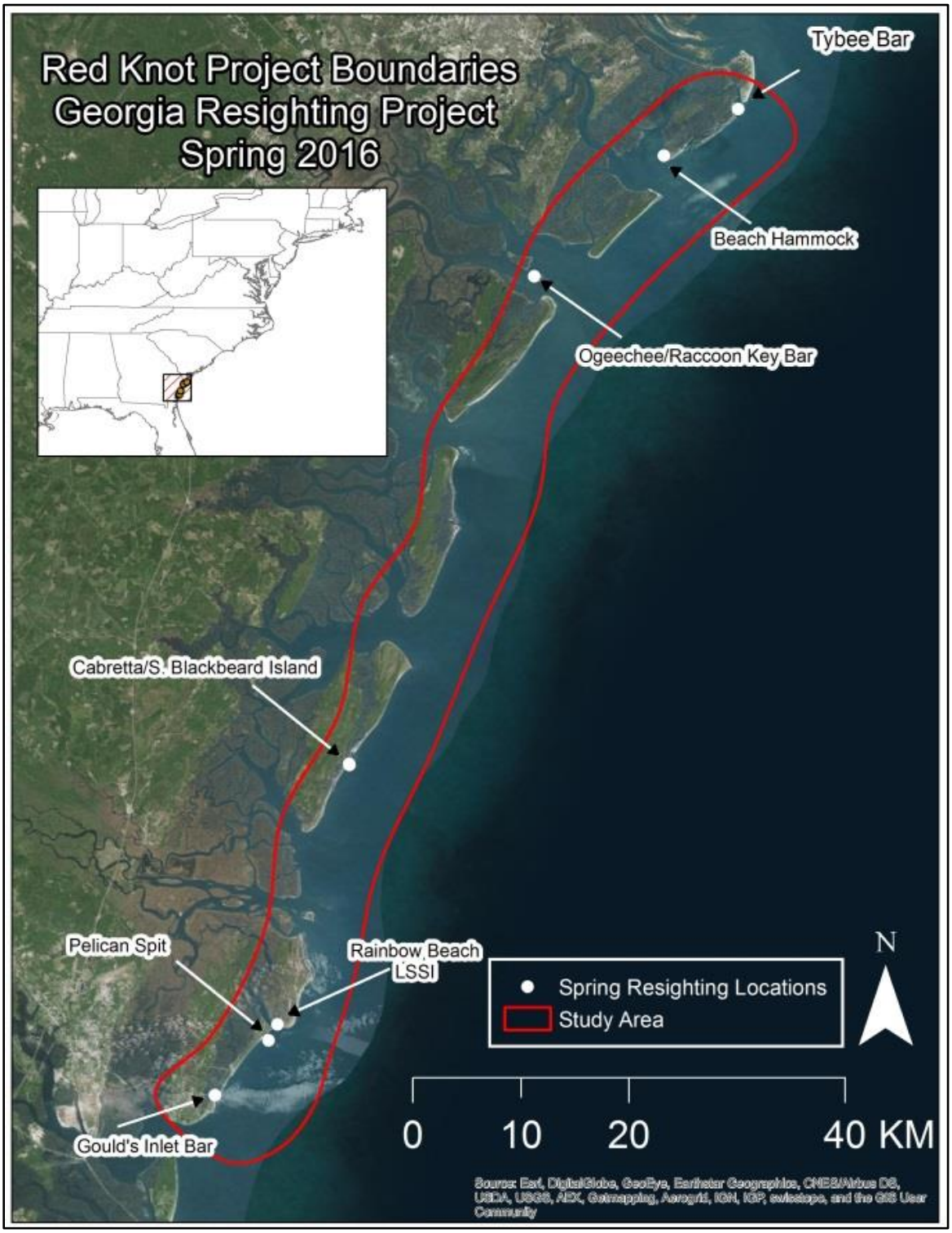

Figure 3. Spring 2016 Red Knot resighting locations on the Georgia Coast.

Field Methods and Sampling Design

The peak of Red Knot spring migration in Georgia is from early to mid-April through late-May to early-June and knots use barrier islands located along the entire coastline from Cumberland Island National Seashore to Tybee Island. Fall migration begins in mid-July and extends through October, and Red Knots are restricted to fewer stopover sites. Red Knots are easiest to observe in Georgia when they concentrate at foraging and roost sites, therefore we focused resight and survey efforts beginning 2.5 hours before high tide (mid-rising tide) to 2.5 hours after high tide (mid-falling tide) during daylight hours. We surveyed along transects that we could complete within a 5-6 hour observation period. During each survey, we used high-quality spotting scopes fitted with 20-60x zoom eye pieces to read flag codes from individually marked Red Knots and recorded data following standardized resighting protocol (Kalasz 2006, Smith 2013, Lyons 2016). Marked to unmarked ratios, flag color and alpha-numeric combination were noted (Lyons 2016).

Statistical Methods and Sampling Design

Statistical analyses.—We converted the observations of marked birds into encounter histories, one for each bird, and analyzed the encounter histories with a Jolly-Seber (JS) model (Jolly 1965, Seber 1965, Crosbie and Manly 1985, Schwarz and Arnason 1996). The JS model includes parameters for capture (p), survival (ϕ), and recruitment (β) probabilities; in the context of a mark-resight migration study, these parameters are interpreted as probability of resighting, residency, and arrival to the study area, respectively. The JS model also includes a parameter for superpopulation size (N), which in the context of a mark-resight migration study is interpreted as marked population size. In our analysis, we chose to use weeks rather than days as the sampling interval for the JS model given the length of the season and size of the dataset; multiple observations of the same individual in a given calendar week were combined for analysis. An m-array summary of the mark-resight data is presented in Table A1.

We fit a fully-time dependent version of the Jolly-Seber model (all parameters were time-varying, $\{\phi_t\ p_t\ \beta_t\}$). Probability of arrival to the stopover area was allowed to vary with time in all models because constant arrival probability did not seem biologically reasonable. Residency (ϕ) and resight (p) probabilities also were allowed to vary with sample occasion (week). We set $p_1 = p_2$ and $p_{K-1} = p_K$ (where K is the number of samples) because not all parameters are estimable in this model; we also set $p = 0$ for any week with no attempt to collect resighting data.

We followed the methods of Royle and Dorazio (2008, Chapter 10) to fit the JS model using a parameterization based on a restricted dynamic occupancy analysis. Royle and Dorazio (2008) use a state-space formulation of the JS model with parameter-expanded data augmentation. For parameter-expanded data augmentation, we augmented the observed encounter histories with all-zero encounter histories (n = 300) representing potential recruits that were not detected (Royle and Dorazio 2012). We followed Lyons et al. (unpubl. ms.) to combine

the JS model with a binomial model for the counts of marked and unmarked birds in an integrated Bayesian analysis. Briefly, the counts of marked animals (m_s) in the scan samples are modeled as a binomial random variable:

$$m_s \sim Bin(\pi, C_s), \qquad (1)$$

where m_s is the number of marked animals in scan sample s, C_s is the number of animals checked for marks in scan sample s, and π is the proportion of the population that is marked. Total stopover population size $\widehat{N^*}$ is estimated by

$$\widehat{N^*} = \widehat{N}/_{\hat{\pi}}, \qquad (2)$$

where $\widehat{N}$ is the superpopulation estimate of marked animals from the JS model and $\hat{\pi}$ is the proportion of the population that is marked (from Eq. 1). Estimates of marked subpopulation sizes at each resighting occasion t $\left(\widehat{N}_t\right)$ are available as derived parameters in the analysis. We calculated an estimate of population size at each mark-resight sampling occasion $\widehat{N}_t^*$ using $\widehat{N}_t$ and $\hat{\pi}$ as in equation 2.

With Bayesian analysis of the JS model, it is possible to estimate stopover duration using a latent state variable in the model that represents time of arrival to, and departure from, the study area (Lyons et al. 2016). The time-specific latent state variable is a Bernoulli random variable for each individual bird in the population that is equal to zero at each sampling occasion before the individual arrives in the study area. For the sampling occasion at which the bird arrives, it is equal to one, and it remains equal to one for all sampling occasions until the bird departs, at which point it again is equal to zero. We sum this latent state variable across sampling occasions to estimate stopover duration (S). With this estimation procedure, estimated stopover duration is not confounded with resighting probability (see Lyons et al. 2016 for details). With our data it is possible to estimate stopover duration separately for each nonbreeding population.

We fit the models using WinBUGS software (Lunn et al. 2000) using noninformative priors for all parameters and three chains of the Markov chain Monte Carlo (MCMC) sampler. We assessed convergence using the Gelman-Rubin statistic (Brooks and Gelman 1998) and visual inspection of plots showing the history of the MCMC sampler.

Data Verification

Prior to analysis of mark-resight data, we reported each individually-marked Red Knot to other researchers for confirmation of the existence of each band combination and flag code (Bandedbirds.org, P. M. Gonzales, N.M. Soledad Curci, pers. comm.). We excluded observations that did not correspond to any banding databases.

Resight Training

We solicited volunteers who were subsequently trained in standardized resighting protocols (Kalasz 2006, Smith 2013, Lyons et al. 2016) to collect Red Knot resight data prior to the fall 2015 and spring 2016 field efforts.

Data Storage

Red Knot resight data is stored at Bandedbirds.org, under the Georgia Shorebird Resighting Project portal. This data is accessible to larger demographic studies being conducted for this species.

RESULTS and OUTCOMES

Spring 2016 Resighting Field Season Results

Seven barrier islands were chosen for intensive resighting efforts during the 2016 spring season. Project biologists surveyed a total of 47 out of 58 potential days during the spring migration window.

A total of 43,686 Red Knots were detected on daily surveys; of those, 10,029 were scanned for flags, and 1,255 individually banded Red Knots were resighted within the spring migrant population. A total of 158 marked to unmarked ratios were recorded during the field season, with an average of 3.8% of Red Knots individually marked over the course of the spring. The estimated superpopulation size for the spring 2016 season is 11,948 Red Knots (95% credible interval: 9,821 – 16,405) season (See Figures 4-6 for population size estimate, percent of the population marked, and stopover duration). The mean Minimum-length-of-stay (MINLOS) for Red Knots staging in Georgia was 9.8day±11.1SD (Figure 6). The median MINLOS was 4 days.

Fall 2015 Resighting Field Season Results

A total of 7 barrier islands were surveyed for Red Knots during the 2015 fall migration season: Wolf Island, Little Egg Island, Little Egg Island Bar, South Blackbeard bar, Tybee Island, and Little Tybee/Williamson/Beach Hammock. The Wolf Island, Little Egg Island, and Wolf Bar locations were intensively surveyed. Project biologists surveyed a total of 21 days between 10 July and 30 September 2015 during the fall migration window.

A total of 3,805 Red Knots were detected on daily surveys; of those, 2,231 individuals were scanned for flags, and 140 individually banded Red Knots were resighted within that group. A total of 78 marked to unmarked ratios were recorded during the field season, with an average 3.4% of Red Knots banded. A total of 68 individuals were identified during the fall season, which was not enough data to analyze the population migrating through the Georgia Coast in fall 2015.

Spring 2015 Resighting Field Season Results

Resight data was gathered during the 2015 spring season under a separate grant awarded by US Fish and Wildlife. Fourteen barrier islands were surveyed for Red Knots during the 2015 migration season: Pelican Spit, Gould's Inlet, Little St. Simons Island, Wolf Island, Little Egg Island, Little Egg Island Bar, Cabretta Island, Blackbeard Island, St. Catherines Island, Ossabaw Island, Ogeechee Bar, Tybee Island, Tybee Bar, and the Little Tybee/Williamson/Beach Hammock complex of islands. Four locations were intensively surveyed: Pelican Spit/Gould's Inlet, the complex of Cabretta and S. Blackbeard Islands, Ossabaw Island, Ogeechee Bar, and Tybee Bar/Beach Hammock. These sites were visited 1-3 times per week for the project duration. Center for Conservation Biology staff surveyed a total of 45 out of 61 potential days during the spring migration window. Project partners were able to cover additional days of surveys of islands outside of the main study areas. Transects were initially set up on the highest Red Knot use islands from the 2013 season, but were repositioned to cover the areas with high Red Knot use in spring 2015. During the 2013 season, Wolf Island, Little Egg Island, and Little Egg Island Bar were dropped as primary survey/resight locations by CCB staff due to low Red Knot use. These sites were used heavily during the latter part of the migration window in spring of 2015. CCB staff surveyed Ossabaw Island, Ogeechee Bar, Pelican Spit/Rainbow Beach/Gould's Inlet, and S.Blackbeard/Cabretta Island intensively.

A total of 45,660 Red Knots were detected on daily resight surveys in spring 2015, of which 1,196 individually banded Red Knots were resighted. A total of 92 marked to unmarked ratios were recorded during the field season, with an average of 4-6% of Red Knots banded. The estimated superpopulation size of Red Knots migrating through the Georgia Coast in spring 2015 is 8,001 birds (95% credible interval: 6,699 – 9,830) (See Figures 7-9 for population size estimate, percent marked, and stopover duration).

Spring 2013 Resighting Field Season Results

Ten barrier islands were surveyed during the 2013 migration season: Gould's Inlet, Little St. Simons Island, Wolf Island, Little Egg Island, Little Egg Island Bar, Cabretta Island and Blackbeard Island, St. Catherines Island, Ossabaw Island, and Ogeechee Bar/Raccoon Key. Four locations were intensively surveyed: Little St. Simons Island, Cabretta Island, Ossabaw Island, and Ogeechee Bar. We surveyed a total of 33 out of 50 potential days during the spring migration window. Project partners were able to survey an additional 28 days of surveys of islands outside of the main study areas. Transects were initially set up on the highest Red Knot use islands from fall 2011, but were repositioned to cover the areas with high Red Knot use in spring 2013. During the 2013 season, Wolf Island, Little Egg Island, and Little Egg Island Bar were dropped as primary survey/resight locations by CCB field staff due to low Red Knot use. US Fish and Wildlife conducted the surveys of those islands, recording all Red Knot use during the migration window. Project partners, professionals, and volunteers covered St.

Catherines Island, Little St. Simons Island, and assisted on Cabretta Island. In total, we accumulated 74 hours of resight effort from professional staff and/or volunteers on Little St. Simons, St. Catherine, and Cabretta Islands.

A total of 18,552 Red Knots were detected on resight surveys, of which 616 individually banded Red Knots were resighted. A total of 61 marked to unmarked ratios were recorded during the field season, with an average of 3.6% of Red Knots banded. A total of 277 individually marked Red Knots were detected at least once during the spring 2013 migration season. These individuals were resighted on a total of 505 separate encounters. The estimated superpopulation size during the spring 2013 season is 13,775 birds (95% credible interval: 10,231 – 20,097) (See Figures 10-12 for population size estimate, percentage of population marked, and stopover duration).

Spring 2016 Mark-recapture Results

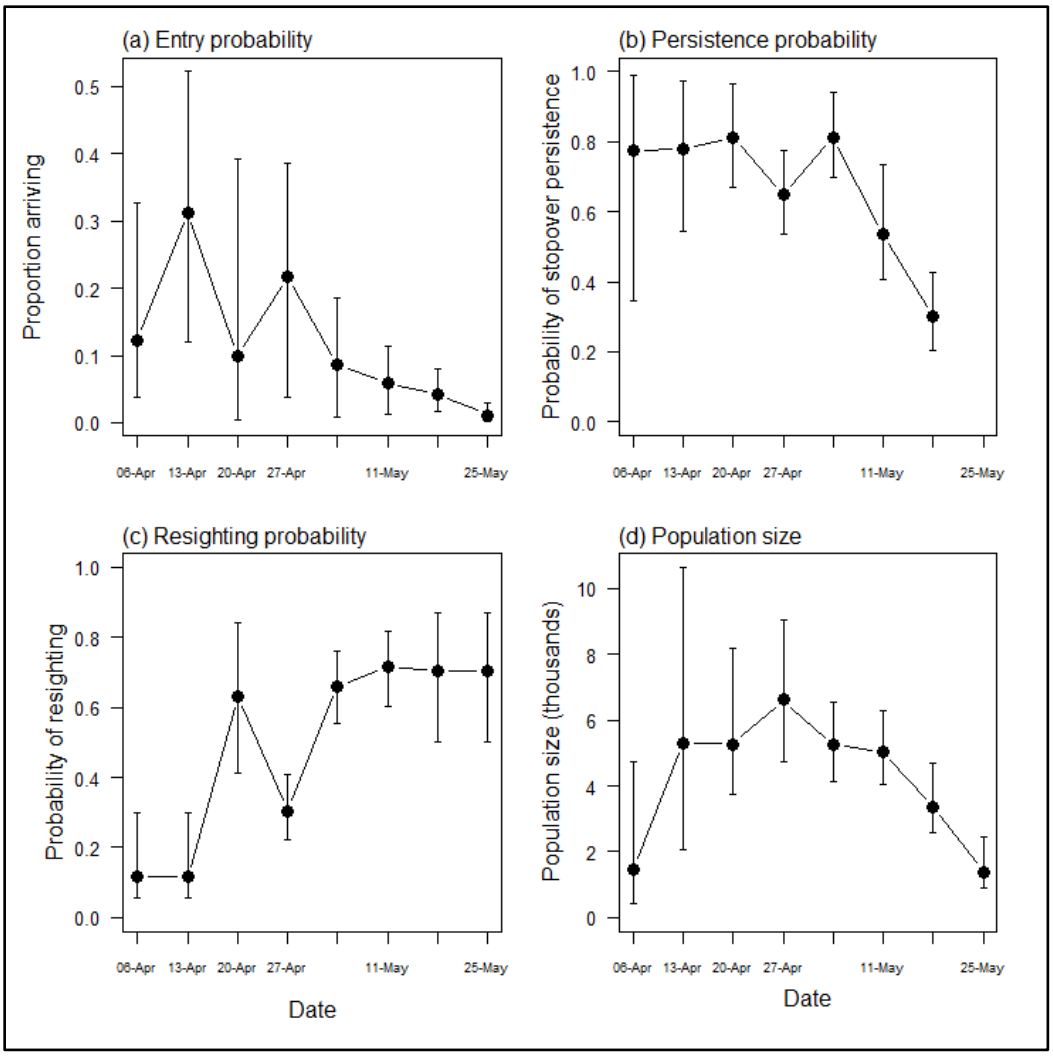

Figure 4. Stopover population dynamics and population size estimates of Red Knots on the Georgia Coast during April – May 2016. Parameter estimates are from a fully time-dependent Jolly-Seber model {β[t]ϕ[t]*p*[t]}. Mark-resight data (n = 330 individually marked birds) were aggregated into eight weekly sampling occasions. Filled circles and error bars show estimated parameters and 95% credible intervals.

