

RADARS HELP IDENTIFY KEY STOPOVER SITES AND OTHER PATTERNS IN BIRD MIGRATION

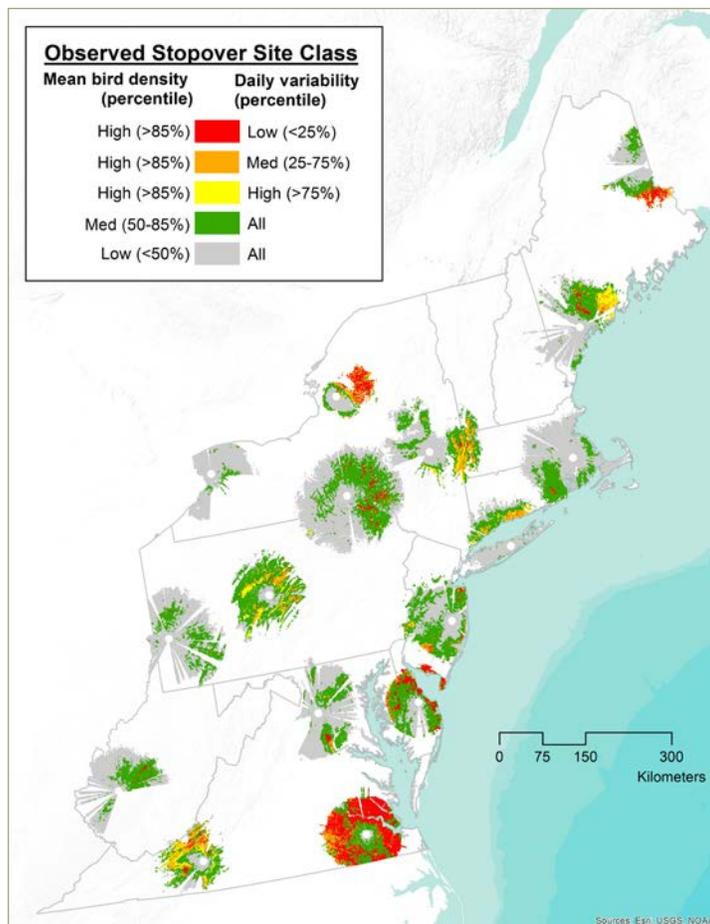
A majority of landbirds breeding in North America migrate to reach wintering grounds, which range from the southern U.S. to as far away as South America. Migration is not a direct flight; these birds typically make numerous stops, sometimes lasting days, during their migratory journeys. They spend most of their time resting and feeding at stopover sites rather than in actual migratory flight. Many bird species suffer higher mortality during the challenging and stressful migration period compared to other phases in their annual cycle, which means population sizes may be limited by events during migration. Effectively managing important migration stopover sites is therefore critical for the conservation of migratory landbirds.

The first step to protecting the most important sites is to figure out where they are located. In response to this need, Dr. Jeff Buler, at the University of Delaware, and his colleagues have used an analysis of NEXRAD weather radar data from the Northeastern U.S. (for the years 2008-2014) to predict potentially important stopover sites for migratory landbirds in these regions during the fall migration period. Their research also provides additional insights on factors influencing the density of migrating birds occurring at a given location, which suggest some management activities that could help improve the quality of stopover habitat for landbirds. The radar data analyses also yielded some cautionary results about the potential impacts of light pollution to migrating birds and trends in overall abundance of migratory landbirds. The full report on this project, maps and data depicting predicted bird density during fall migration, and a user's guide for these maps are now available through the North Atlantic [LCC's DataBasin data portal \(https://nalcc.databasin.org/galleries/f5cc97e920ec49dfb76bc039a53c3e0a\)](https://nalcc.databasin.org/galleries/f5cc97e920ec49dfb76bc039a53c3e0a). Below is a summary of key results and recommendations from this research.



Richard Hurd

Migrating American Redstarts are attracted to stopover sites with more caterpillars and ripe fruit.



What radar shows us: Radars detect birds initiating migratory flights from stopover sites and provide an estimate of the relative density of birds leaving a given location. This map depicts the relative average bird density (and daily variability) observed across the fall migration period within the area sampled by each of the radars used in this study. Red and orange areas most consistently have relatively high densities of birds using them throughout fall migration.

Ecological Associations at Patch, Landscape, and Regional Scales

Food availability and dense shrub cover: This research assessed ecological factors that influenced migrant landbird density in the Northeast at multiple spatial scales. At the patch level, migrant bird density was positively related to arthropod (insects and spiders) density and fruit abundance, which provide critical food sources for birds looking to refuel during stopover. This association was seen with several particular types of fruit, including grape, American holly, partridge berry, and species of Smilax. Bird density was also positively associated with dense shrub cover, which provides these small birds refuge from predators.

Land cover types: At the landscape level, results indicated that migrant birds favored landscapes with a greater amount of hardwood forest cover, but also showed clear preference for hardwood forest patches within more developed landscapes.

Distance to urban centers and the coast: Notably, bird densities increased at moderate to close distances to bright light emanating from urban centers, indicating a degree of light attraction by migrants at a broad scale (see below for more details). The most important regional-scale variable was distance to the coast, with highest bird densities closest to the Atlantic Ocean. Across the landscape and regional scales, results showed interactions among the positive responses of birds to vicinity to the coast, bright lights, and amount of hardwood forest, indicating that migrant stopover was extra concentrated in woods around brightly lit areas near the Atlantic coast.

