Report for the Nuttall Club

Examining Migration and Seasonal Interactions of Prairie Warblers Using Geolocators and Stable Isotope Analysis

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Objectives

We conducted a study in 2016 and 2017 on prairie warblers (*Setophaga discolor*), using geolocators to examine their migration and wintering locations. Our main objective was to track migrating prairie warblers from Massachusetts and New York to obtain novel data on wintering locations, migratory routes and schedules. A secondary objective was to examine relationships between birds' wintering habitat (using stable isotopes) and migratory schedules. Lastly, since prairie warblers are one of the smallest and lightest bird species to carry geolocators, we also examined the effects of the geolocators on prairie warblers' return rates.

Methods and Results

We have been extensively studying a color-banded population of prairie warblers in Montague, Massachusetts at the Montague Plains Wildlife Management Area since 2008 (Akresh et al. 2015). We conducted territory mapping and resighting in May and June 2016, and observed that a number of previously color-banded birds returned to the study site in 2016. In late May and June 2016, we captured prairie warbler males using target mist-netting, in order to attach geolocators on birds, and to capture and color-band additional males to use as 'control' birds when examining return rates. We attached geolocators (ML-6040 Biotrack/Lotek model) using a leg-loop backpack harness on 22 prairie warbler adult males (Peterson et al. 2015, Streby et al. 2015). With the leg-loops, the geolocator attachment was 0.45-0.47g. We used the leg-loop method as described by Streby et al. (2015), using 0.5 mm jewelry cord. The leg-loops were about 14-15mm from the knot to the end of the stretched loop. We are also collaborating with Dr. Steve Campbell and Neil Gifford at the Albany Pine Bush Preserve in New York. In New York, an additional 25 male prairie warblers were tagged with geolocators in 2016. At both sites, we have captured and color-banded additional males to examine return rates for birds with and without geolocators.

In Massachusetts, in 2016 we captured and attached geolocators on 11 males that had not been previously banded, and also attached geolocators on 11 returning males that had been banded in previous years (before 2016). Nine of the 22 birds were aged as birds

in their second year (SY), and the other 13 were aged as after second year (ASY). We attached geolocators on relatively larger individuals. The mean mass of the geolocator birds was 8.18g +/- 0.23g SD, and ranged from 7.78g to 8.83g. The average wing chord was 57.

Funding from the Nuttall Club allowed us to hire two field assistants in Massachusetts in late April and May of 2017. These field assistants greatly helped in surveying the plots and resighting the returning color-banded birds, and also assisted in capturing returning birds.

In late April and May of 2017, we re-sighted returning color-banded birds by visiting plots every 2-4 days (Akresh et al. 2015), in Massachusetts and also in New York. Returning birds with geolocators were captured with target and/or constant-effort netting. In Massachusetts, we resighted 9 of the 22 birds we put geolocators on (41%), and we were able to recapture all 9 birds and retrieve their geolocators (Figure 1). Some birds were very difficult to capture, and required setting up 12 mist-nets in their territory for 2-3 mornings, while other birds were easily captured with a single target net. Data was successfully downloaded from all 9 geolocators, but 3 geolocators had incomplete data (the batteries died during the non-breeding season). In New York, 12 of the 25 birds (48%) that had geolocators were resighted by our collaborators, although data was successfully downloaded from only 8 of these 12 birds. Almost all of the geolocator birds had some calluses on their backs, and some on their inner legs, due to the leg-loop harness and geolocator rubbing against the skin, but the birds otherwise seemed healthy.

In Massachusetts, the 41% return rate of geolocator birds contrasts with a slightly higher 55% return rate of 'control' color-banded birds (n=65) that were sighted or captured in 2016, and then observed in 2017. In contrast to these return rates, we observed a 72% return rate for 174 cases of banded, territorial males in 2008-2012 (Akresh et al. 2015). In 2016 and 2017, we did not determine if some of the birds were territorial or not, and some birds captured or seen in 2016 may have moved and set up a breeding territory off site. Thus, the lower observed return rates in 2016-2017, even for control birds, is likely due to including non-territorial birds in the sample. In Massachusetts, of the birds we attached geolocators on in 2016, only 2 of the 9 SY males returned (22%). In contrast, 7/13 (54%) of the ASY males returned. Of newly banded birds in 2016 that had geolocators, 4 of 11 returned (36%), while 5/11 (45%) previously banded birds returned. There was little difference in the mass of returning geolocator birds (8.13 g +/- 0.19 SD) versus not-returning geolocator birds (8.21 g +/- 0.26 SD). The lightest male that had a geolocator (7.78g) returned the following year.