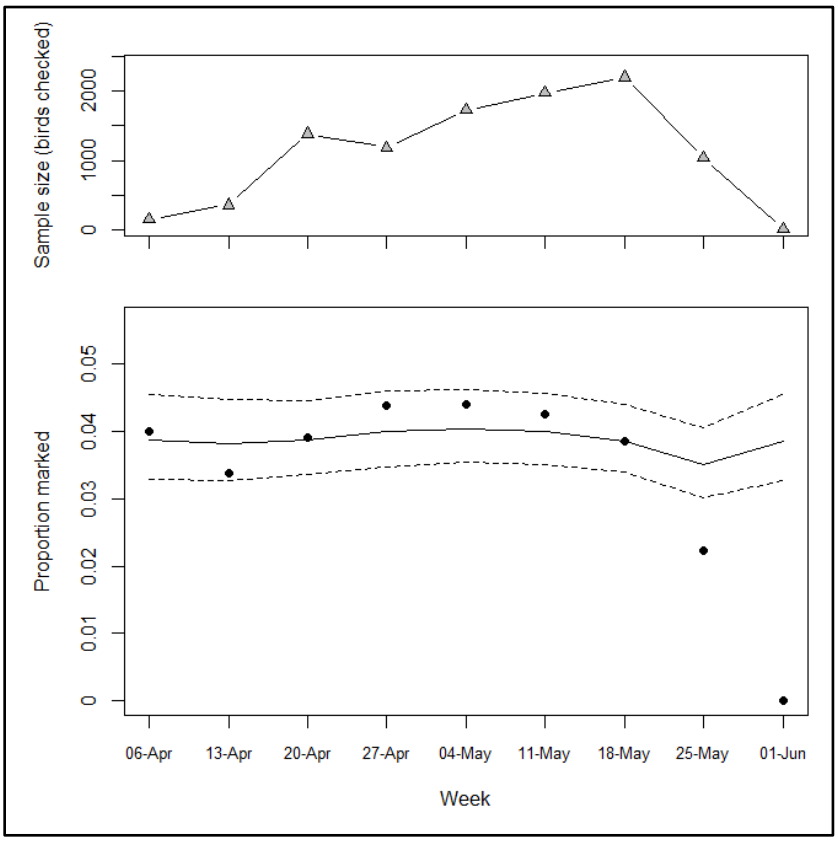

Figure 5. Fraction of the population with distinct markers (leg flags and color bands) during April – May 2016 at sites along the Georgia Coast. Fitted values (solid line in bottom panel) and 95% credible interval (dashed line) are from a generalized linear mixed model (GLMM) with a random effect for each week of the study. Filled circles are # marked/# checked for marks. Average marked proportion was 0.038 (95% CI 0.031 – 0.045).

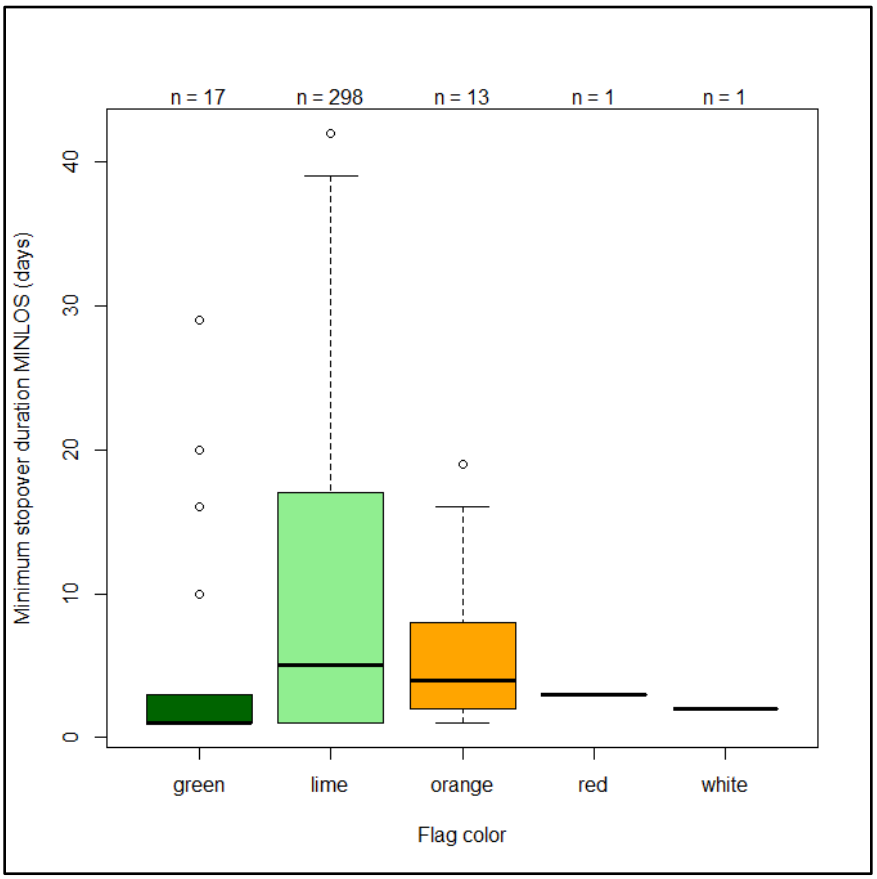

Figure 6. Minimum-length-of-stay by flag color in spring 2016 (n = 330 birds). MINLOS is date of last sighting minus date of first sighting plus 1; it is not a model-based estimate. As an index of stopover duration, MINLOS is biased low because it does not account for time in study area before first, and after last, detection. Average and median MINLOS were 9.8 and 4 day(s), respectively. A model-based estimate of stopover duration (one that accounts for time before first, and after last, detection) was equal to 3.4 weeks (95% CI 3.1 – 3.9 weeks).

Spring 2015 Mark-recapture Results

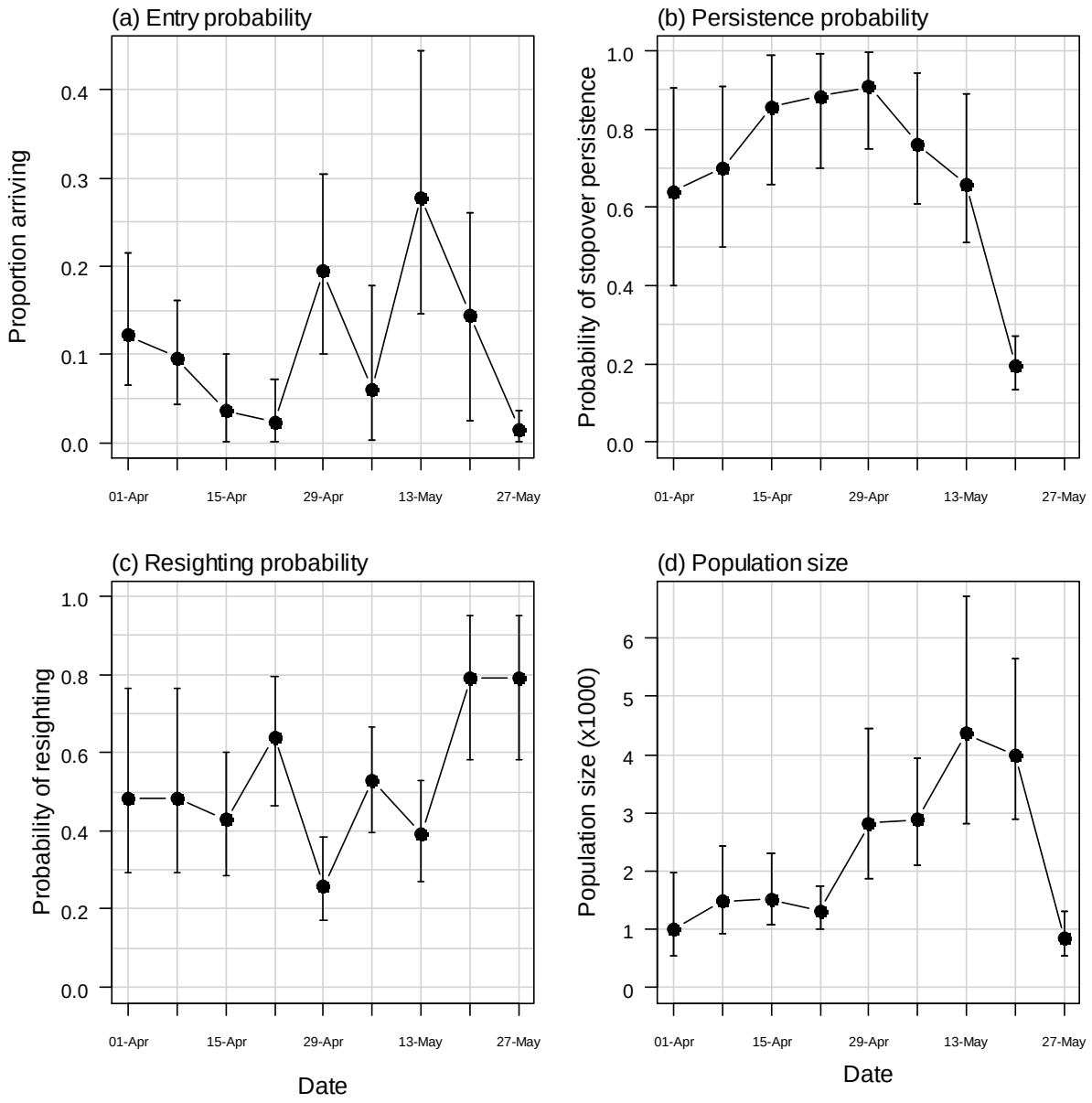

Figure 7. Stopover population dynamics and population size estimates of Red Knots on the Georgia Coast during April – May 2015. Parameter estimates are from a fully time-dependent Jolly-Seber model (b[t]phi[t]p[t]). Mark-resight data were aggregated into weekly sampling occasions; x-axis label is the mid-point of each week. Filled circles and error bars show estimated parameters and 95% credible intervals.

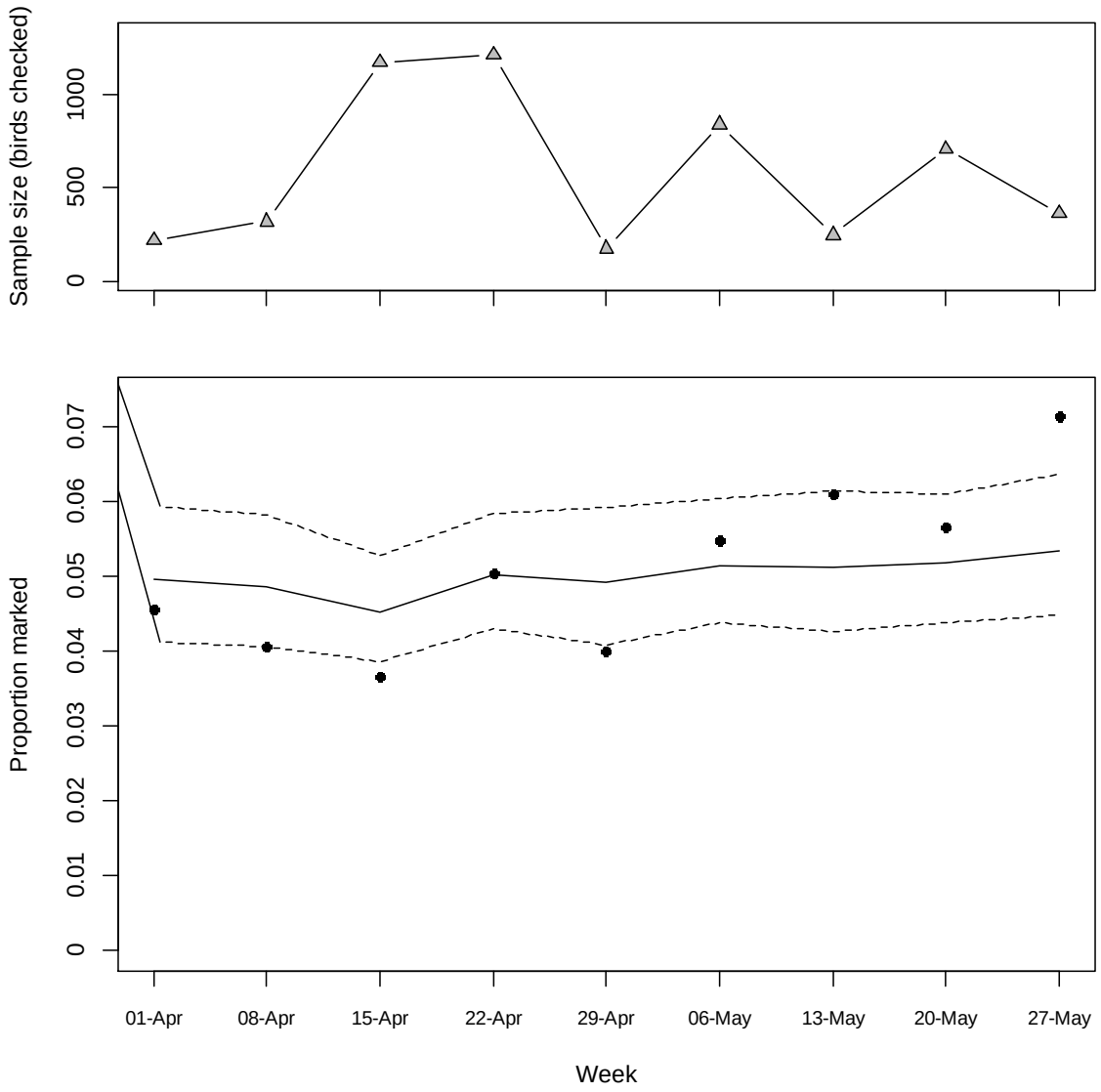

Figure 8. Fraction of the population with marks over time during April – May 2015 at the Georgia Coast. Fitted values (solid line) and 95% credible interval (dashed line) are from a generalized linear mixed model (GLMM) with a random effect for each week of the study. Filled circles are the fitted values from a GLM, i.e., the MLEs (#marked/#checked).

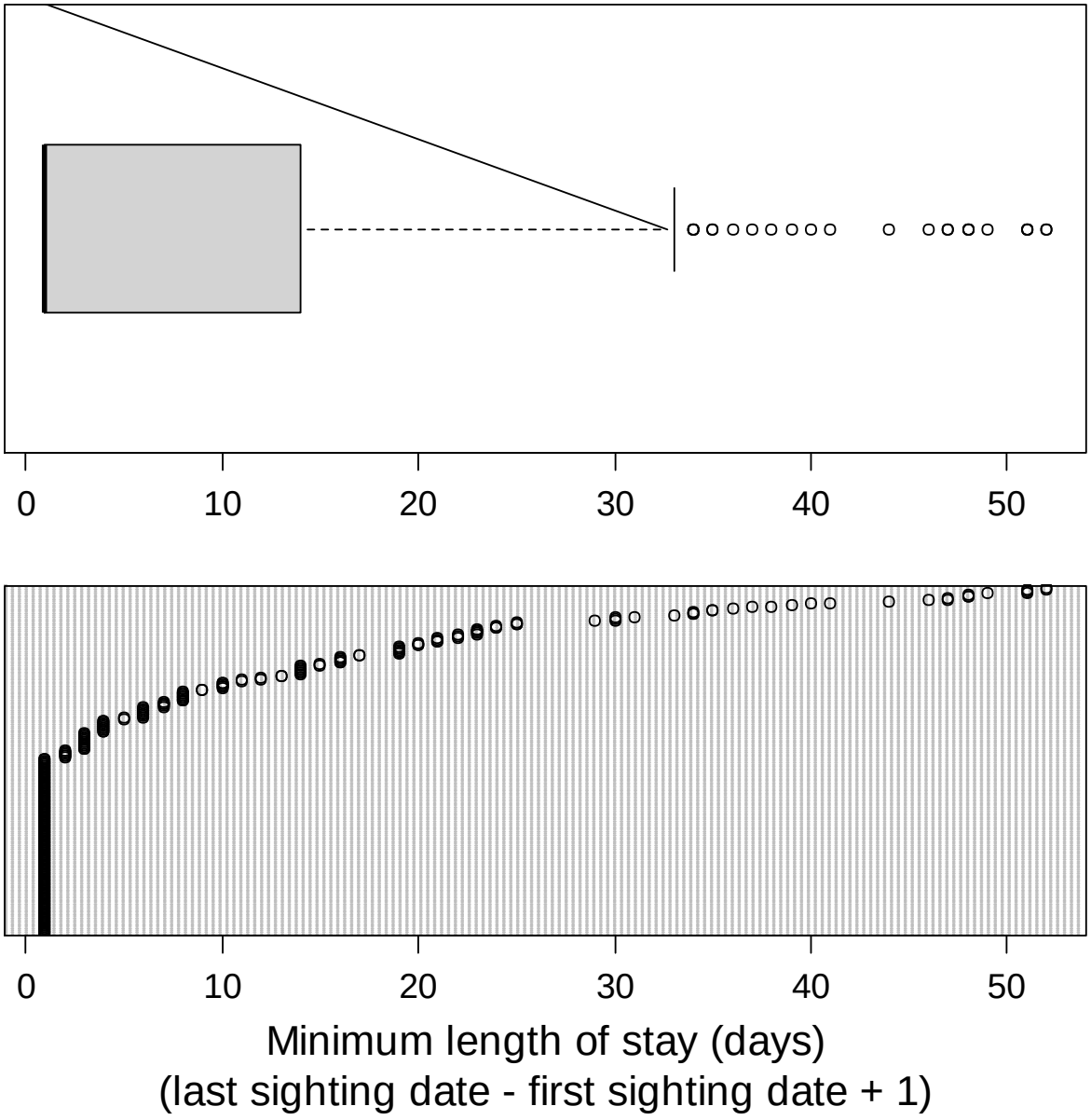

Figure 9. Minimum-length-of-stay of Red Knots on the Georgia Coast during April – May 2015. Minimum-length-of-stay is the interval between first and last sighting of an individual marked bird. Model does not account for time before first, or after last, sighting.

Spring 2013 Mark-recapture Model Results

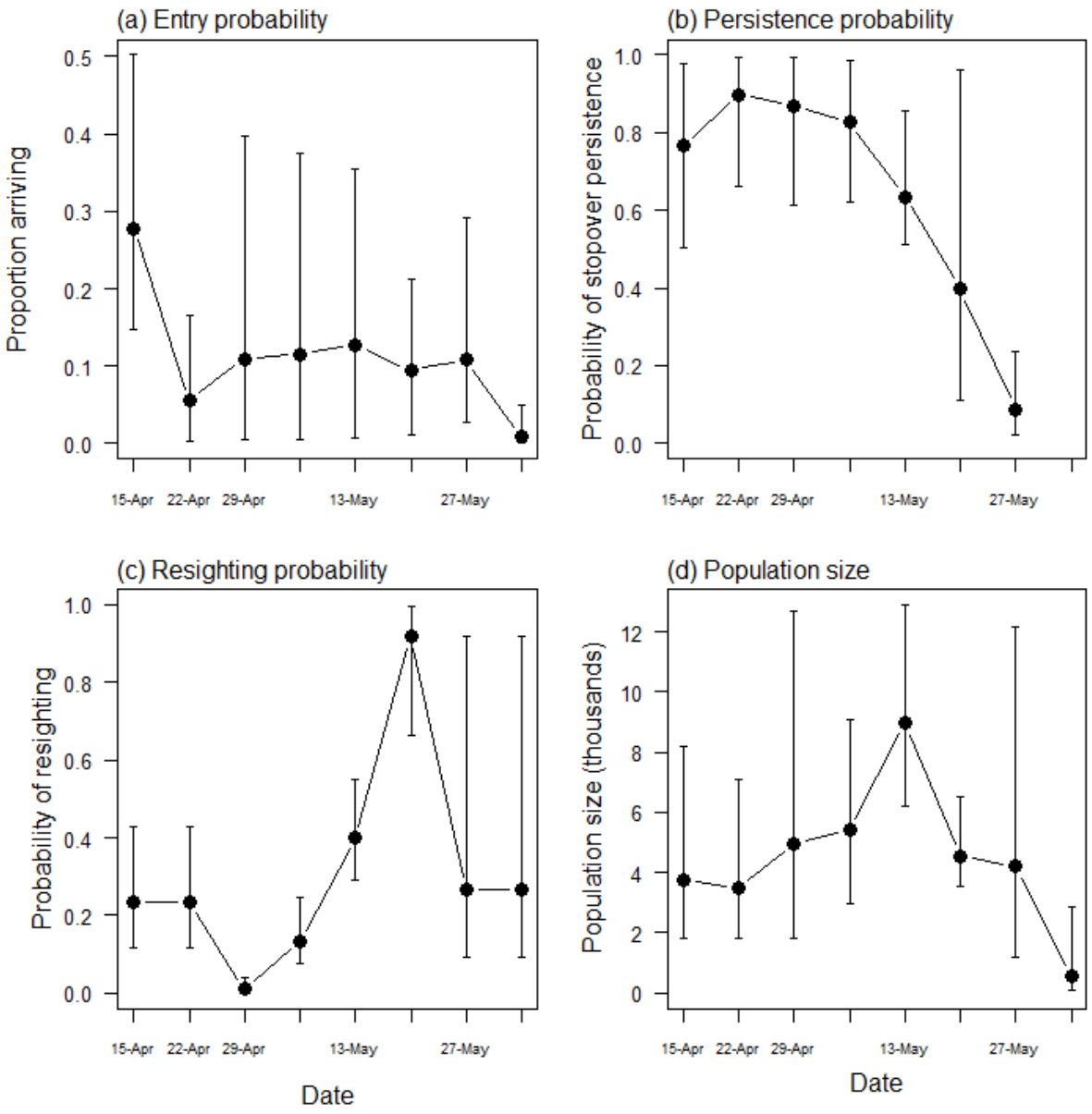

Figure 10. Stopover population dynamics and population size estimates of Red Knots on the Georgia Coast during April – June 2013. Parameter estimates are from a fully time-dependent Jolly-Seber model (b[t]phi[t]p[t]). Mark-resight data (n = 274 individually marked birds) were aggregated into eight weekly sampling occasions. Filled circles and error bars show estimated parameters and 95% credible intervals.