Predicted Seasonal Bird Stopover Use During Fall Migration

Stopover use changes within the migration period: When the full fall migration period is broken out into two-week windows, subtle shifts in areas with predicted high stopover density are seen in the Northeast. Predicted bird densities for coastal Virginia and southern New England decline from high to medium over this period of

time, suggesting the importance of these areas for long-distance, neotropical migrants (warblers, vireos, flycatchers) which migrate during the earlier time windows. Predicted densities along the St. Lawrence River and northern borders of the U.S. generally increase from moderate to high over time, indicating their importance for the later-migrating short-distance, temperate migrants (sparrows, juncos, blackbirds).

Trends in Observed Bird Density During Fall Migration in the Northeast From 2008-2014

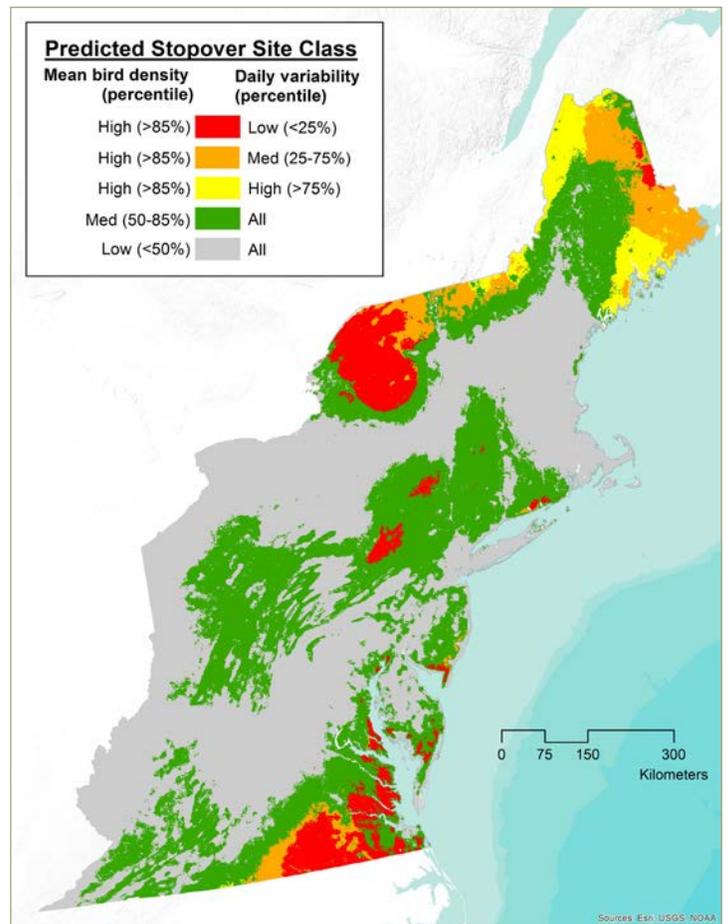
Trends over time: The observed radar data can also be analyzed to look for trends over time in bird densities at the radar sites. Such analyses, as depicted in this map, show declines in detected bird densities around many of the radars. The average trend across all radars was a decline of 4.2% per year in bird density, which equates to a 29% total decline from the period 2008-2014. Declines were particularly noticeable in Virginia, Massachusetts, and Maine. However increases were observed along the Connecticut coast, in New Jersey, and in parts of the Delmarva Peninsula. These radars only sample a limited amount of the Northeast region, so caution should be used in drawing conclusions about the whole region, but these results point to potentially disturbing declines in overall abundance of migrating landbirds over the period of this study. Such results are consistent with concerns highlighted in the recent Partners in Flight Landbird Conservation Plan (Rosenberg et. al. 2016 or insert link), which estimated that 46 landbird species in North America have lost half or more of their total populations since 1970.

Impacts of Artificial Light on Migrating Landbirds

Artificial light: Another noteworthy finding from this research is that migrant bird density increased at the regional scale with proximity to areas with bright lights, which correspond to areas with high proportion of developed (urban) land cover. This result suggests that in-flight migrating birds are attracted to artificial light at a broad scale. Combined with the results showing that migrants are also attracted to areas with larger amounts of deciduous forest cover, this study implies that migrating landbirds are being drawn to brightly-lit urban areas where they then try to find the most forested patches available. It is unclear whether these forests in more developed landscapes provide high-quality stopover habitat, but these results raise concerns about the impact of artificial light on migratory bird populations, drawing them into more developed landscapes where they can be exposed to additional predators, higher collision risks, and potentially lower-quality forest patches. Further details on these results are available in this publication: <http://onlinelibrary.wiley.com/doi/10.1111/ele.12902/abstract>.

Conservation Recommendations

- Forests and other natural habitats on or near coastlines are conservation priorities because they provide resting or landing sites for birds before or after overwater crossings. Coastal habitats are also important for landbirds that migrate along the coast, which may disproportionately be juvenile birds on their first migration.
- Migrants are drawn to brightly lit areas in and around urban areas and rely on forest tracts as well as tree canopy and shrub cover in parks and residential communities. Maintaining or enhancing these wooded areas should be encouraged.
- To improve stopover habitat quality, forests and wooded areas should be managed to improve vegetation structure (increase shrub density) and increase the abundance of fruit-bearing and native plants, which generally support more insects than non-native plants.
- Maps of predicted stopover densities identify sites throughout the regions with high or consistent use. At the local level, these maps could guide local conservation groups, land trusts, bird clubs, as well as local, state, and federal governments to select important sites for conservation work that would benefit migrating landbirds. The maps can also be useful at the regional scale for broader conservation planning.



Predicted stopover use at the regional scale: Observed bird stopover densities from the radars were used along with variables relating to geographic and landscape characteristics to develop models predicting bird stopover use across the entirety of the Northeast region, as shown here. Confidence in these predictions of stopover use should be considered highest near the radar sites where the observed data were collected, with lower confidence for areas farther away and more dissimilar from radar sites. For more details, see the full report referenced above.

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