In 2017, we were able to catch a number of geolocator birds close to their arrival dates, and took claw and blood samples from all these geolocator birds to analyze carbon isotope signatures ($\delta^{13}C$), which will indicate birds' wintering habitat (Marra et al. 1998). In addition to the 21 claw and blood samples obtained from returning geolocator birds in Massachusetts and New York, in Massachusetts we captured and sampled over 30 other birds in May to compare their isotope signatures with geolocator birds. Claw and blood

samples will be compiled from both sites and sent out (likely to the Cornell University Stable Isotope Laboratory) for stable isotope analyses in the near future.

We have so far conducted preliminary analyses of the geolocator light data, using the 'GeoLight' package in the R Statistical Program. A light intensity threshold of 2.5 units was used to determine twilight times (Figure 2). Initial results using this package show that prairie warblers in Massachusetts appear to be wintering in Hispaniola (n=9; Figures 3 and 4). Some birds appear to have wintering locations farther east, and others farther west, thus, some birds are likely wintering in Haiti, while others are wintering in the Dominican Republic. Based on estimated locations, the birds from New York (n=8) are also wintering on Hispaniola. During spring migration, birds appear to be migrating through Florida, and then up the coast to Massachusetts. Birds appear to be stopping over during migration within the Caribbean, in Florida, or in other states along the spring migration route up to Massachusetts. Fall migration routes were more difficult to determine, due to large variance in estimated geolocator locations. Some of the fall migration occurred during the equinox, making it difficult to determine locations based on the light data.

Future Work

Unfortunately, location estimates from the geolocator data are imprecise, and can have location errors on average of 100-200 km, which we noticed occurred even on the birds' breeding grounds. We will conduct future work to look into using newer analytical packages in R, such as 'FlightR' and 'SGAT', in order to obtain more precise locations throughout the migratory and wintering seasons (e.g., Cooper et al. 2017). These packages can conduct analyses such that there is little likelihood or probability of having a wintering location of the bird in the ocean. Additionally, the packages can use a sequence of geolocator locations to better determine and hone in on a single location at a given time. Lastly, these packages can attempt to get at migration speed and stopover locations.

In the coming year, we will continue our analyses with these other R packages, and send out the claw and blood samples for isotope analysis. We will then write up a manuscript for publication. We are very grateful to the Blake-Nuttall Fund for supporting this research. Please convey our appreciation to the members of the Nuttall Ornithological Club.

References

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Figure 1. A prairie warbler fitted with a geolocator.