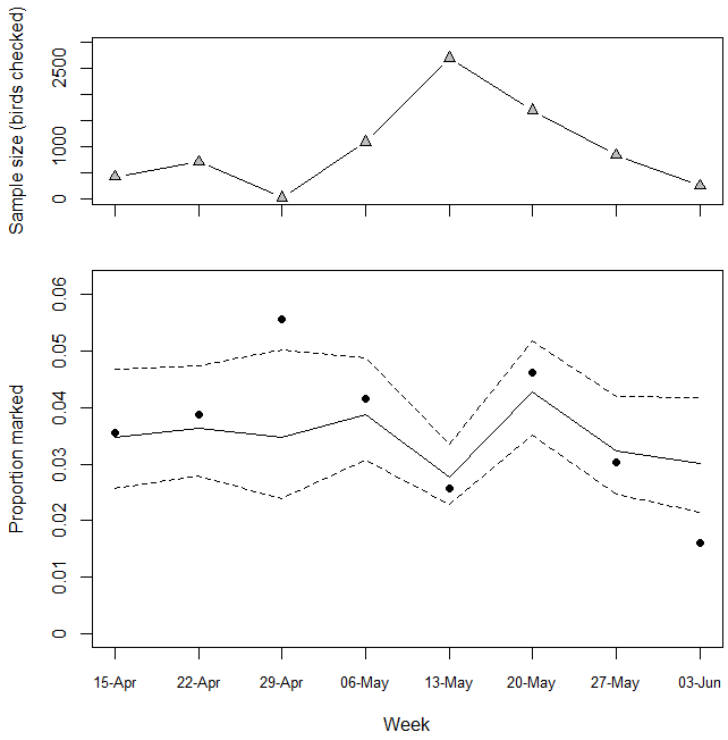

Figure 11. Fraction of the population with distinct markers (leg flags and color bands) during April – June 2013 at the Georgia Coast. Fitted values (solid line in bottom panel) and 95% credible interval (dashed line) are from a generalized linear mixed model (GLMM) with a random effect for each week of the study. Filled circles are # marked/# checked for marks. Average marked proportion was 0.034 (95% CI 0.024 – 0.045).

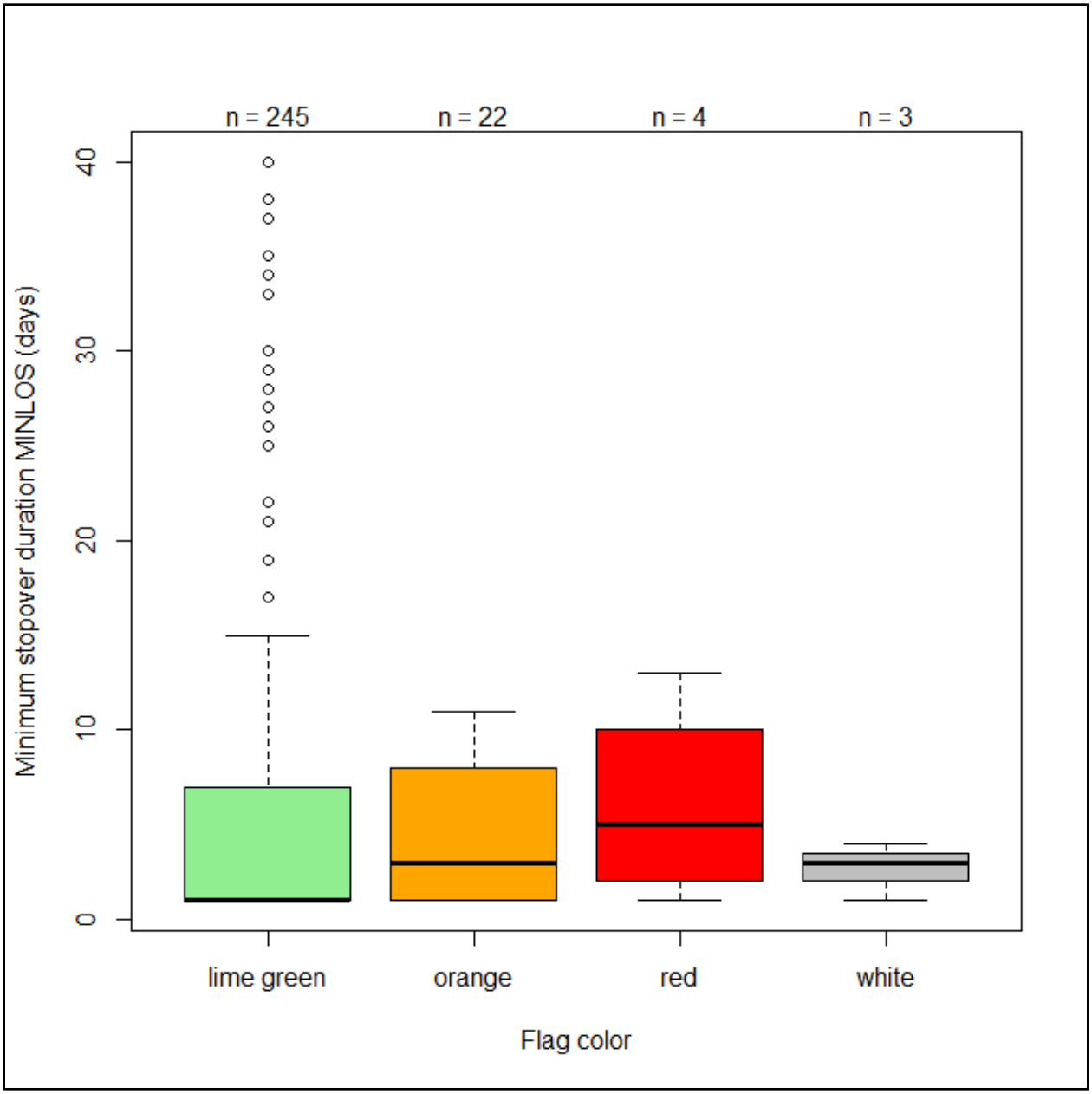

Figure 12. Minimum-length-of-stay by flag color during 2013 spring migration season (n = 274 birds). MINLOS is date of last sighting minus date of first sighting plus 1; it is not a model-based estimate. As an index of stopover duration, MINLOS is biased low because it does not account for time in study area before first, and after last, detection. Average and median MINLOS were 6.0 and 1 day(s), respectively. A model-based estimate of stopover duration (one that accounts for time before first, and after last, detection) was equal to 3.4 weeks (95% CI 2.7 – 4.2 weeks).

Spring 2016 Aerial Surveys

Two aerial surveys were conducted during the spring 2016 season. The first aerial survey was conducted on 5 May 2016 and a total of 4,657 Red Knots were detected along the Georgia Coast (Figure 13). The second survey was conducted on 19 May 2016 and 2,944 Red Knots were detected (Figure 14).

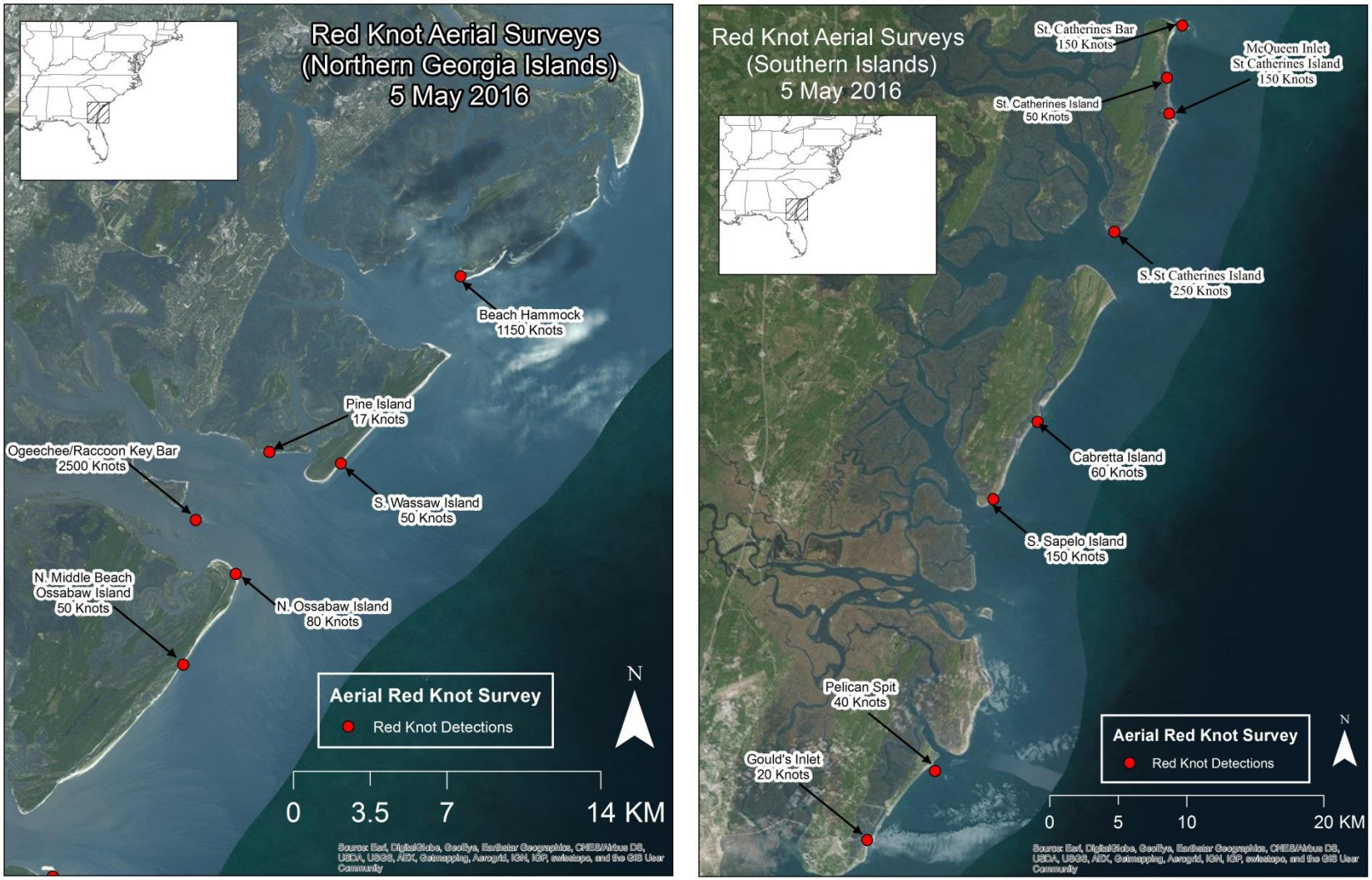

Figure 13. Results of 5 May 2016 aerial survey, Northern and Southern barrier islands.

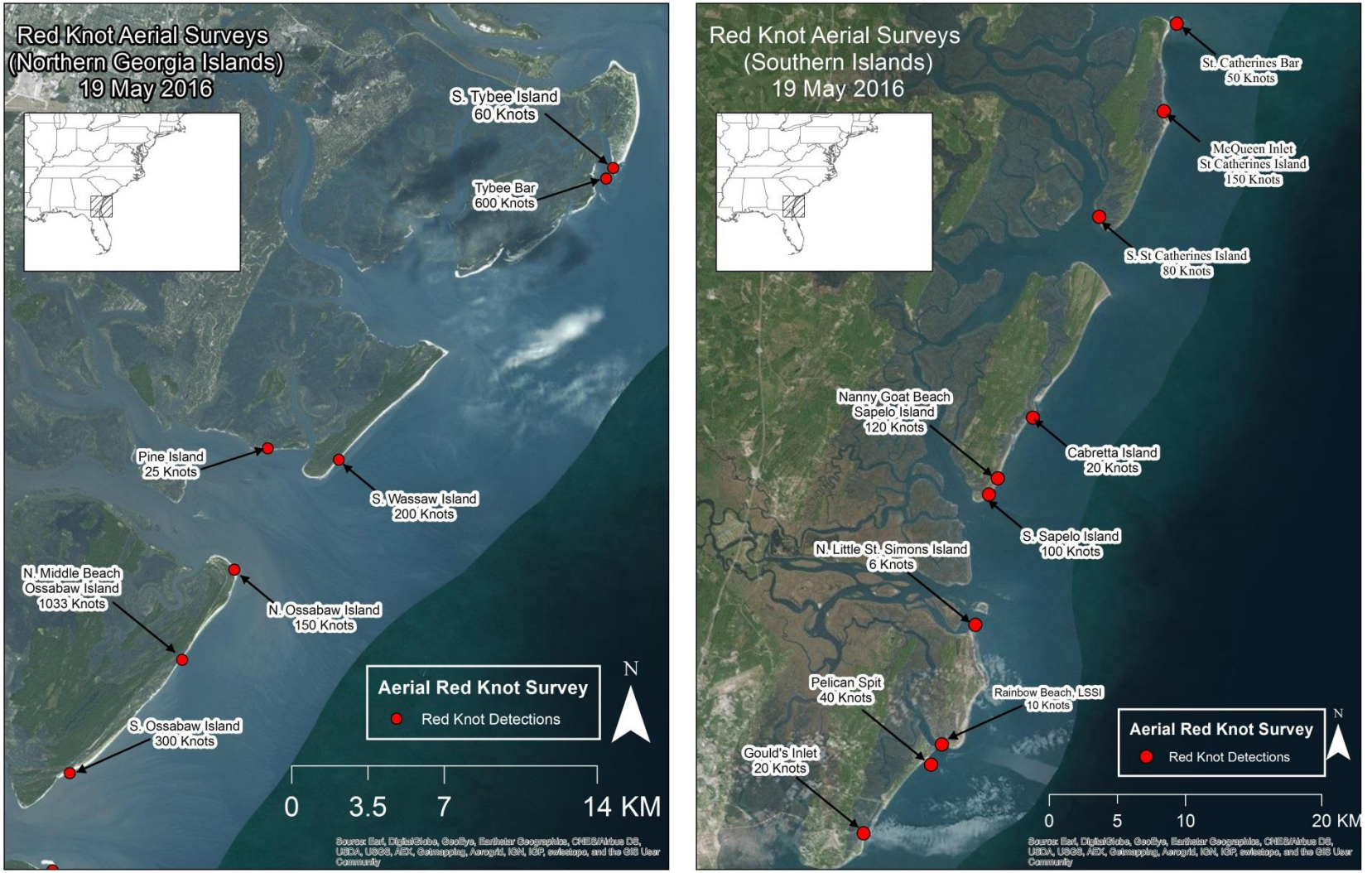

Figure 14. Results of 19 May 2016 aerial survey, Northern and Southern barrier islands.

Spring 2016 Ground Surveys

A total of 43,686 Red Knots were detected on daily surveys during the spring 2016 season (Figures 15-X). All surveys were conducted prior to initiation of resighting Red Knot flocks at each location.

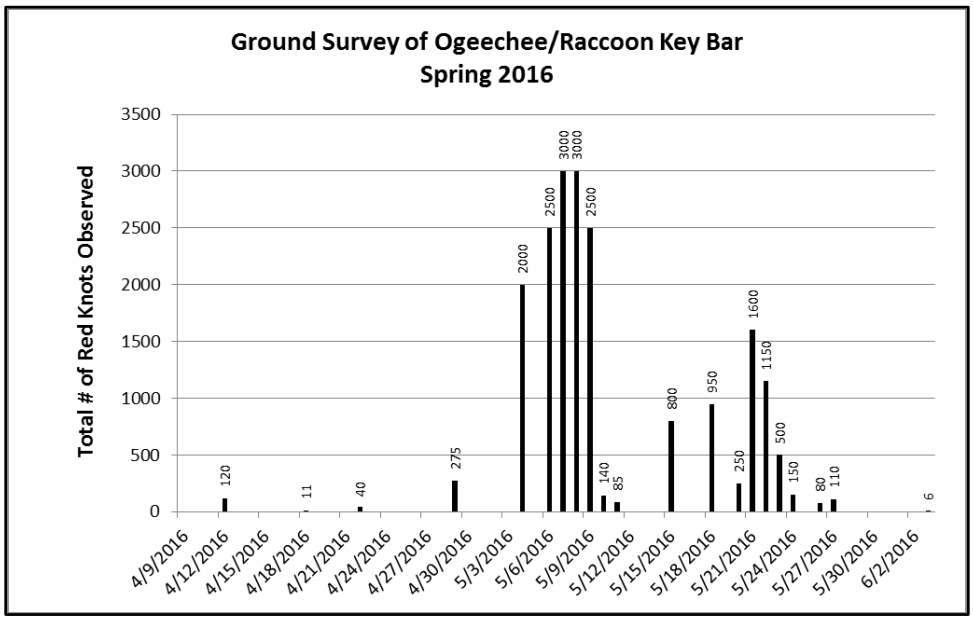

Figure 15. Spring 2016 Red Knot ground survey data of Ogeechee/Raccoon Key Bar.

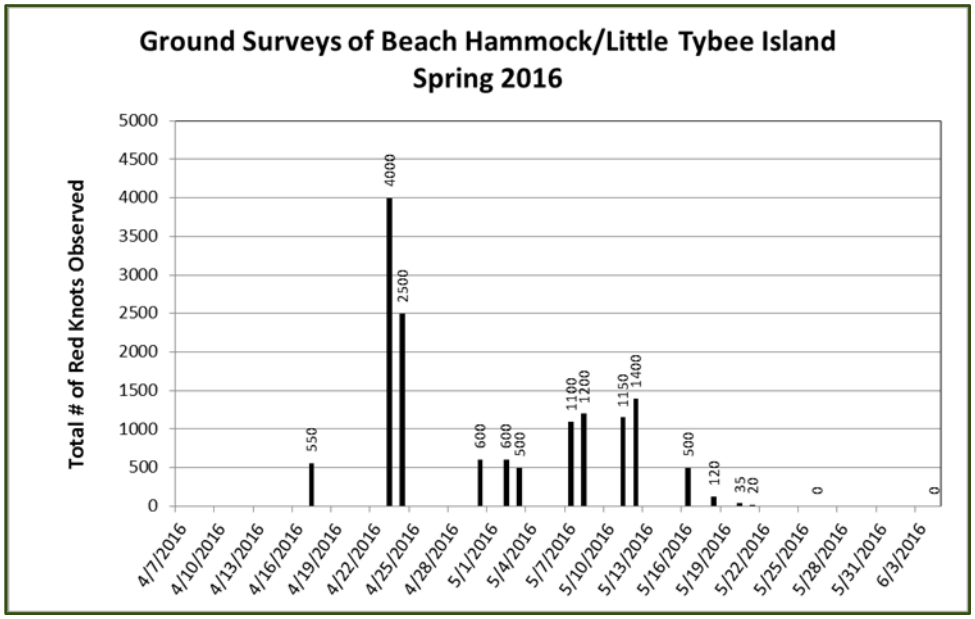

Figure 16. Spring 2016 Red Knot ground survey data of Little Tybee Island and Beach Hammock.

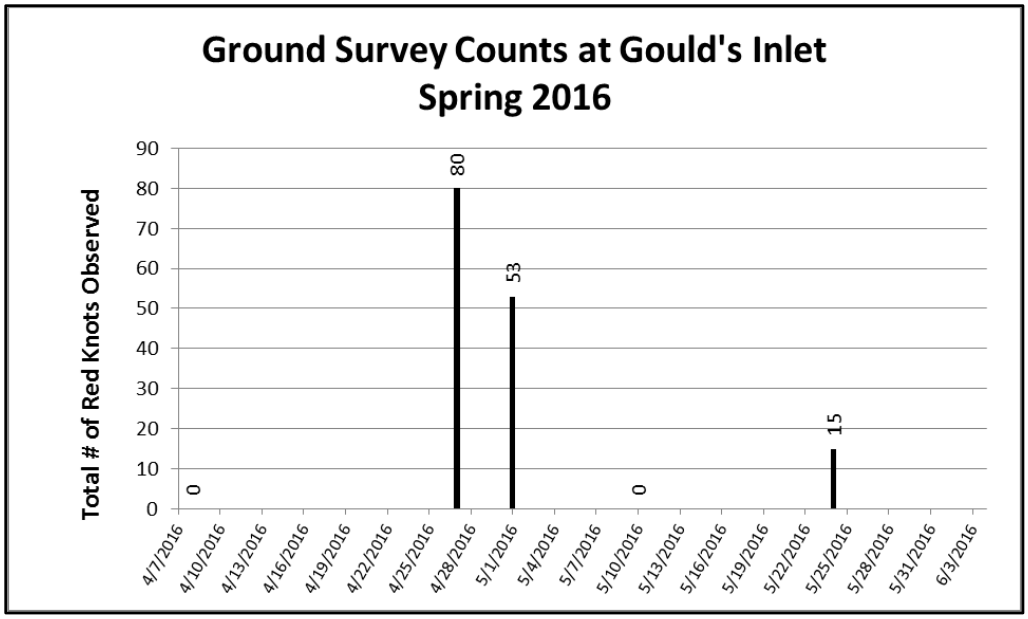

Figure 17. Spring 2016 Red Knot ground survey data of Gould's Inlet.

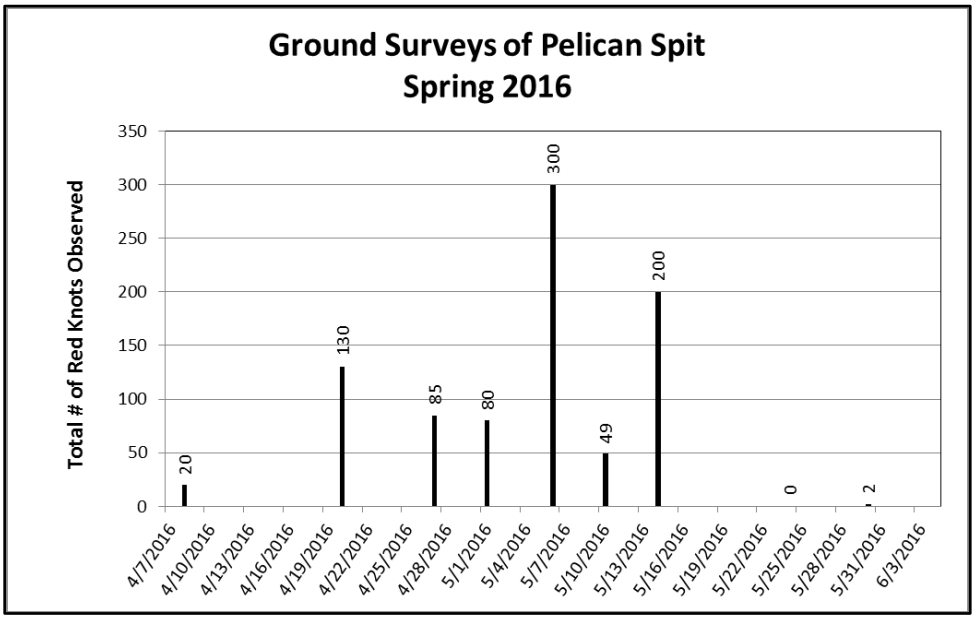

Figure 18. Spring 2016 Red Knot ground survey data of Pelican Spit.

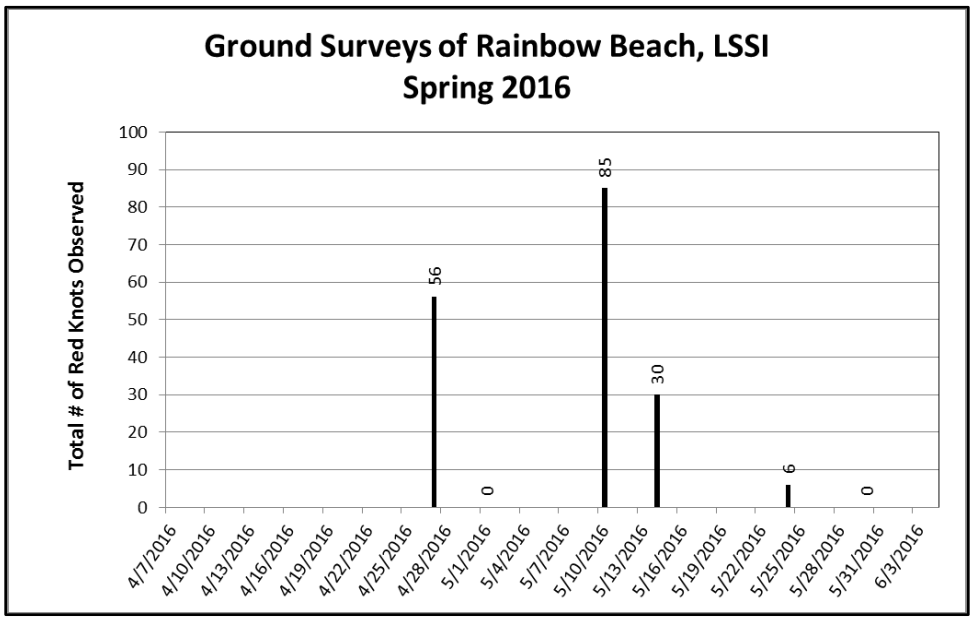

Figure 19. Spring 2016 Red Knot ground survey data of Rainbow Beach, Little St. Simons Island.

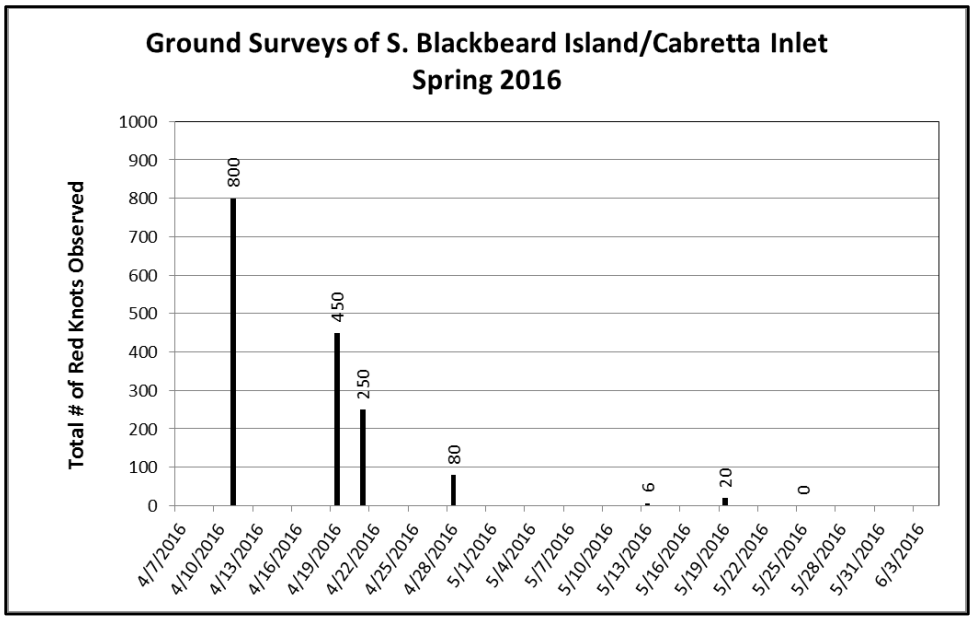

Figure 20. Spring 2016 Red Knot ground survey data of Blackbeard Island/Cabretta Island complex and flats.

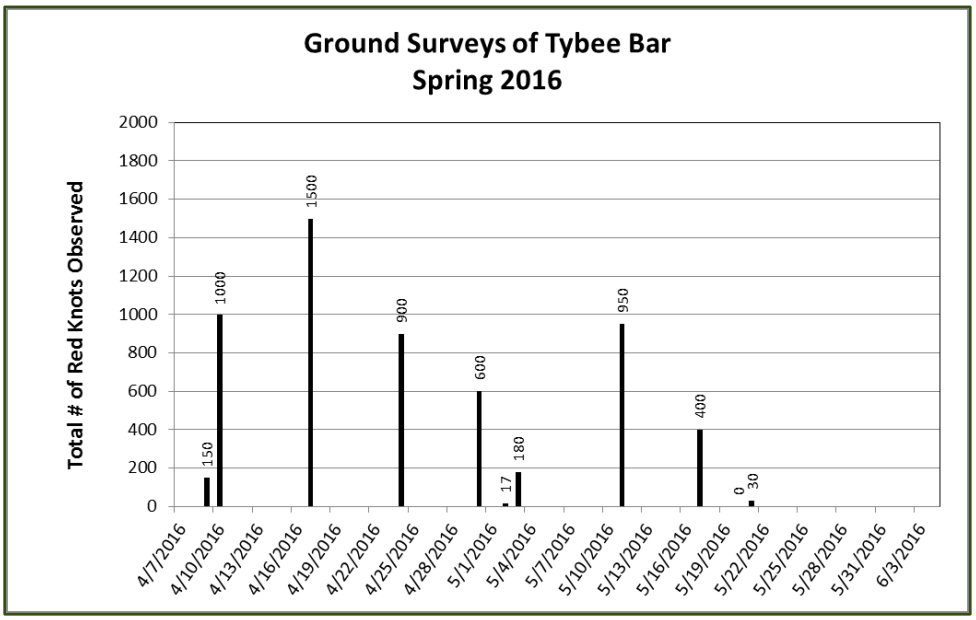

Figure 21. Spring 2016 Red Knot ground survey data from Tybee Bar and S. Tybee Island.

Ground Based and Aerial Red Knot Surveys Overview 2013-2016

All data from ground based and aerial surveys from spring 2013, spring 2015, fall 2015, and spring 2016 were compiled into a GIS database. Included in this database are the estimated number of Red Knots observed, island name, survey type (ground based or aerial), and coordinates associated with each entry. All survey information has been disseminated to resource managers through the Georgia Shorebird Alliance partnership.

Public Outreach Overview 2014-2017

Project partners have made a concerted effort to educate the public about Red Knot and shorebird conservation issues (linked stories below). The conservation implications of Red Knots and human interactions, dog interactions, wind turbine siting near high use shorebird areas, and general interest stories were presented to over 50,000 members of the general public.

http://savannahnow.com/news/2016-05-22/georgia-coast-critical-long-distance-fliers

http://shorebirdscience.org/chasing-the-tides-and-running-from-storms-the-quest-for-red-knots-in-georgia/

http://www.ccbbirds.org/2016/04/04/studying-the-red-knot-in-coastal-georgia/

http://www.ccbbirds.org/2015/07/01/ccb-completes-successful-season-of-red-knot-resighting-in-georgia/

http://gpbnews.org/post/19000-mile-journey-red-knot

http://www.ccbbirds.org/2017/03/28/people-and-shorebirds-flock-to-beaches/

http://savannahnow.com/news-latest-news/2014-12-09/red-knot-ga-visitor-gains-endangered-species-act-protection

http://www.georgiawildlife.com/node/4120

http://www.myajc.com/news/state--regional/birds-need-the-beach-too/Xj54W8YvHUBFLMYaLJAXAN/

http://www.washingtontimes.com/news/2016/apr/16/biologists-warn-that-dogs-birds-dont-mix-on-georgi/

http://archive.northjersey.com/news/world/ga-island-considers-birds-fate-if-turbine-built-1.665835?page=all

http://www.windaction.org/posts/39496-on-tybee-the-question-is-blowin-in-the-wind#.WN3MXWd5EZI

Volunteer Training

Solicitations for Red Knot resighting volunteer opportunities and training events were held in Georgia in fall 2011, spring 2013, spring and fall 2015 and spring 2016. Fletcher Smith, Jim Lyons and Tim Keyes trained approximately 90 individuals during the 2015 and 2016 seasons, and 12 volunteers contributed 422 hours of resighting during that time period. This accounting of volunteer effort does not take into account travel costs and vacation days used to assist the project. Various federal, state, and private professionals contributed over 30 Red Knot surveys while working on projects along the barrier islands of Georgia.

DISCUSSION and PROJECT OUTCOMES

The Georgia Coast is a major stopover area for *rufa* Red Knots in spring migration. The superpopulation utilizing the coast in fall migration can exceed 23,000 birds (Lyons et al. 2017 *in press*) and the estimates of spring migration superpopulation from this study ranges between 8,000 and 14,000 birds. The total estimated population of *rufa* Red Knots is 42,000 birds (Andres et al. 2012), suggesting that a high percentage of *rufa* knots are using the Georgia Coast in spring and in some years fall migration. There appears to be less variation in spring migration superpopulations between years than in fall migration, suggesting a more stable (but less abundant) food source for spring migrants.

The numbers of Red Knots utilizing the barrier islands in spring and fall along the Georgia Coast varies year to year based on changes in abundance and distribution of the bivalves *Mulinia lateralis* and *Donax variablis.* During periods when the bivalve prey base cycles upwards, many thousands of Red Knots will use Georgia for migration stopover and in certain years for wintering (Harrington et al. 2007, Niles et al. 2010b, Lyons et al. 2017 *in press*). During years of low bivalve abundance, very few Red Knots will stop in Georgia in fall migration, explaining the low numbers of knots and resights during the fall 2015 season. This prey sampling behavior is similar to other stopover sites across the Northern Hemisphere (Alerstam et al. 1992, Truitt et al. 2001). The spring and fall stopover locations and wintering sites in Georgia play a critical role in the long-term persistence

of the declining Red Knot population. To that end, the conservation community needs to better understand the reasons for the boom and bust cycling of the bivalve populations along the coast.

Horseshoe crab spawning events were highly variable between years spatially and temporally. The horseshoe crab spawning events of spring 2015 and 2016 were longer in duration and more substantial than the spring 2013 event. High numbers of horseshoe crabs were observed spawning at Pelican Spit, Ogeechee Bar, Beach Hammock, Tybee Bar, and later at Little Egg Island and Little Egg Bar in 2015 and at Tybee Bar, Beach Hammock, Ogeechee Bar, Little St. Simons Island, St. Catherines Island, and St. Catherines Bar in 2016. Small numbers of horseshoe crab were observed spawning on Pelican Spit in 2016, contrasting with the large spawning event of 2015. The large horseshoe crab spawning event at Cabretta Island and S. Blackbeard detected in 2013 was not repeated in 2015 or 2016. High counts of Red Knots (and thousands of other shorebirds) were observed at all of the major horseshoe crab spawning sites in 2015 and 2016. There is likely an underlying pattern to the distribution of horseshoe crab spawning events along the Georgia Coast that is not yet known. The importance of crab eggs to the survival of Red Knots in the Delaware Bay is well documented (Atkinson et al. 2003, Baker et al. 2004, Karpanty et al. 2006, Gillings et al. 2007, Niles et al. 2009, McGowan et al. 2011), and further studies should be undertaken to monitor the cycles of horseshoe crab spawning and egg abundance along the Georgia Coast. Predation of gravid female horseshoe crab by feral hogs was observed in several locations along the island chain, and efforts to reduce the predation of crabs should be a high priority for resource managers.

The numbers of Red Knots utilizing the Georgia Coast in spring migration are split between two populations. The "Southeastern" population winters along the South Atlantic Coast into the Brazil, and Texas Coast, and the long distance migrants winter predominately in southern South America. The strategies the two populations use to survive are quite different, though there appears to be much habitat use overlap in Georgia in spring. We documented 13 (3.9%, N=330 total individuals resighted) known provenance long-distance migrants (i.e. Flag Orange signifying "banded in Argentina" or Flag Red "Chile") during the spring 2016 season, 49 (16%, N=302 total individuals resighted) during spring 2015, and 22 (8%, N=274 total individuals resighted) during spring 2013. Georgia is well documented as an important as a stopover and wintering location for the "southeastern" population (Harrington et al. 2007, Lyons et al. 2017 *in press*), but data collected during this project suggests that Georgia contains more long-distance spring migrants than previously thought. The use of geolocators on the species has shown the importance of stopover sites in the South Atlantic and has shown that the "Southeastern" wintering Red Knots are of the subspecies *rufa*, not *roselaari* as was previously thought (Buehler and Baker 2005, Niles et al. 2012, Newstead et al. 2013).

One of the most important conservation issues along the Atlantic Coast flyway is the impact of human disturbance on migrating shorebirds (Winn et al. 2013, Watts 2017 *in press*). The focus of regulatory agencies along the Georgia Coast has typically been on protection of resident nesting shorebirds. Three of the most critical spring shorebird stopover sites (Tybee Bar, Beach Hammock, and Ogeechee Bar) were completely overrun by humans and dogs during multiple weekends of 2013, 2015, and 2016 (CCB unpublished data). The

horseshoe crab spawning events typically take place on sub-tidal sandy flats, and those same sand flats have long been used by recreational boaters along the Georgia Coast. A directed outreach campaign to inform boaters of the overlap of people and critical foraging habitat is a necessary step moving forward to reduce occurrences of human disturbance at the most critical sites. Continued monitoring of this issue moving forward should be a focus of biologists and land managers protecting these resources.

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APPENDICES

APPENDIX I. TABLE WITH ALL INDIVIDUALLY TAGGED RED KNOTS ENCOUNTERED BETWEEN 2013 AND 2016 IN COASTAL GEORGIA, SHOWING RESIGHT YEAR, SEASON, FLAG COLOR AND CODE, CUMULATIVE RESIGHTS PER SEASON, AND CAPTURE ORIGIN.