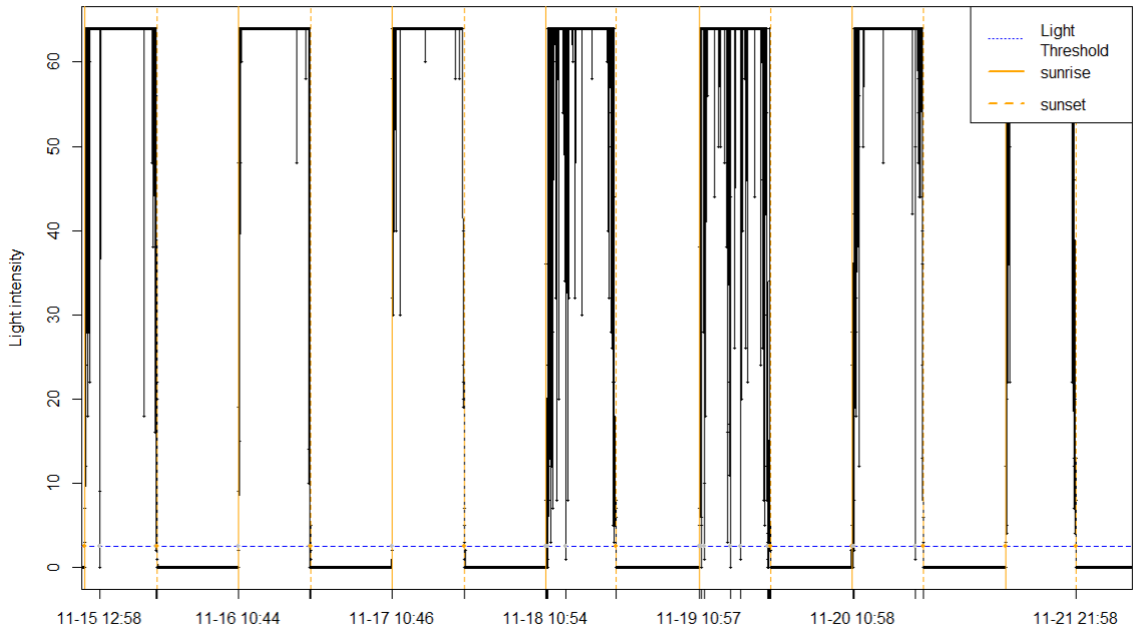

Figure 2. An example of a week of light data obtained from a geolocator placed on a prairie warbler.