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Dark Green-072	3	USA
2016	Spring	Dark Green-A5U	1	USA
2016	Spring	Dark Green-ACT	1	USA
2016	Spring	Dark Green-AHV	2	USA
2016	Spring	Dark Green-AMV	1	USA
2016	Spring	Dark Green-CUP	1	USA
2016	Spring	Dark Green-CUY	3	USA
2016	Spring	Dark Green-CVP	1	USA
2016	Spring	Dark Green-EAJ	1	USA
2016	Spring	Dark Green-ECA	5	USA
2016	Spring	Dark Green-ELA	3	USA
2016	Spring	Dark Green-ETJ	4	USA
2016	Spring	Dark Green-ETX	1	USA
2016	Spring	Dark Green-EUY	1	USA
2016	Spring	Dark Green-HNE	2	USA
2016	Spring	Dark Green-HU1	1	USA
2016	Spring	Dark Green-HUJ	1	USA
2016	Spring	Dark Green-HUK	1	USA
2016	Spring	Dark Green-JMA	1	USA
2016	Spring	Lime Green-010	6	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-01P	2	USA
2016	Spring	Lime Green-025	2	USA
2016	Spring	Lime Green-034	11	USA
2016	Spring	Lime Green-036	1	USA
2016	Spring	Lime Green-048	1	USA
2016	Spring	Lime Green-071	3	USA
2016	Spring	Lime Green-07V	13	USA
2016	Spring	Lime Green-098	2	USA
2016	Spring	Lime Green-0C6	8	USA
2016	Spring	Lime Green-0C8	2	USA
2016	Spring	Lime Green-0H2	9	USA
2016	Spring	Lime Green-0H6	10	USA
2016	Spring	Lime Green-0K6	15	USA
2016	Spring	Lime Green-0N9	1	USA
2016	Spring	Lime Green-100	2	USA
2016	Spring	Lime Green-103	1	USA
2016	Spring	Lime Green-105	1	USA
2016	Spring	Lime Green-118	1	USA
2016	Spring	Lime Green-127	5	USA
2016	Spring	Lime Green-128	8	USA
2016	Spring	Lime Green-134	6	USA
2016	Spring	Lime Green-140	5	USA
2016	Spring	Lime Green-148	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-151	1	USA
2016	Spring	Lime Green-153	2	USA
2016	Spring	Lime Green-158	1	USA
2016	Spring	Lime Green-165	1	USA
2016	Spring	Lime Green-168	1	USA
2016	Spring	Lime Green-1A9	2	USA
2016	Spring	Lime Green-1E8	12	USA
2016	Spring	Lime Green-1E9	5	USA
2016	Spring	Lime Green-1H2	8	USA
2016	Spring	Lime Green-1H4	7	USA
2016	Spring	Lime Green-1KV	2	USA
2016	Spring	Lime Green-1M9	11	USA
2016	Spring	Lime Green-1M9	2	USA
2016	Spring	Lime Green-1MH	2	USA
2016	Spring	Lime Green-1MU	3	USA
2016	Spring	Lime Green-1MU	2	USA
2016	Spring	Lime Green-1MV	11	USA
2016	Spring	Lime Green-1NK	1	USA
2016	Spring	Lime Green-1XX	3	USA
2016	Spring	Lime Green-1Y6	1	USA
2016	Spring	Lime Green-1YV	5	USA
2016	Spring	Lime Green-222	1	USA
2016	Spring	Lime Green-223	5	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-242	4	USA
2016	Spring	Lime Green-25P	5	USA
2016	Spring	Lime Green-271	7	USA
2016	Spring	Lime Green-273	1	USA
2016	Spring	Lime Green-289	9	USA
2016	Spring	Lime Green-289	2	USA
2016	Spring	Lime Green-2E0	10	USA
2016	Spring	Lime Green-2E6	1	USA
2016	Spring	Lime Green-2JA	1	USA
2016	Spring	Lime Green-2JL	1	USA
2016	Spring	Lime Green-2YJ	2	USA
2016	Spring	Lime Green-301	6	USA
2016	Spring	Lime Green-315	4	USA
2016	Spring	Lime Green-332	8	USA
2016	Spring	Lime Green-344	1	USA
2016	Spring	Lime Green-354	8	USA
2016	Spring	Lime Green-356	1	USA
2016	Spring	Lime Green-36P	2	USA
2016	Spring	Lime Green-3C4	2	USA
2016	Spring	Lime Green-3E1	2	USA
2016	Spring	Lime Green-3E4	1	USA
2016	Spring	Lime Green-3ET	1	USA
2016	Spring	Lime Green-3H1	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-3H3	8	USA
2016	Spring	Lime Green-3ML	12	USA
2016	Spring	Lime Green-3MU	2	USA
2016	Spring	Lime Green-3NC	3	USA
2016	Spring	Lime Green-47T	5	USA
2016	Spring	Lime Green-4H1	2	USA
2016	Spring	Lime Green-4MN	2	USA
2016	Spring	Lime Green-500	2	USA
2016	Spring	Lime Green-501	1	USA
2016	Spring	Lime Green-503	6	USA
2016	Spring	Lime Green-504	1	USA
2016	Spring	Lime Green-508	5	USA
2016	Spring	Lime Green-50T	16	USA
2016	Spring	Lime Green-510	9	USA
2016	Spring	Lime Green-511	4	USA
2016	Spring	Lime Green-513	4	USA
2016	Spring	Lime Green-515	3	USA
2016	Spring	Lime Green-518	15	USA
2016	Spring	Lime Green-523	5	USA
2016	Spring	Lime Green-530	8	USA
2016	Spring	Lime Green-531	2	USA
2016	Spring	Lime Green-533	20	USA
2016	Spring	Lime Green-536	7	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-538	11	USA
2016	Spring	Lime Green-53J	1	USA
2016	Spring	Lime Green-540	1	USA
2016	Spring	Lime Green-541	7	USA
2016	Spring	Lime Green-545	8	USA
2016	Spring	Lime Green-556	4	USA
2016	Spring	Lime Green-567	1	USA
2016	Spring	Lime Green-569	1	USA
2016	Spring	Lime Green-575	8	USA
2016	Spring	Lime Green-57P	1	USA
2016	Spring	Lime Green-585	1	USA
2016	Spring	Lime Green-591	5	USA
2016	Spring	Lime Green-59T	10	USA
2016	Spring	Lime Green-59T	1	USA
2016	Spring	Lime Green-5C8	4	USA
2016	Spring	Lime Green-5E4	2	USA
2016	Spring	Lime Green-5E5	3	USA
2016	Spring	Lime Green-5EJ	1	USA
2016	Spring	Lime Green-5L6	3	USA
2016	Spring	Lime Green-5LY	2	USA
2016	Spring	Lime Green-620	1	USA
2016	Spring	Lime Green-62U	1	USA
2016	Spring	Lime Green-636	18	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-638	3	USA
2016	Spring	Lime Green-641	7	USA
2016	Spring	Lime Green-644	14	USA
2016	Spring	Lime Green-645	6	USA
2016	Spring	Lime Green-646	6	USA
2016	Spring	Lime Green-647	3	USA
2016	Spring	Lime Green-65T	2	USA
2016	Spring	Lime Green-67A	5	USA
2016	Spring	Lime Green-683	5	USA
2016	Spring	Lime Green-684	6	USA
2016	Spring	Lime Green-684	1	USA
2016	Spring	Lime Green-686	6	USA
2016	Spring	Lime Green-687	9	USA
2016	Spring	Lime Green-693	3	USA
2016	Spring	Lime Green-697	1	USA
2016	Spring	Lime Green-699	2	USA
2016	Spring	Lime Green-69T	1	USA
2016	Spring	Lime Green-6C5	12	USA
2016	Spring	Lime Green-6C7	17	USA
2016	Spring	Lime Green-6C9	8	USA
2016	Spring	Lime Green-6E2	1	USA
2016	Spring	Lime Green-6HH	1	USA
2016	Spring	Lime Green-6YL	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-737	1	USA
2016	Spring	Lime Green-76X	3	USA
2016	Spring	Lime Green-78X	3	USA
2016	Spring	Lime Green-79X	11	USA
2016	Spring	Lime Green-7C3	2	USA
2016	Spring	Lime Green-7C5	8	USA
2016	Spring	Lime Green-7C9	4	USA
2016	Spring	Lime Green-7CL	1	USA
2016	Spring	Lime Green-7CV	2	USA
2016	Spring	Lime Green-7ET	1	USA
2016	Spring	Lime Green-7K9	1	USA
2016	Spring	Lime Green-847	5	USA
2016	Spring	Lime Green-84X	6	USA
2016	Spring	Lime Green-8C2	4	USA
2016	Spring	Lime Green-8C5	8	USA
2016	Spring	Lime Green-8C7	1	USA
2016	Spring	Lime Green-8C9	5	USA
2016	Spring	Lime Green-8ML	1	USA
2016	Spring	Lime Green-8P2	2	USA
2016	Spring	Lime Green-8P9	12	USA
2016	Spring	Lime Green-8P9	1	USA
2016	Spring	Lime Green-91:G	1	USA
2016	Spring	Lime Green-915	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-95A	7	USA
2016	Spring	Lime Green-96N	10	USA
2016	Spring	Lime Green-96T	3	USA
2016	Spring	Lime Green-96X	1	USA
2016	Spring	Lime Green-99C	1	USA
2016	Spring	Lime Green-9C3	7	USA
2016	Spring	Lime Green-9C7	4	USA
2016	Spring	Lime Green-9C9	6	USA
2016	Spring	Lime Green-9CE	3	USA
2016	Spring	Lime Green-9CL	13	USA
2016	Spring	Lime Green-9JL	2	USA
2016	Spring	Lime Green-9JM	1	USA
2016	Spring	Lime Green-9JN	6	USA
2016	Spring	Lime Green-9JT	3	USA
2016	Spring	Lime Green-9U2	2	USA
2016	Spring	Lime Green-A03	3	USA
2016	Spring	Lime Green-A23	3	USA
2016	Spring	Lime Green-A75	5	USA
2016	Spring	Lime Green-AE3	2	USA
2016	Spring	Lime Green-AE8	1	USA
2016	Spring	Lime Green-AHV	1	USA
2016	Spring	Lime Green-AJ6	1	USA
2016	Spring	Lime Green-AP3	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-AT5	1	USA
2016	Spring	Lime Green-AV4	3	USA
2016	Spring	Lime Green-AX3	3	USA
2016	Spring	Lime Green-AX8	5	USA
2016	Spring	Lime Green-AY8	1	USA
2016	Spring	Lime Green-C4Y	5	USA
2016	Spring	Lime Green-C67	1	USA
2016	Spring	Lime Green-C8C	1	USA
2016	Spring	Lime Green-CJ6	2	USA
2016	Spring	Lime Green-CL6	2	USA
2016	Spring	Lime Green-E18	7	USA
2016	Spring	Lime Green-E3A	2	USA
2016	Spring	Lime Green-E5K	1	USA
2016	Spring	Lime Green-E60	1	USA
2016	Spring	Lime Green-E6A	1	USA
2016	Spring	Lime Green-E6M	2	USA
2016	Spring	Lime Green-E7A	3	USA
2016	Spring	Lime Green-E7C	1	USA
2016	Spring	Lime Green-E7L	6	USA
2016	Spring	Lime Green-E7N	1	USA
2016	Spring	Lime Green-EAJ	1	USA
2016	Spring	Lime Green-EJA	1	USA
2016	Spring	Lime Green-ET3	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-H10	2	USA
2016	Spring	Lime Green-H1A	2	USA
2016	Spring	Lime Green-H1C	1	USA
2016	Spring	Lime Green-H20	7	USA
2016	Spring	Lime Green-H2C	2	USA
2016	Spring	Lime Green-H2V	3	USA
2016	Spring	Lime Green-H2Y	1	USA
2016	Spring	Lime Green-H36	10	USA
2016	Spring	Lime Green-H36	1	USA
2016	Spring	Lime Green-H87	1	USA
2016	Spring	Lime Green-HJ6	2	USA
2016	Spring	Lime Green-HT6	1	USA
2016	Spring	Lime Green-HU4	1	USA
2016	Spring	Lime Green-HU5	1	USA
2016	Spring	Lime Green-HUJ	2	USA
2016	Spring	Lime Green-J58	3	USA
2016	Spring	Lime Green-JAE	1	USA
2016	Spring	Lime Green-JE6	2	USA
2016	Spring	Lime Green-JJ6	1	USA
2016	Spring	Lime Green-JT3	9	USA
2016	Spring	Lime Green-JT6	4	USA
2016	Spring	Lime Green-KKV	1	USA
2016	Spring	Lime Green-KM4	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-KP3	1	USA
2016	Spring	Lime Green-KT3	1	USA
2016	Spring	Lime Green-KV4	2	USA
2016	Spring	Lime Green-KX2	1	USA
2016	Spring	Lime Green-LE4	3	USA
2016	Spring	Lime Green-LU6	1	USA
2016	Spring	Lime Green-ME3	1	USA
2016	Spring	Lime Green-ML3	2	USA
2016	Spring	Lime Green-MMJ	1	USA
2016	Spring	Lime Green-MP9	6	USA
2016	Spring	Lime Green-MU7	2	USA
2016	Spring	Lime Green-N16	1	USA
2016	Spring	Lime Green-N20	2	USA
2016	Spring	Lime Green-NE6	5	USA
2016	Spring	Lime Green-NE6	1	USA
2016	Spring	Lime Green-NJ8	1	USA
2016	Spring	Lime Green-NL6	1	USA
2016	Spring	Lime Green-NT1	2	USA
2016	Spring	Lime Green-NT6	1	USA
2016	Spring	Lime Green-NU4	3	USA
2016	Spring	Lime Green-NV3	1	USA
2016	Spring	Lime Green-NV7	1	USA
2016	Spring	Lime Green-NX2	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-NX8	2	USA
2016	Spring	Lime Green-NYE	5	USA
2016	Spring	Lime Green-P0U	5	USA
2016	Spring	Lime Green-P6M	1	USA
2016	Spring	Lime Green-PE6	1	USA
2016	Spring	Lime Green-PM3	2	USA
2016	Spring	Lime Green-PN3	5	USA
2016	Spring	Lime Green-PU3	1	USA
2016	Spring	Lime Green-T0A	1	USA
2016	Spring	Lime Green-T1K	2	USA
2016	Spring	Lime Green-T2N	2	USA
2016	Spring	Lime Green-T59	2	USA
2016	Spring	Lime Green-TJ4	2	USA
2016	Spring	Lime Green-TN6	3	USA
2016	Spring	Lime Green-TNV	1	USA
2016	Spring	Lime Green-TTY	5	USA
2016	Spring	Lime Green-TU3	1	USA
2016	Spring	Lime Green-TVX	3	USA
2016	Spring	Lime Green-U57	3	USA
2016	Spring	Lime Green-U6M	1	USA
2016	Spring	Lime Green-U7L	1	USA
2016	Spring	Lime Green-UA7	17	USA
2016	Spring	Lime Green-UC3	10	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-UJ6	1	USA
2016	Spring	Lime Green-UU5	2	USA
2016	Spring	Lime Green-UXH	2	USA
2016	Spring	Lime Green-V2C	6	USA
2016	Spring	Lime Green-V71	1	USA
2016	Spring	Lime Green-V75	7	USA
2016	Spring	Lime Green-VK7	4	USA
2016	Spring	Lime Green-VL6	2	USA
2016	Spring	Lime Green-VNC	1	USA
2016	Spring	Lime Green-VP6	1	USA
2016	Spring	Lime Green-VTM	2	USA
2016	Spring	Lime Green-VVP	1	USA
2016	Spring	Lime Green-VXY	1	USA
2016	Spring	Lime Green-VYP	1	USA
2016	Spring	Lime Green-X16	1	USA
2016	Spring	Lime Green-X19	1	USA
2016	Spring	Lime Green-X1N	3	USA
2016	Spring	Lime Green-X1N	1	USA
2016	Spring	Lime Green-X2C	7	USA
2016	Spring	Lime Green-X3T	1	USA
2016	Spring	Lime Green-X3X	1	USA
2016	Spring	Lime Green-X4E	5	USA
2016	Spring	Lime Green-X5J	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Lime Green-X63	1	USA
2016	Spring	Lime Green-X6A	6	USA
2016	Spring	Lime Green-X6M	7	USA
2016	Spring	Lime Green-X6U	10	USA
2016	Spring	Lime Green-X81	1	USA
2016	Spring	Lime Green-X9V	2	USA
2016	Spring	Lime Green-XE4	3	USA
2016	Spring	Lime Green-XHH	1	USA
2016	Spring	Lime Green-XKN	1	USA
2016	Spring	Lime Green-XN3	5	USA
2016	Spring	Lime Green-XNC	1	USA
2016	Spring	Lime Green-XNK	1	USA
2016	Spring	Lime Green-XT2	1	USA
2016	Spring	Lime Green-XTN	1	USA
2016	Spring	Lime Green-XU4	1	USA
2016	Spring	Lime Green-XV4	2	USA
2016	Spring	Lime Green-XXM	3	USA
2016	Spring	Lime Green-YA8	1	USA
2016	Spring	Lime Green-YAE	2	USA
2016	Spring	Lime Green-YT9	4	USA
2016	Spring	Orange-AXH	3	Argentina
2016	Spring	Orange-CIJ	14	Argentina
2016	Spring	Orange-E7N	4	Argentina

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2016	Spring	Orange-EA1	4	Argentina
2016	Spring	Orange-JA1	4	Argentina
2016	Spring	Orange-JY1	4	Argentina
2016	Spring	Orange-P9Y	1	Argentina
2016	Spring	Orange-U3Y	11	Argentina
2016	Spring	Orange-U7V	1	Argentina
2016	Spring	Orange-UH1	5	Argentina
2016	Spring	Orange-VJ1	4	Argentina
2016	Spring	Orange-X7Y	3	Argentina
2016	Spring	Orange-ZW	4	Argentina
2016	Spring	Red-JK	3	Chile
2016	Spring	White-ECV	2	Canada
2016	Spring	White-HEH	2	Canada
2015	Fall	Dark Green-CTX	1	USA
2015	Fall	Lime Green-0C6	1	USA
2015	Fall	Lime Green-16E	5	USA
2015	Fall	Lime Green-1H4	1	USA
2015	Fall	Lime Green-2E0	1	USA
2015	Fall	Lime Green-2E9	1	USA
2015	Fall	Lime Green-346	1	USA
2015	Fall	Lime Green-3MT	3	USA
2015	Fall	Lime Green-505	5	USA
2015	Fall	Lime Green-506	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Fall	Lime Green-519	1	USA
2015	Fall	Lime Green-530	1	USA
2015	Fall	Lime Green-533	2	USA
2015	Fall	Lime Green-576	1	USA
2015	Fall	Lime Green-578	3	USA
2015	Fall	Lime Green-585	1	USA
2015	Fall	Lime Green-636	1	USA
2015	Fall	Lime Green-686	1	USA
2015	Fall	Lime Green-6C6	1	USA
2015	Fall	Lime Green-84X	5	USA
2015	Fall	Lime Green-8C5	1	USA
2015	Fall	Lime Green-8UA	1	USA
2015	Fall	Lime Green-915	2	USA
2015	Fall	Lime Green-96T	5	USA
2015	Fall	Lime Green-9C7	8	USA
2015	Fall	Lime Green-9C9	1	USA
2015	Fall	Lime Green-9PX	5	USA
2015	Fall	Lime Green-A13	1	USA
2015	Fall	Lime Green-A76	1	USA
2015	Fall	Lime Green-AL6	3	USA
2015	Fall	Lime Green-CE4	2	USA
2015	Fall	Lime Green-CM9	1	USA
2015	Fall	Lime Green-CX2	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Fall	Lime Green-E7J	1	USA
2015	Fall	Lime Green-E7Y	2	USA
2015	Fall	Lime Green-H87	1	USA
2015	Fall	Lime Green-HPC	2	USA
2015	Fall	Lime Green-HU5	3	USA
2015	Fall	Lime Green-LU2	1	USA
2015	Fall	Lime Green-M63	2	USA
2015	Fall	Lime Green-MPK	1	USA
2015	Fall	Lime Green-NC3	3	USA
2015	Fall	Lime Green-NJ8	4	USA
2015	Fall	Lime Green-NN6	1	USA
2015	Fall	Lime Green-P9N	1	USA
2015	Fall	Lime Green-TA7	1	USA
2015	Fall	Lime Green-TJ4	2	USA
2015	Fall	Lime Green-TMH	4	USA
2015	Fall	Lime Green-U5U	1	USA
2015	Fall	Lime Green-U7H	4	USA
2015	Fall	Lime Green-U7J	4	USA
2015	Fall	Lime Green-V5M	6	USA
2015	Fall	Lime Green-V5T	1	USA
2015	Fall	Lime Green-V75	1	USA
2015	Fall	Lime Green-VLC	1	USA
2015	Fall	Lime Green-VYP	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Fall	Lime Green-X0J	1	USA
2015	Fall	Lime Green-X3N	1	USA
2015	Fall	Lime Green-X4E	1	USA
2015	Fall	Lime Green-X94	1	USA
2015	Fall	Lime Green-XVE	5	USA
2015	Fall	Lime Green-XY8	2	USA
2015	Fall	Lime Green-Y10	1	USA
2015	Fall	Lime Green-Y19	1	USA
2015	Fall	Lime Green-YH7	1	USA
2015	Fall	Lime Green-YLV	4	USA
2015	Fall	Orange-E7N	1	Argentina
2015	Fall	Red-HNH	1	Chile
2015	Spring	Dark Green-017	7	USA
2015	Spring	Dark Green-026	2	USA
2015	Spring	Lime Green-007	5	USA
2015	Spring	Lime Green-01H	4	USA
2015	Spring	Lime Green-025	9	USA
2015	Spring	Lime Green-028	1	USA
2015	Spring	Lime Green-031	10	USA
2015	Spring	Lime Green-033	2	USA
2015	Spring	Lime Green-034	11	USA
2015	Spring	Lime Green-03J	1	USA
2015	Spring	Lime Green-03Y	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-067	1	USA
2015	Spring	Lime Green-06K	4	USA
2015	Spring	Lime Green-071	2	USA
2015	Spring	Lime Green-07V	3	USA
2015	Spring	Lime Green-098	4	USA
2015	Spring	Lime Green-0C4	4	USA
2015	Spring	Lime Green-0H2	3	USA
2015	Spring	Lime Green-0H6	3	USA
2015	Spring	Lime Green-0K6	3	USA
2015	Spring	Lime Green-112	2	USA
2015	Spring	Lime Green-151	1	USA
2015	Spring	Lime Green-155	4	USA
2015	Spring	Lime Green-162	4	USA
2015	Spring	Lime Green-165	3	USA
2015	Spring	Lime Green-166	1	USA
2015	Spring	Lime Green-16M	1	USA
2015	Spring	Lime Green-196	2	USA
2015	Spring	Lime Green-1A8	2	USA
2015	Spring	Lime Green-1E0	2	USA
2015	Spring	Lime Green-1H2	9	USA
2015	Spring	Lime Green-1H4	3	USA
2015	Spring	Lime Green-1H5	4	USA
2015	Spring	Lime Green-1HC	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-1MK	16	USA
2015	Spring	Lime Green-1MU	3	USA
2015	Spring	Lime Green-1MV	11	USA
2015	Spring	Lime Green-1MY	1	USA
2015	Spring	Lime Green-1U4	3	USA
2015	Spring	Lime Green-1V2	1	USA
2015	Spring	Lime Green-1VC	1	USA
2015	Spring	Lime Green-1XX	4	USA
2015	Spring	Lime Green-1YX	2	USA
2015	Spring	Lime Green-227	2	USA
2015	Spring	Lime Green-258	5	USA
2015	Spring	Lime Green-271	7	USA
2015	Spring	Lime Green-2A1	1	USA
2015	Spring	Lime Green-2C7	1	USA
2015	Spring	Lime Green-2KP	1	USA
2015	Spring	Lime Green-2YJ	6	USA
2015	Spring	Lime Green-301	5	USA
2015	Spring	Lime Green-311	10	USA
2015	Spring	Lime Green-313	1	USA
2015	Spring	Lime Green-315	3	USA
2015	Spring	Lime Green-332	2	USA
2015	Spring	Lime Green-346	4	USA
2015	Spring	Lime Green-352	15	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-354	6	USA
2015	Spring	Lime Green-3CJ	3	USA
2015	Spring	Lime Green-3E1	4	USA
2015	Spring	Lime Green-3H3	2	USA
2015	Spring	Lime Green-3ML	3	USA
2015	Spring	Lime Green-3MN	3	USA
2015	Spring	Lime Green-3MU	4	USA
2015	Spring	Lime Green-3MV	1	USA
2015	Spring	Lime Green-3N0	1	USA
2015	Spring	Lime Green-3NC	7	USA
2015	Spring	Lime Green-3NM	5	USA
2015	Spring	Lime Green-3NO	1	USA
2015	Spring	Lime Green-47T	2	USA
2015	Spring	Lime Green-4C2	3	USA
2015	Spring	Lime Green-4MN	1	USA
2015	Spring	Lime Green-4VY	4	USA
2015	Spring	Lime Green-503	3	USA
2015	Spring	Lime Green-508	5	USA
2015	Spring	Lime Green-510	5	USA
2015	Spring	Lime Green-513	2	USA
2015	Spring	Lime Green-518	2	USA
2015	Spring	Lime Green-519	3	USA
2015	Spring	Lime Green-533	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-541	5	USA
2015	Spring	Lime Green-545	4	USA
2015	Spring	Lime Green-546	4	USA
2015	Spring	Lime Green-548	4	USA
2015	Spring	Lime Green-556	4	USA
2015	Spring	Lime Green-56T	3	USA
2015	Spring	Lime Green-578	4	USA
2015	Spring	Lime Green-591	6	USA
2015	Spring	Lime Green-595	1	USA
2015	Spring	Lime Green-5C8	12	USA
2015	Spring	Lime Green-5E4	1	USA
2015	Spring	Lime Green-5EJ	10	USA
2015	Spring	Lime Green-5L6	2	USA
2015	Spring	Lime Green-5NC	1	USA
2015	Spring	Lime Green-631	1	USA
2015	Spring	Lime Green-636	2	USA
2015	Spring	Lime Green-646	2	USA
2015	Spring	Lime Green-684	2	USA
2015	Spring	Lime Green-686	4	USA
2015	Spring	Lime Green-687	1	USA
2015	Spring	Lime Green-6A7	2	USA
2015	Spring	Lime Green-6C5	7	USA
2015	Spring	Lime Green-6C7	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-6C9	1	USA
2015	Spring	Lime Green-74C	2	USA
2015	Spring	Lime Green-75X	7	USA
2015	Spring	Lime Green-79X	10	USA
2015	Spring	Lime Green-7C1	1	USA
2015	Spring	Lime Green-7C5	6	USA
2015	Spring	Lime Green-7C9	4	USA
2015	Spring	Lime Green-7CH	1	USA
2015	Spring	Lime Green-7ET	11	USA
2015	Spring	Lime Green-7K5	1	USA
2015	Spring	Lime Green-7K9	1	USA
2015	Spring	Lime Green-81C	1	USA
2015	Spring	Lime Green-847	14	USA
2015	Spring	Lime Green-8C2	2	USA
2015	Spring	Lime Green-8C5	12	USA
2015	Spring	Lime Green-8C9	1	USA
2015	Spring	Lime Green-8T5	2	USA
2015	Spring	Lime Green-915	11	USA
2015	Spring	Lime Green-99C	2	USA
2015	Spring	Lime Green-9C7	9	USA
2015	Spring	Lime Green-9C9	3	USA
2015	Spring	Lime Green-9CE	2	USA
2015	Spring	Lime Green-9CT	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-9JK	1	USA
2015	Spring	Lime Green-9JL	6	USA
2015	Spring	Lime Green-9KM	4	USA
2015	Spring	Lime Green-9KP	2	USA
2015	Spring	Lime Green-9M1	2	USA
2015	Spring	Lime Green-A03	4	USA
2015	Spring	Lime Green-A07	4	USA
2015	Spring	Lime Green-A23	16	USA
2015	Spring	Lime Green-A73	5	USA
2015	Spring	Lime Green-A75	3	USA
2015	Spring	Lime Green-A8T	3	USA
2015	Spring	Lime Green-AH5	2	USA
2015	Spring	Lime Green-AT5	7	USA
2015	Spring	Lime Green-AX3	4	USA
2015	Spring	Lime Green-AX8	4	USA
2015	Spring	Lime Green-AY8	3	USA
2015	Spring	Lime Green-C4Y	1	USA
2015	Spring	Lime Green-C7E	1	USA
2015	Spring	Lime Green-CA6	1	USA
2015	Spring	Lime Green-CJ6	5	USA
2015	Spring	Lime Green-CLH	1	USA
2015	Spring	Lime Green-E6X	2	USA
2015	Spring	Lime Green-E7H	11	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-E7M	12	USA
2015	Spring	Lime Green-E7U	3	USA
2015	Spring	Lime Green-E7Y	2	USA
2015	Spring	Lime Green-EM6	6	USA
2015	Spring	Lime Green-FM6	1	USA
2015	Spring	Lime Green-FU6	1	USA
2015	Spring	Lime Green-H03	1	USA
2015	Spring	Lime Green-H1C	6	USA
2015	Spring	Lime Green-H1J	4	USA
2015	Spring	Lime Green-H20	12	USA
2015	Spring	Lime Green-H2C	1	USA
2015	Spring	Lime Green-H3T	1	USA
2015	Spring	Lime Green-H8C	1	USA
2015	Spring	Lime Green-HA4	1	USA
2015	Spring	Lime Green-HM1	1	USA
2015	Spring	Lime Green-HM4	3	USA
2015	Spring	Lime Green-HTU	1	USA
2015	Spring	Lime Green-HU4	5	USA
2015	Spring	Lime Green-HU5	11	USA
2015	Spring	Lime Green-INJ	1	USA
2015	Spring	Lime Green-K4J	1	USA
2015	Spring	Lime Green-K4P	1	USA
2015	Spring	Lime Green-KH3	12	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-KN3	2	USA
2015	Spring	Lime Green-KP3	3	USA
2015	Spring	Lime Green-KTN	1	USA
2015	Spring	Lime Green-KV4	2	USA
2015	Spring	Lime Green-KX4	1	USA
2015	Spring	Lime Green-LE4	1	USA
2015	Spring	Lime Green-LKM	1	USA
2015	Spring	Lime Green-LMV	1	USA
2015	Spring	Lime Green-M1K	1	USA
2015	Spring	Lime Green-M66	4	USA
2015	Spring	Lime Green-M72	6	USA
2015	Spring	Lime Green-M9A	3	USA
2015	Spring	Lime Green-ME3	11	USA
2015	Spring	Lime Green-ML3	4	USA
2015	Spring	Lime Green-N02	1	USA
2015	Spring	Lime Green-N04	5	USA
2015	Spring	Lime Green-N16	2	USA
2015	Spring	Lime Green-NJ4	1	USA
2015	Spring	Lime Green-NJ6	6	USA
2015	Spring	Lime Green-NJ8	6	USA
2015	Spring	Lime Green-NL6	1	USA
2015	Spring	Lime Green-NV2	15	USA
2015	Spring	Lime Green-NVS	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-NX2	1	USA
2015	Spring	Lime Green-NX4	1	USA
2015	Spring	Lime Green-NX6	2	USA
2015	Spring	Lime Green-NX8	14	USA
2015	Spring	Lime Green-NYM	2	USA
2015	Spring	Lime Green-OH2	1	USA
2015	Spring	Lime Green-P0U	3	USA
2015	Spring	Lime Green-P34	2	USA
2015	Spring	Lime Green-P6M	1	USA
2015	Spring	Lime Green-P8M	2	USA
2015	Spring	Lime Green-P9M	1	USA
2015	Spring	Lime Green-PE6	1	USA
2015	Spring	Lime Green-PX6	2	USA
2015	Spring	Lime Green-T1K	7	USA
2015	Spring	Lime Green-T55	1	USA
2015	Spring	Lime Green-TN6	1	USA
2015	Spring	Lime Green-TU2	1	USA
2015	Spring	Lime Green-TU3	14	USA
2015	Spring	Lime Green-TU4	8	USA
2015	Spring	Lime Green-TU5	1	USA
2015	Spring	Lime Green-TU8	1	USA
2015	Spring	Lime Green-U3J	1	USA
2015	Spring	Lime Green-U7J	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-UC3	3	USA
2015	Spring	Lime Green-UJ2	1	USA
2015	Spring	Lime Green-UJ6	2	USA
2015	Spring	Lime Green-UXH	1	USA
2015	Spring	Lime Green-V19	1	USA
2015	Spring	Lime Green-VL6	4	USA
2015	Spring	Lime Green-VLC	1	USA
2015	Spring	Lime Green-VP4	1	USA
2015	Spring	Lime Green-VP6	2	USA
2015	Spring	Lime Green-VPA	1	USA
2015	Spring	Lime Green-VVP	2	USA
2015	Spring	Lime Green-VX1	1	USA
2015	Spring	Lime Green-VXY	4	USA
2015	Spring	Lime Green-VYP	3	USA
2015	Spring	Lime Green-X1N	2	USA
2015	Spring	Lime Green-X1Y	1	USA
2015	Spring	Lime Green-X3X	1	USA
2015	Spring	Lime Green-X5J	8	USA
2015	Spring	Lime Green-X5Y	6	USA
2015	Spring	Lime Green-X63	1	USA
2015	Spring	Lime Green-X7J	2	USA
2015	Spring	Lime Green-X7T	1	USA
2015	Spring	Lime Green-X88	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Lime Green-XET	3	USA
2015	Spring	Lime Green-XL4	1	USA
2015	Spring	Lime Green-XP3	1	USA
2015	Spring	Lime Green-XV4	6	USA
2015	Spring	Lime Green-Y19	2	USA
2015	Spring	Lime Green-Y55	4	USA
2015	Spring	Lime Green-YAE	1	USA
2015	Spring	Lime Green-YT9	3	USA
2015	Spring	Lime Green-Z6	5	USA
2015	Spring	Orange-146	2	Argentina
2015	Spring	Orange-154	5	Argentina
2015	Spring	Orange-217	5	Argentina
2015	Spring	Orange-225	2	Argentina
2015	Spring	Orange-227	4	Argentina
2015	Spring	Orange-252	7	Argentina
2015	Spring	Orange-255	9	Argentina
2015	Spring	Orange-257	2	Argentina
2015	Spring	Orange-263	2	Argentina
2015	Spring	Orange-39N	1	Argentina
2015	Spring	Orange-AED	4	Argentina
2015	Spring	Orange-AEM	5	Argentina
2015	Spring	Orange-ATP	1	Argentina
2015	Spring	Orange-AXH	2	Argentina

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Orange-AXP	1	Argentina
2015	Spring	Orange-C9H	8	Argentina
2015	Spring	Orange-CIJ	1	Argentina
2015	Spring	Orange-CLH	3	Argentina
2015	Spring	Orange-CPD	4	Argentina
2015	Spring	Orange-E7H	4	Argentina
2015	Spring	Orange-E7N	3	Argentina
2015	Spring	Orange-E9M	2	Argentina
2015	Spring	Orange-EA1	1	Argentina
2015	Spring	Orange-H3T	1	Argentina
2015	Spring	Orange-HM1	2	Argentina
2015	Spring	Orange-K3E	4	Argentina
2015	Spring	Orange-KX1	4	Argentina
2015	Spring	Orange-KX3	1	Argentina
2015	Spring	Orange-L4K	2	Argentina
2015	Spring	Orange-LKM	5	Argentina
2015	Spring	Orange-LXE	4	Argentina
2015	Spring	Orange-MNX	4	Argentina
2015	Spring	Orange-MX1	2	Argentina
2015	Spring	Orange-OX	10	Argentina
2015	Spring	Orange-P4H	3	Argentina
2015	Spring	Orange-P4Y	3	Argentina
2015	Spring	Orange-P9H	1	Argentina