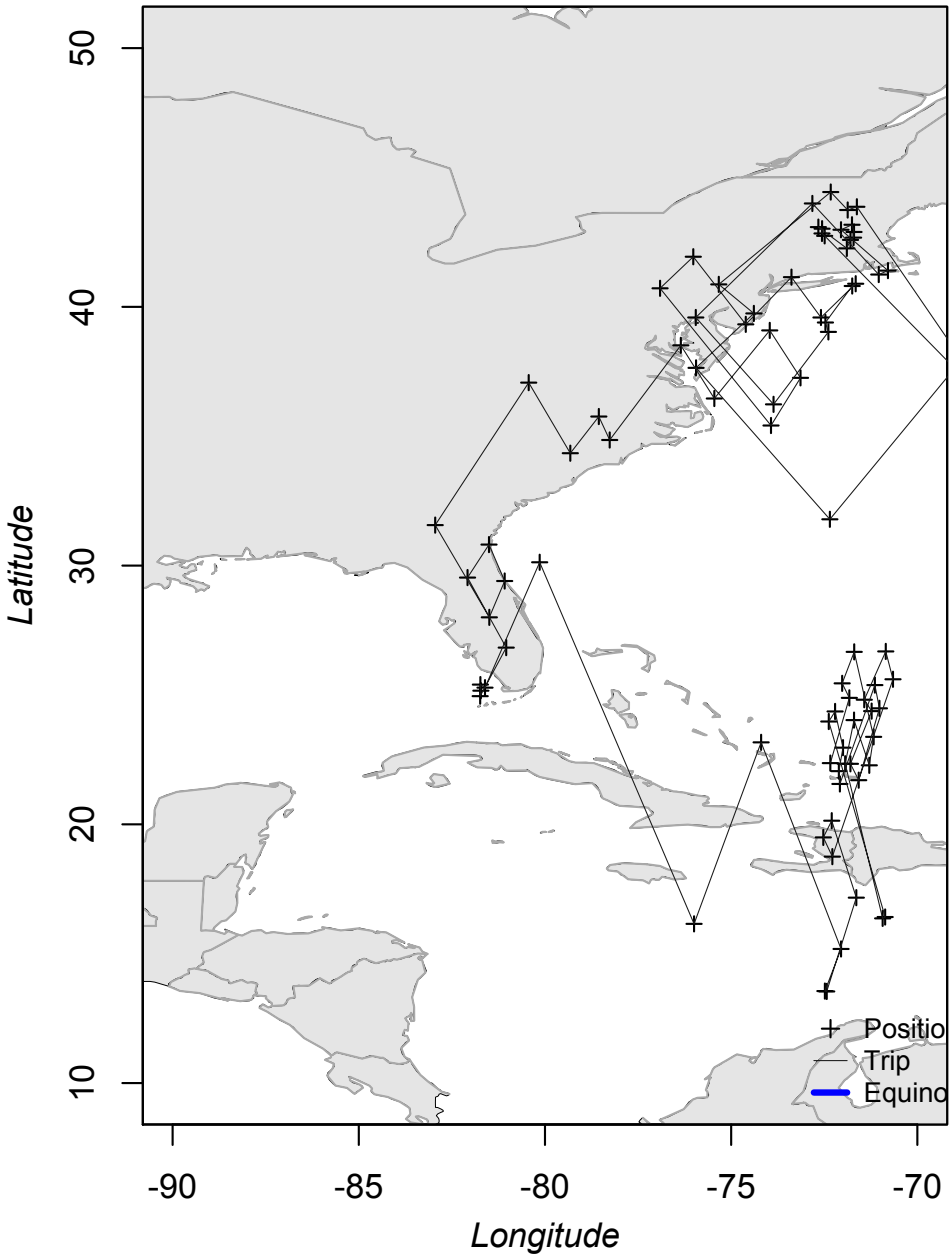

Figure 3. A preliminary examination of late winter, spring migration, and summer breeding locations in 2017 estimated from the geolocator light data for a single male prairie warbler breeding in Massachusetts. The analysis was conducted using the 'GeoLight' package in R.

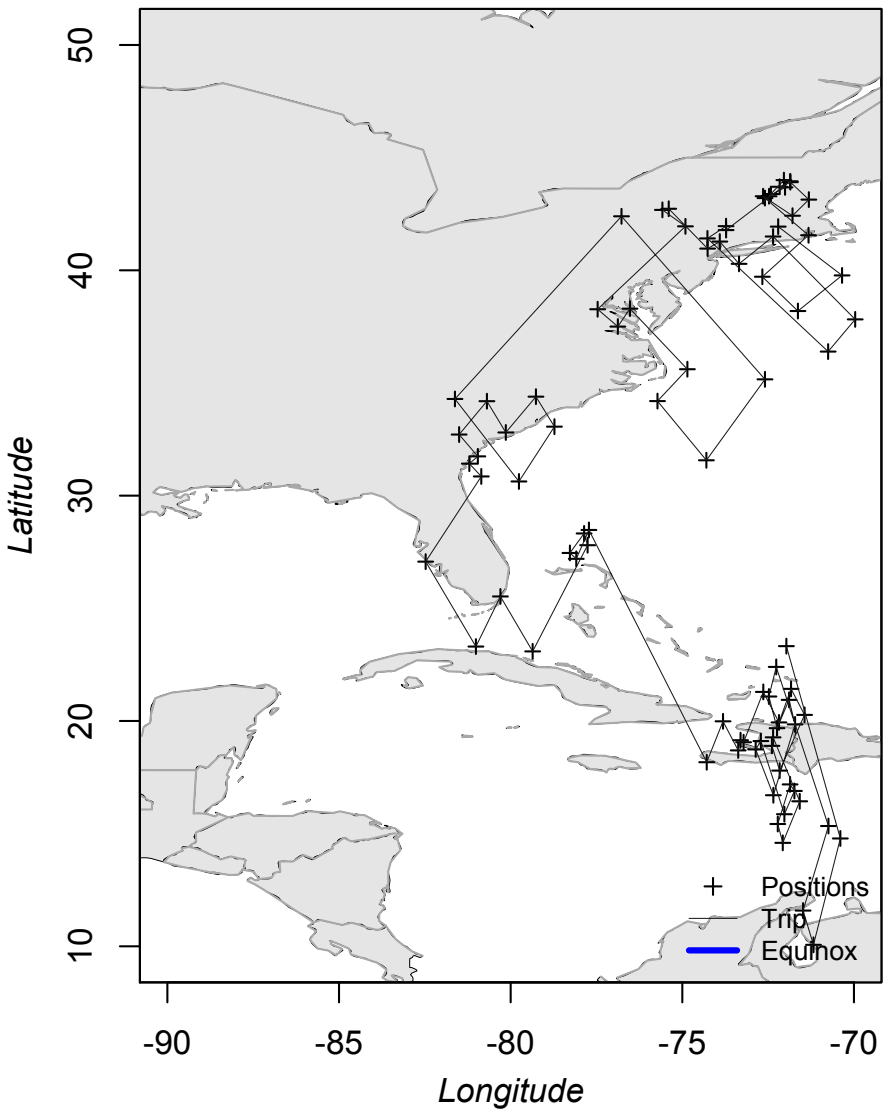

Figure 4. A preliminary examination of late winter, spring migration, and summer breeding locations in 2017 estimated from the geolocator light data for a different male prairie warbler breeding in Massachusetts. The analysis was conducted using the 'GeoLight' package in R.