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2015	Spring	Orange-PV1	2	Argentina
2015	Spring	Orange-S3X	3	Argentina
2015	Spring	Orange-T9M	3	Argentina
2015	Spring	Orange-U31	1	Argentina
2015	Spring	Orange-U3K	3	Argentina
2015	Spring	Orange-U3Y	5	Argentina
2015	Spring	Orange-WE	3	Argentina
2015	Spring	Orange-X3K	3	Argentina
2015	Spring	Orange-ZW	2	Argentina
2015	Spring	Red-AUN	1	Chile
2015	Spring	Red-LH3	1	Chile
2015	Spring	Red-TY	2	Chile
2015	Spring	White-07	1	Canada
2015	Spring	White-64	3	Canada
2015	Spring	White-6J	1	Canada
2013	Spring	Lime Green-007	2	USA
2013	Spring	Lime Green-01A	1	USA
2013	Spring	Lime Green-030	3	USA
2013	Spring	Lime Green-032	1	USA
2013	Spring	Lime Green-034	1	USA
2013	Spring	Lime Green-052	2	USA
2013	Spring	Lime Green-060	1	USA
2013	Spring	Lime Green-067	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-071	1	USA
2013	Spring	Lime Green-07V	3	USA
2013	Spring	Lime Green-092	2	USA
2013	Spring	Lime Green-098	1	USA
2013	Spring	Lime Green-0C4	1	USA
2013	Spring	Lime Green-0E8	3	USA
2013	Spring	Lime Green-0H2	5	USA
2013	Spring	Lime Green-0H6	2	USA
2013	Spring	Lime Green-0K6	2	USA
2013	Spring	Lime Green-0K9	1	USA
2013	Spring	Lime Green-103	2	USA
2013	Spring	Lime Green-104	4	USA
2013	Spring	Lime Green-112	2	USA
2013	Spring	Lime Green-116	1	USA
2013	Spring	Lime Green-124	1	USA
2013	Spring	Lime Green-128	3	USA
2013	Spring	Lime Green-13U	1	USA
2013	Spring	Lime Green-146	1	USA
2013	Spring	Lime Green-14C	4	USA
2013	Spring	Lime Green-155	3	USA
2013	Spring	Lime Green-163	2	USA
2013	Spring	Lime Green-165	2	USA
2013	Spring	Lime Green-166	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-170	2	USA
2013	Spring	Lime Green-184	1	USA
2013	Spring	Lime Green-188	2	USA
2013	Spring	Lime Green-1A8	1	USA
2013	Spring	Lime Green-1E9	1	USA
2013	Spring	Lime Green-1H2	2	USA
2013	Spring	Lime Green-1H4	1	USA
2013	Spring	Lime Green-1H5	1	USA
2013	Spring	Lime Green-1MU	2	USA
2013	Spring	Lime Green-1MV	1	USA
2013	Spring	Lime Green-1T6	1	USA
2013	Spring	Lime Green-1U4	1	USA
2013	Spring	Lime Green-1UH	1	USA
2013	Spring	Lime Green-1XK	1	USA
2013	Spring	Lime Green-1XV	1	USA
2013	Spring	Lime Green-1XX	9	USA
2013	Spring	Lime Green-1YM	2	USA
2013	Spring	Lime Green-244	1	USA
2013	Spring	Lime Green-255	10	USA
2013	Spring	Lime Green-258	3	USA
2013	Spring	Lime Green-25P	1	USA
2013	Spring	Lime Green-25X	4	USA
2013	Spring	Lime Green-266	3	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-268	1	USA
2013	Spring	Lime Green-273	4	USA
2013	Spring	Lime Green-284	2	USA
2013	Spring	Lime Green-2AC	4	USA
2013	Spring	Lime Green-2H0	1	USA
2013	Spring	Lime Green-2H4	3	USA
2013	Spring	Lime Green-2H7	1	USA
2013	Spring	Lime Green-2HU	1	USA
2013	Spring	Lime Green-2YJ	2	USA
2013	Spring	Lime Green-301	1	USA
2013	Spring	Lime Green-311	6	USA
2013	Spring	Lime Green-315	1	USA
2013	Spring	Lime Green-332	5	USA
2013	Spring	Lime Green-335	2	USA
2013	Spring	Lime Green-339	8	USA
2013	Spring	Lime Green-35A	1	USA
2013	Spring	Lime Green-369	4	USA
2013	Spring	Lime Green-36P	1	USA
2013	Spring	Lime Green-3C4	1	USA
2013	Spring	Lime Green-3H4	1	USA
2013	Spring	Lime Green-3JJ	1	USA
2013	Spring	Lime Green-3MJ	4	USA
2013	Spring	Lime Green-3ML	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-3MU	4	USA
2013	Spring	Lime Green-3NM	1	USA
2013	Spring	Lime Green-3TU	1	USA
2013	Spring	Lime Green-48T	9	USA
2013	Spring	Lime Green-4C2	3	USA
2013	Spring	Lime Green-4H5	7	USA
2013	Spring	Lime Green-50T	3	USA
2013	Spring	Lime Green-59T	1	USA
2013	Spring	Lime Green-5C8	1	USA
2013	Spring	Lime Green-5L6	7	USA
2013	Spring	Lime Green-5XK	1	USA
2013	Spring	Lime Green-63V	2	USA
2013	Spring	Lime Green-6C9	3	USA
2013	Spring	Lime Green-72C	1	USA
2013	Spring	Lime Green-75X	7	USA
2013	Spring	Lime Green-79X	1	USA
2013	Spring	Lime Green-7C2	2	USA
2013	Spring	Lime Green-7C3	11	USA
2013	Spring	Lime Green-7C5	1	USA
2013	Spring	Lime Green-7C9	2	USA
2013	Spring	Lime Green-7CY	3	USA
2013	Spring	Lime Green-7EN	3	USA
2013	Spring	Lime Green-7ET	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-7XT	3	USA
2013	Spring	Lime Green-84X	1	USA
2013	Spring	Lime Green-8C5	2	USA
2013	Spring	Lime Green-99C	2	USA
2013	Spring	Lime Green-9A7	1	USA
2013	Spring	Lime Green-9AH	1	USA
2013	Spring	Lime Green-9C3	2	USA
2013	Spring	Lime Green-9C7	10	USA
2013	Spring	Lime Green-9C9	1	USA
2013	Spring	Lime Green-9JT	2	USA
2013	Spring	Lime Green-9JY	1	USA
2013	Spring	Lime Green-9KA	2	USA
2013	Spring	Lime Green-9KM	1	USA
2013	Spring	Lime Green-9NX	3	USA
2013	Spring	Lime Green-A9U	2	USA
2013	Spring	Lime Green-AC9	1	USA
2013	Spring	Lime Green-AE6	1	USA
2013	Spring	Lime Green-AL6	1	USA
2013	Spring	Lime Green-ANJ	1	USA
2013	Spring	Lime Green-AT5	1	USA
2013	Spring	Lime Green-AV0	2	USA
2013	Spring	Lime Green-AY8	1	USA
2013	Spring	Lime Green-C1V	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-C4V	5	USA
2013	Spring	Lime Green-C4Y	3	USA
2013	Spring	Lime Green-C8T	1	USA
2013	Spring	Lime Green-CJ6	1	USA
2013	Spring	Lime Green-CN4	1	USA
2013	Spring	Lime Green-CN9	5	USA
2013	Spring	Lime Green-CX9	2	USA
2013	Spring	Lime Green-E1P	1	USA
2013	Spring	Lime Green-E2T	2	USA
2013	Spring	Lime Green-E2V	2	USA
2013	Spring	Lime Green-E3J	1	USA
2013	Spring	Lime Green-E4E	1	USA
2013	Spring	Lime Green-E6A	1	USA
2013	Spring	Lime Green-E6K	3	USA
2013	Spring	Lime Green-E6M	3	USA
2013	Spring	Lime Green-EA7	1	USA
2013	Spring	Lime Green-EKA	4	USA
2013	Spring	Lime Green-ENC	1	USA
2013	Spring	Lime Green-ETK	6	USA
2013	Spring	Lime Green-EU5	2	USA
2013	Spring	Lime Green-EY5	3	USA
2013	Spring	Lime Green-H1C	7	USA
2013	Spring	Lime Green-H1J	1	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-H1T	1	USA
2013	Spring	Lime Green-H1U	1	USA
2013	Spring	Lime Green-H21	1	USA
2013	Spring	Lime Green-H2C	1	USA
2013	Spring	Lime Green-H2E	2	USA
2013	Spring	Lime Green-H2Y	1	USA
2013	Spring	Lime Green-H5J	2	USA
2013	Spring	Lime Green-H8C	1	USA
2013	Spring	Lime Green-HAU	3	USA
2013	Spring	Lime Green-HM4	1	USA
2013	Spring	Lime Green-HU4	1	USA
2013	Spring	Lime Green-HU6	2	USA
2013	Spring	Lime Green-JH6	2	USA
2013	Spring	Lime Green-JHC	1	USA
2013	Spring	Lime Green-JM6	2	USA
2013	Spring	Lime Green-JN6	1	USA
2013	Spring	Lime Green-JT3	2	USA
2013	Spring	Lime Green-JT6	1	USA
2013	Spring	Lime Green-JX3	1	USA
2013	Spring	Lime Green-K3T	1	USA
2013	Spring	Lime Green-K4J	2	USA
2013	Spring	Lime Green-KH3	2	USA
2013	Spring	Lime Green-KT3	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-KT6	1	USA
2013	Spring	Lime Green-KV4	5	USA
2013	Spring	Lime Green-LB:O	1	USA
2013	Spring	Lime Green-LC1	4	USA
2013	Spring	Lime Green-LE6	1	USA
2013	Spring	Lime Green-LK3	1	USA
2013	Spring	Lime Green-LM6	2	USA
2013	Spring	Lime Green-ME3	3	USA
2013	Spring	Lime Green-MHX	1	USA
2013	Spring	Lime Green-ML3	1	USA
2013	Spring	Lime Green-MM4	2	USA
2013	Spring	Lime Green-MP9	4	USA
2013	Spring	Lime Green-MU:O	1	USA
2013	Spring	Lime Green-MYP	1	USA
2013	Spring	Lime Green-NH4	6	USA
2013	Spring	Lime Green-NJ6	1	USA
2013	Spring	Lime Green-NV2	2	USA
2013	Spring	Lime Green-NX2	2	USA
2013	Spring	Lime Green-NX8	5	USA
2013	Spring	Lime Green-NYE	1	USA
2013	Spring	Lime Green-P0K	2	USA
2013	Spring	Lime Green-P63	1	USA
2013	Spring	Lime Green-PA4	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-PEP	1	USA
2013	Spring	Lime Green-PHC	1	USA
2013	Spring	Lime Green-PP5	1	USA
2013	Spring	Lime Green-PV4	3	USA
2013	Spring	Lime Green-SSW	1	USA
2013	Spring	Lime Green-T1K	1	USA
2013	Spring	Lime Green-T3U	3	USA
2013	Spring	Lime Green-T45	2	USA
2013	Spring	Lime Green-T4E	4	USA
2013	Spring	Lime Green-THE	2	USA
2013	Spring	Lime Green-TJ4	1	USA
2013	Spring	Lime Green-TLN	2	USA
2013	Spring	Lime Green-TN:G	1	USA
2013	Spring	Lime Green-TT6	2	USA
2013	Spring	Lime Green-TU3	5	USA
2013	Spring	Lime Green-TU4	2	USA
2013	Spring	Lime Green-TU5	1	USA
2013	Spring	Lime Green-TU6	1	USA
2013	Spring	Lime Green-TV6	2	USA
2013	Spring	Lime Green-UA2	1	USA
2013	Spring	Lime Green-UA7	1	USA
2013	Spring	Lime Green-UC3	4	USA
2013	Spring	Lime Green-UE6	2	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-UXH	1	USA
2013	Spring	Lime Green-V6A	1	USA
2013	Spring	Lime Green-VCE	1	USA
2013	Spring	Lime Green-VEM	1	USA
2013	Spring	Lime Green-VJ6	2	USA
2013	Spring	Lime Green-VK7	3	USA
2013	Spring	Lime Green-VKN	2	USA
2013	Spring	Lime Green-VKY	1	USA
2013	Spring	Lime Green-VLC	1	USA
2013	Spring	Lime Green-VM4	1	USA
2013	Spring	Lime Green-VP6	3	USA
2013	Spring	Lime Green-VT6	2	USA
2013	Spring	Lime Green-VTM	4	USA
2013	Spring	Lime Green-VXY	1	USA
2013	Spring	Lime Green-VYA	1	USA
2013	Spring	Lime Green-X1V	2	USA
2013	Spring	Lime Green-X3T	1	USA
2013	Spring	Lime Green-X3X	1	USA
2013	Spring	Lime Green-X5J	4	USA
2013	Spring	Lime Green-X7J	4	USA
2013	Spring	Lime Green-XE4	1	USA
2013	Spring	Lime Green-XH6	4	USA
2013	Spring	Lime Green-XN3	5	USA

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Lime Green-XV4	1	USA
2013	Spring	Lime Green-XYV	4	USA
2013	Spring	Lime Green-Y4P	2	USA
2013	Spring	Lime Green-Y7N	4	USA
2013	Spring	Lime Green-YL2	1	USA
2013	Spring	Lime Green-YL4	2	USA
2013	Spring	Lime Green-YT9	3	USA
2013	Spring	Orange-104	1	Argentina
2013	Spring	Orange-AEM	5	Argentina
2013	Spring	Orange-AGA	8	Argentina
2013	Spring	Orange-AGH	1	Argentina
2013	Spring	Orange-AKH	4	Argentina
2013	Spring	Orange-B8	1	Argentina
2013	Spring	Orange-C9C	1	Argentina
2013	Spring	Orange-C9H	3	Argentina
2013	Spring	Orange-CIJ	5	Argentina
2013	Spring	Orange-CPM	1	Argentina
2013	Spring	Orange-E4P	3	Argentina
2013	Spring	Orange-E4X	2	Argentina
2013	Spring	Orange-E7H	4	Argentina
2013	Spring	Orange-ELE	4	Argentina
2013	Spring	Orange-H6M	1	Argentina
2013	Spring	Orange-J4C	4	Argentina

Resight Year	Resight Season	Flag Color/Code	Cumulative Resights/Season	Banding Origin
2013	Spring	Orange-LAN	2	Argentina
2013	Spring	Orange-S3X	3	Argentina
2013	Spring	Orange-U3H	1	Argentina
2013	Spring	Orange-U3Y	1	Argentina
2013	Spring	Orange-Y3H	4	Argentina
2013	Spring	Orange-ZW	1	Argentina
2013	Spring	Red-CC	2	Chile
2013	Spring	Red-HJL	4	Chile
2013	Spring	Red-HPC	2	Chile
2013	Spring	Red-Y/M:FR/RYY	2	Chile
2013	Spring	White-5P	2	Canada
2013	Spring	White-PN	2	Canada
2013	Spring	White-VL	1	Canada

APPENDIX II. TABLE WITH SURVEY LOCATION, DATE, TOTAL NUMBER OF RED KNOTS DETECTED, LATITUDE AND LONGITUDE, AND SURVEY TYPE (GROUND BASED OR AERIAL) FROM 2013-2016.

Date	Location	# of Knots	Latitude	Longitude	Survey Type
16-Apr-2013	Blackbeard Island/Cabretta Island Bar	20	31.4331	-81.23509	Ground
18-Apr-2013	Blackbeard Island/Cabretta Island Bar	300	31.4331	-81.23509	Ground
18-Apr-2013	Ossabaw Island (N. Middle Beach)	52	31.783378	-81.061213	Ground
19-Apr-2013	Gould's Inlet	50	31.159048	-81.364428	Ground
23-Apr-2013	Ossabaw Island (N. Middle Beach)	106	31.783378	-81.061213	Ground
24-Apr-2013	Blackbeard Island/Cabretta Island Bar	180	31.4331	-81.23509	Ground
24-Apr-2013	Little St. Simons Island	283	31.25097	-81.27527	Ground
25-Apr-2013	Little Egg Island Bar	55	31.310308	-81.272663	Ground
25-Apr-2013	Wolf Island	24	31.326283	-81.286001	Ground
27-Apr-2013	Ogeechee Bar/Raccoon Key Bar	800	31.841545	-81.053452	Ground
3-May-2013	Blackbeard Island/Cabretta Island Bar	18	31.4331	-81.23509	Ground
7-May-2013	Ossabaw Island (North End)	30	31.819085	-81.312529	Ground
8-May-2013	Little Egg Island Bar	100	31.310308	-81.272663	Ground
9-May-2013	Blackbeard Island/Cabretta Island Bar	112	31.4331	-81.23509	Ground
9-May-2013	Ogeechee Bar/Raccoon Key Bar	120	31.841545	-81.053452	Ground
10-May-2013	Little St. Simons Island	0	31.25097	-81.27527	Ground
11-May-2013	Blackbeard Island/Cabretta Island Bar	160	31.4331	-81.23509	Ground
12-May-2013	Blackbeard Island/Cabretta Island Bar	200	31.4331	-81.23509	Ground
13-May-2013	Ossabaw Island (North End)	11	31.819085	-80.912689	Ground
13-May-2013	Ossabaw Island (N. Middle Beach)	190	31.783378	-81.061213	Ground
14-May-2013	Blackbeard Island/Cabretta Island Bar	145	31.4331	-81.23509	Ground
14-May-2013	Little Egg Island Bar	0	31.310308	-81.272663	Ground
14-May-2013	Little St. Simons Island	0	31.25097	-81.27527	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
14-May-2013	Wolf Bar	0	31.315705	-81.259772	Ground
14-May-2013	Wolf Island	0	31.326283	-81.286001	Ground
15-May-2013	Ossabaw Island (North End)	85	31.819085	-81.30575	Ground
15-May-2013	Ogeechee Bar/Raccoon Key Bar	0	31.841545	-81.053452	Ground
15-May-2013	Ossabaw Island (N. Middle Beach)	350	31.783378	-81.061213	Ground
16-May-2013	Blackbeard Island/Cabretta Island Bar	189	31.4331	-81.23509	Ground
16-May-2013	Little Egg Island Bar	1	31.310308	-81.272663	Ground
16-May-2013	Little St. Simons Island	353	31.25097	-81.27527	Ground
16-May-2013	Little St. Simons Island	31	31.25097	-81.27527	Ground
16-May-2013	Little St. Simons Island	406	31.25097	-81.27527	Ground
17-May-2013	Ossabaw Island (N. Middle Beach)	100	31.783378	-81.061213	Ground
17-May-2013	Ossabaw Island (N. Middle Beach)	380	31.783378	-81.061213	Ground
18-May-2013	Blackbeard Island/Cabretta Island Bar	450	31.4331	-81.23509	Ground
20-May-2013	Blackbeard Island/Cabretta Island Bar	120	31.4331	-81.23509	Ground
20-May-2013	Ossabaw Island (N. Middle Beach)	709	31.783378	-81.061213	Ground
21-May-2013	Blackbeard Island/Cabretta Island Bar	462	31.4331	-81.23509	Ground
22-May-2013	Ogeechee Bar/Raccoon Key Bar	1200	31.841545	-81.053452	Ground
22-May-2013	Ossabaw Island (N. Middle Beach)	1590	31.783378	-81.061213	Ground
23-May-2013	Blackbeard Island/Cabretta Island Bar	800	31.4331	-81.23509	Ground
23-May-2013	Little St. Simons Island	257	31.25097	-81.27527	Ground
24-May-2013	Ogeechee Bar/Raccoon Key Bar	2500	31.841545	-81.053452	Ground
25-May-2013	Ogeechee Bar/Raccoon Key Bar	1500	31.841545	-81.053452	Ground
26-May-2013	Blackbeard Island/Cabretta Island Bar	106	31.4331	-81.23509	Ground
27-May-2013	Ogeechee Bar/Raccoon Key Bar	550	31.841545	-81.053452	Ground
28-May-2013	Blackbeard Island/Cabretta Island Bar	30	31.4331	-81.23509	Ground
28-May-2013	Little St. Simons Island	35	31.25097	-81.27527	Ground
2-Jun-2013	Ogeechee Bar/Raccoon Key Bar	220	31.841545	-81.053452	Ground
4-Jun-2013	Ogeechee Bar/Raccoon Key Bar	250	31.841545	-81.053452	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
1-Apr-2015	Gould's Inlet	50	31.159048	-81.364428	Ground
1-Apr-2015	Ogeechee Bar/Raccoon Key Bar	0	31.841545	-81.053452	Ground
2-Apr-2015	Cumberland Island	57	30.958428	-81.403302	Ground
3-Apr-2015	Blackbeard Island/Cabretta Island Bar	500	31.4331	-81.23509	Ground
4-Apr-2015	Pelican Spit	150	31.204082	-81.312529	Ground
6-Apr-2015	Blackbeard Island/Cabretta Island Bar	500	31.4331	-81.23509	Ground
7-Apr-2015	Gould's Inlet	100	31.159048	-81.364428	Ground
9-Apr-2015	Ogeechee Bar/Raccoon Key Bar	10	31.841545	-81.053452	Ground
10-Apr-2015	Gould's Inlet	140	31.159048	-81.364428	Ground
14-Apr-2015	Gould's Inlet	111	31.159048	-81.364428	Ground
14-Apr-2015	Tybee/Tybee Bar	0	31.98063	-80.85597	Ground
15-Apr-2015	Blackbeard Island/Cabretta Island Bar	480	31.4331	-81.23509	Ground
16-Apr-2015	Ossabaw Island (North End)	25	31.819085	-81.403226	Ground
16-Apr-2015	Ogeechee Bar/Raccoon Key Bar	20	31.841545	-81.053452	Ground
16-Apr-2015	Pelican Spit	350	31.204082	-81.312529	Ground
17-Apr-2015	Blackbeard Island/Cabretta Island Bar	90	31.4331	-81.23509	Ground
20-Apr-2015	Gould's Inlet	150	31.159048	-81.364428	Ground
20-Apr-2015	Pelican Spit	180	31.204082	-81.312529	Ground
21-Apr-2015	Blackbeard Island/Cabretta Island Bar	500	31.4331	-81.23509	Ground
21-Apr-2015	St. Catherines Bar	Many?	31.69486094	-81.12422875	Ground
22-Apr-2015	Gould's Inlet	175	31.159048	-81.364428	Ground
22-Apr-2015	Pelican Spit	70	31.204082	-81.312529	Ground
22-Apr-2015	Rainbow Beach, LSSI	36	31.217755	-81.30575	Ground
23-Apr-2015	Blackbeard Island/Cabretta Island Bar	500	31.4331	-81.23509	Ground
27-Apr-2015	Blackbeard Island/Cabretta Island Bar	320	31.4331	-81.23509	Ground
30-Apr-2015	Blackbeard Island/Cabretta Island Bar	70	31.4331	-81.23509	Ground
1-May-2015	Pelican Spit	450	31.204082	-81.312529	Ground
2-May-2015	Ogeechee Bar/Raccoon Key Bar	175	31.841545	-81.053452	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
2-May-2015	Pelican Spit	750	31.204082	-81.312529	Ground
3-May-2015	Ogeechee Bar/Raccoon Key Bar	300 (Dawn Roost Count)	31.841545	-81.053452	Ground
3-May-2015	Ogeechee Bar/Raccoon Key Bar	750 (Evening Roost Count)	31.841545	-81.053452	Ground
3-May-2015	Ossabaw Island (N. Middle Beach)	18	31.783378	-81.061213	Ground
4-May-2015	Little Egg Island Bar	50	31.310308	-81.272663	Ground
4-May-2015	Pelican Spit	600	31.204082	-81.312529	Ground
5-May-2015	Ogeechee Bar/Raccoon Key Bar	600	31.841545	-81.053452	Ground
6-May-2015	Gould's Inlet	200	31.159048	-81.364428	Ground
6-May-2015	Pelican Spit	500	31.204082	-81.312529	Ground
7-May-2015	Blackbeard Island/Cabretta Island Bar	250	31.4331	-81.23509	Ground
8-May-2015	Tybee/Tybee Bar	2700	31.98063	-80.85597	Ground
9-May-2015	Pelican Spit	300	31.204082	-81.312529	Ground
10-May-2015	Tybee/Tybee Bar	2000	31.98063	-80.85597	Ground
11-May-2015	Ogeechee Bar/Raccoon Key Bar	450	31.841545	-81.053452	Ground
12-May-2015	Blackbeard Island/Cabretta Island Bar	250	31.4331	-81.23509	Ground
14-May-2015	Blackbeard Island/Cabretta Island Bar	160	31.4331	-81.23509	Ground
14-May-2015	Ogeechee Bar/Raccoon Key Bar	200	31.841545	-81.053452	Ground
15-May-2015	Pelican Spit	300	31.204082	-81.312529	Ground
16-May-2015	Ogeechee Bar/Raccoon Key Bar	900	31.841545	-81.053452	Ground
16-May-2015	Tybee/Tybee Bar	900	31.98063	-80.85597	Ground
17-May-2015	Little Egg Island Bar	500	31.310308	-81.272663	Ground
17-May-2015	Ogeechee Bar/Raccoon Key Bar	800	31.841545	-81.053452	Ground
17-May-2015	St. Catherines Bar	600	31.69486094	-81.12422875	Ground
18-May-2015	Ogeechee Bar/Raccoon Key Bar	600	31.841545	-81.053452	Ground
18-May-2015	Pelican Spit	70	31.204082	-81.312529	Ground
18-May-2015	Rainbow Beach, LSSI	30	31.217755	-81.30575	Ground
19-May-2015	Blackbeard Island/Cabretta Island Bar	40	31.4331	-81.23509	Ground
19-May-2015	Little Egg Island Bar	600	31.310308	-81.272663	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
19-May-2015	Wolf Bar	225	31.315705	-81.259772	Ground
20-May-2015	Ogeechee Bar/Raccoon Key Bar	800	31.841545	-81.053452	Ground
20-May-2015	Tybee/Tybee Bar	1050	31.98063	-80.85597	Ground
21-May-2015	Beach Hammock/Little Tybee	2000	31.943727	-80.928644	Ground
21-May-2015	Pelican Spit	90	31.204082	-81.312529	Ground
21-May-2015	Rainbow Beach, LSSI	25	31.217755	-81.30575	Ground
23-May-2015	Ogeechee Bar/Raccoon Key Bar	1800	31.841545	-81.053452	Ground
24-May-2015	Little Egg Island Bar	200	31.310308	-81.272663	Ground
24-May-2015	Wolf Bar	250	31.315705	-81.259772	Ground
26-May-2015	Tybee/Tybee Bar	15	31.98063	-80.85597	Ground
27-May-2015	Pelican Spit	3	31.204082	-81.312529	Ground
27-May-2015	Rainbow Beach, LSSI	2	31.217755	-81.30575	Ground
28-May-2015	Ogeechee Bar/Raccoon Key Bar	40	31.841545	-81.053452	Ground
28-May-2015	Wolf Bar	9	31.315705	-81.259772	Ground
31-May-2015	Ogeechee Bar/Raccoon Key Bar	2	31.841545	-81.053452	Ground
10-Jul-2015	Little Egg Island Bar	52	31.310308	-81.272663	Ground
20-Jul-2015	Little Egg Island Bar	1	31.310308	-81.272663	Ground
20-Jul-2015	Wolf Bar	0	31.315705	-81.259772	Ground
20-Jul-2015	Wolf Island	200	31.326283	-81.286001	Ground
22-Jul-2015	Ogeechee Bar/Raccoon Key Bar	0	31.841545	-81.053452	Ground
24-Jul-2015	Blackbeard Island/Cabretta Island Bar	0	31.4331	-81.23509	Ground
24-Jul-2015	St Catherines Island (South)	0	31.56635	-81.184404	Ground
27-Jul-2015	Little Egg Island Bar	0	31.310308	-81.272663	Ground
27-Jul-2015	Wolf Bar	0	31.315705	-81.259772	Ground
27-Jul-2015	Wolf Island	306	31.326283	-81.286001	Ground
31-Jul-2015	Wolf Island	417	31.326283	-81.286001	Ground
4-Aug-2015	Wolf Island	242	31.326283	-81.286001	Ground
7-Aug-2015	Wolf Island	242	31.326283	-81.286001	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
13-Aug-2015	Wolf Island	455	31.326283	-81.286001	Ground
14-Aug-2015	Wolf Island	398	31.326283	-81.286001	Ground
19-Aug-2015	Wolf Island	347	31.326283	-81.286001	Ground
24-Aug-2015	Wolf Island	409	31.326283	-81.286001	Ground
28-Aug-2015	Wolf Island	252	31.326283	-81.286001	Ground
1-Sep-2015	Wolf Island	245	31.326283	-81.286001	Ground
4-Sep-2015	Wolf Island	86	31.326283	-81.286001	Ground
11-Sep-2015	Wolf Island	110	31.326283	-81.286001	Ground
17-Sep-2015	Wolf Island	0	31.326283	-81.286001	Ground
21-Sep-2015	Wolf Island	22	31.326283	-81.286001	Ground
25-Sep-2015	Tybee/Tybee Bar	110	31.98063	-80.85597	Ground
28-Sep-2015	Wolf Island	68	31.326283	-81.286001	Ground
30-Sep-2015	Tybee/Tybee Bar	33	31.98063	-80.85597	Ground
8-Apr-2016	Gould's Inlet	0	31.159048	-81.364428	Ground
8-Apr-2016	Pelican Spit	20	31.204082	-81.312529	Ground
9-Apr-2016	Tybee/Tybee Bar	150	31.98063	-80.85597	Ground
10-Apr-2016	Tybee/Tybee Bar	1000	31.98063	-80.85597	Ground
11-Apr-2016	Blackbeard Island/Cabretta Island Bar	800	31.4331	-81.23509	Ground
12-Apr-2016	Ogeechee Bar/Raccoon Key Bar	120	31.841545	-81.053452	Ground
14-Apr-2016	Gould's Inlet	Small flocks, maybe 20 to 30	31.159048	-81.364428	Ground
17-Apr-2016	Beach Hammock/Little Tybee	550	31.943727	-80.928644	Ground
17-Apr-2016	Tybee/Tybee Bar	1500	31.98063	-80.85597	Ground
18-Apr-2016	Ogeechee Bar/Raccoon Key Bar	11	31.841545	-81.053452	Ground
19-Apr-2016	Blackbeard Island/Cabretta Island Bar	450	31.4331	-81.23509	Ground
20-Apr-2016	Pelican Spit	130	31.204082	-81.312529	Ground
21-Apr-2016	Blackbeard Island/Cabretta Island Bar	250	31.4331	-81.23509	Ground
22-Apr-2016	Ogeechee Bar/Raccoon Key Bar	40	31.841545	-81.053452	Ground
22-Apr-2016	Ossabaw Island (N. Middle Beach)	140	31.783378	-81.061213	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
23-Apr-2016	Beach Hammock/Little Tybee	4000	31.943727	-80.928644	Ground
24-Apr-2016	Beach Hammock/Little Tybee	2500	31.943727	-80.928644	Ground
24-Apr-2016	Tybee/Tybee Bar	High Hundreds (700-900)	31.98063	-80.85597	Ground
25-Apr-2016	Little Egg Island Bar	0	31.310308	-81.272663	Ground
27-Apr-2016	Gould's Inlet	80	31.159048	-81.364428	Ground
27-Apr-2016	Pelican Spit	85	31.204082	-81.312529	Ground
27-Apr-2016	Rainbow Beach, LSSI	35	31.217755	-81.30575	Ground
28-Apr-2016	Blackbeard Island/Cabretta Island Bar	80	31.4331	-81.23509	Ground
29-Apr-2016	Ogeechee Bar/Raccoon Key Bar	275	31.841545	-81.053452	Ground
30-Apr-2016	Beach Hammock/Little Tybee	600	31.943727	-80.928644	Ground
30-Apr-2016	Tybee/Tybee Bar	600	31.98063	-80.85597	Ground
1-May-2016	Gould's Inlet	53	31.159048	-81.364428	Ground
1-May-2016	Pelican Spit	80	31.204082	-81.312529	Ground
1-May-2016	Rainbow Beach, LSSI	0	31.217755	-81.30575	Ground
2-May-2016	Beach Hammock/Little Tybee	600	31.943727	-80.928644	Ground
3-May-2016	Beach Hammock/Little Tybee	500	31.943727	-80.928644	Ground
3-May-2016	St. Catherines Bar	600	31.69486094	-81.12422875	Ground
3-May-2016	Tybee/Tybee Bar	180	31.98063	-80.85597	Ground
4-May-2016	St. Catherines Island (McQueen Inlet)	400	31.63680741	-81.13438373	Ground
4-May-2016	Ogeechee Bar/Raccoon Key Bar	2000	31.841545	-81.053452	Ground
5-May-2016	Cumberland Island	0	30.955574	-81.403226	Aerial
5-May-2016	Jekyll Island	0	31.10637	-81.404592	Aerial
5-May-2016	Saint Simons Island	0	31.150894	-81.364283	Aerial
5-May-2016	Gould's Inlet	20	31.159048	-81.364428	Aerial
5-May-2016	Pelican Spit	40	31.204082	-81.312529	Aerial
5-May-2016	Little St. Simons Island	0	31.25097	-81.27527	Aerial
5-May-2016	Little Egg Island Bar	0	31.310308	-81.272663	Aerial
5-May-2016	Wolf Bar	0	31.315705	-81.259772	Aerial

Date	Location	# of Knots	Latitude	Longitude	Survey Type
5-May-2016	Wolf Island	0	31.326283	-81.286001	Aerial
5-May-2016	Sapelo Island (South)	150	31.38290644	-81.26906293	Aerial
5-May-2016	Blackbeard Island/Cabretta Island Bar	60	31.4331	-81.23509	Aerial
5-May-2016	Blackbeard Island	0	31.493507	-81.195399	Aerial
5-May-2016	St Catherines Island (South)	250	31.56635	-81.184404	Aerial
5-May-2016	St. Catherines Island (McQueen Inlet)	150	31.63680741	-81.13438373	Aerial
5-May-2016	St. Catherines Island (Middle)	50	31.66031079	-81.13604575	Aerial
5-May-2016	St. Catherines Bar	150	31.69486094	-81.12422875	Aerial
5-May-2016	Ossabaw Island (N. Middle Beach)	50	31.783378	-81.061213	Aerial
5-May-2016	Ossabaw Island (North End)	80	31.8192064	-81.0363662	Aerial
5-May-2016	Ogeechee Bar/Raccoon Key Bar	2500	31.841545	-81.053452	Aerial
5-May-2016	Pine Island	17	31.86930128	-81.02019624	Aerial
5-May-2016	Wassaw Island (South)	50	31.86453556	-80.98573196	Aerial
5-May-2016	Beach Hammock/Little Tybee	1150	31.943727	-80.928644	Aerial
5-May-2016	Little Tybee Island	0	31.957692	-80.885872	Aerial
5-May-2016	Tybee/Tybee Bar	0	31.98063	-80.85597	Aerial
6-May-2016	Ogeechee Bar/Raccoon Key Bar	2500	31.841545	-81.053452	Ground
6-May-2016	Pelican Spit	300	31.204082	-81.312529	Ground
7-May-2016	Beach Hammock/Little Tybee	1100	31.943727	-80.928644	Ground
7-May-2016	Ogeechee Bar/Raccoon Key Bar	3000	31.841545	-81.053452	Ground
8-May-2016	Beach Hammock/Little Tybee	1200	31.943727	-80.928644	Ground
8-May-2016	Ogeechee Bar/Raccoon Key Bar	3000	31.841545	-81.053452	Ground
9-May-2016	Ogeechee Bar/Raccoon Key Bar	2500	31.841545	-81.053452	Ground
10-May-2016	Gould's Inlet	0	31.159048	-81.364428	Ground
10-May-2016	Ogeechee Bar/Raccoon Key Bar	140	31.841545	-81.053452	Ground
10-May-2016	Pelican Spit	49	31.204082	-81.312529	Ground
10-May-2016	Rainbow Beach, LSSI	85	31.217755	-81.30575	Ground
11-May-2016	Beach Hammock/Little Tybee	1150	31.943727	-80.928644	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
11-May-2016	Ogeechee Bar/Raccoon Key Bar	85	31.841545	-81.053452	Ground
11-May-2016	Tybee/Tybee Bar	950	31.98063	-80.85597	Ground
12-May-2016	Beach Hammock/Little Tybee	1400	31.943727	-80.928644	Ground
13-May-2016	Blackbeard Island/Cabretta Island Bar	6	31.4331	-81.23509	Ground
13-May-2016	St Catherines Island (South)	50	31.56635	-81.184404	Ground
14-May-2016	Pelican Spit	200	31.204082	-81.312529	Ground
14-May-2016	Rainbow Beach, LSSI	30	31.217755	-81.30575	Ground
14-May-2016	St. Catherines Bar	80	31.69486094	-81.12422875	Ground
15-May-2016	Ogeechee Bar/Raccoon Key Bar	800	31.841545	-81.053452	Ground
16-May-2016	Beach Hammock/Little Tybee	500	31.943727	-80.928644	Ground
17-May-2016	Tybee/Tybee Bar	400	31.98063	-80.85597	Ground
18-May-2016	Beach Hammock/Little Tybee	120	31.943727	-80.928644	Ground
18-May-2016	Ogeechee Bar/Raccoon Key Bar	950	31.841545	-81.053452	Ground
19-May-2016	Blackbeard Island/Cabretta Island Bar	20	31.4331	-81.23509	Ground
19-May-2016	Cumberland Island	0	30.955574	-81.403226	Aerial
19-May-2016	Jekyll Island	0	31.10637	-81.404592	Aerial
19-May-2016	Saint Simons Island	0	31.150894	-81.364283	Aerial
19-May-2016	Gould's Inlet	40	31.159048	-81.364428	Aerial
19-May-2016	Pelican Spit	0	31.204082	-81.312529	Aerial
19-May-2016	Rainbow Beach, LSSI	0	31.217755	-81.30575	Aerial
19-May-2016	Little St. Simons Island	6	31.25097	-81.27527	Aerial
19-May-2016	Little Egg Island Bar	0	31.310308	-81.272663	Aerial
19-May-2016	Wolf Bar	0	31.315705	-81.259772	Aerial
19-May-2016	Wolf Island	0	31.326283	-81.286001	Aerial
19-May-2016	Sapelo Island (South)	220	31.38290644	-81.26906293	Aerial
19-May-2016	Blackbeard Island/Cabretta Island Bar	20	31.4331	-81.23509	Aerial
19-May-2016	Blackbeard Island	0	31.493507	-81.195399	Aerial
19-May-2016	St Catherines Island (South)	80	31.56635	-81.184404	Aerial

Date	Location	# of Knots	Latitude	Longitude	Survey Type
19-May-2016	St. Catherines Island (McQueen Inlet)	150	31.63680741	-81.13438373	Aerial
19-May-2016	St. Catherines Bar	50	31.69486094	-81.12422875	Aerial
19-May-2016	Ossabaw Island (South)	300	31.73501159	-81.11597422	Aerial
19-May-2016	Ossabaw Island (N. Middle Beach)	1033	31.783378	-81.061213	Aerial
19-May-2016	Ossabaw Island (North End)	150	31.8192064	-81.0363662	Aerial
19-May-2016	Ogeechee Bar/Raccoon Key Bar	0	31.841545	-81.053452	Aerial
19-May-2016	Pine Island	25	31.86930128	-81.02019624	Aerial
19-May-2016	Wassaw Island (South)	200	31.86453556	-80.98573196	Aerial
19-May-2016	Beach Hammock/Little Tybee	0	31.943727	-80.928644	Aerial
19-May-2016	Little Tybee Island	0	31.957692	-80.885872	Aerial
19-May-2016	Tybee/Tybee Bar	660	31.98063	-80.85597	Aerial
20-May-2016	Beach Hammock/Little Tybee	35	31.943727	-80.928644	Ground
20-May-2016	Ogeechee Bar/Raccoon Key Bar	250	31.841545	-81.053452	Ground
20-May-2016	Tybee/Tybee Bar	0	31.98063	-80.85597	Ground
21-May-2016	Beach Hammock/Little Tybee	20	31.943727	-80.928644	Ground
21-May-2016	Ogeechee Bar/Raccoon Key Bar	1600	31.841545	-81.053452	Ground
21-May-2016	Tybee/Tybee Bar	30	31.98063	-80.85597	Ground
22-May-2016	Ogeechee Bar/Raccoon Key Bar	150	31.841545	-81.053452	Ground
22-May-2016	Ogeechee Bar/Raccoon Key Bar	1150	31.841545	-81.053452	Ground
22-May-2016	Raccoon Key	200	31.856522	-81.060235	Ground
22-May-2016	The Egg Island near Ossabaw	50	31.83474	-81.063655	Ground
23-May-2016	Ogeechee Bar/Raccoon Key Bar	500	31.841545	-81.053452	Ground
24-May-2016	Gould's Inlet	15	31.159048	-81.364428	Ground
24-May-2016	Ogeechee Bar/Raccoon Key Bar	150	31.841545	-81.053452	Ground
24-May-2016	Pelican Spit	0	31.204082	-81.312529	Ground
24-May-2016	Rainbow Beach, LSSI	6	31.217755	-81.30575	Ground
25-May-2016	Blackbeard Island/Cabretta Island Bar	0	31.4331	-81.23509	Ground
26-May-2016	Beach Hammock/Little Tybee	0	31.943727	-80.928644	Ground

Date	Location	# of Knots	Latitude	Longitude	Survey Type
26-May-2016	Ogeechee Bar/Raccoon Key Bar	80	31.841545	-81.053452	Ground
27-May-2016	Ogeechee Bar/Raccoon Key Bar	110	31.841545	-81.053452	Ground
30-May-2016	Pelican Spit	2	31.204082	-81.312529	Ground
30-May-2016	Rainbow Beach, LSSI	0	31.217755	-81.30575	Ground
3-Jun-2016	Ogeechee Bar/Raccoon Key Bar	0	31.841545	-81.053452	Ground
4-Jun-2016	Beach Hammock/Little Tybee	0	31.943727	-80.928644	Ground