

TURFGRASS TRENDS

NATURAL REFUGES

Golf Courses as Bird Habitats

Though research on golf course wildlife has increased dramatically in the past decade, researchers still don't know a lot about how animals adapt to golf courses. The high levels of human disturbance, pesticide use and habitat alteration often found on golf courses concern wildlife conservationists. Realistically, while golf courses are not "natural," they can rival the habitat features of parks, backyards, farms and military reserves as an integral part of the current landscape mosaic (Terman 1997). In many ways, golf courses are a better-than-nothing option in highly urbanized areas and subsequently may function as natural refuges depending on the rarity of natural landscape in the area (Jackson and Cristol 2010).

Research has focused on either estimating how many animals are using golf courses (diversity) or how successful wildlife is at raising offspring on golf courses (reproductive success). Though this research has helped tremendously with our understanding of how golf courses affect wildlife, scientists don't fully understand how animals move around and make use of the various habitat types on a golf course. Several studies have touched on this subject, looking at study species ranging from salamanders to wolves (McDonough and Paton 2007; Shepherd and Whittington 2006). Researchers on one Connecticut golf course used radio-tagged salamanders to demonstrate that these small amphibians have no problem crossing fairways to reach their desired breeding ponds (McDonough and Paton 2007). In Canada, a local golf course had problems with elk and other large game that were destroying habitat and creating problems for players. Researchers determined that the elk were staying close to humans to avoid being hunted by their natural predators, wolves, who are more wary of coming close to human activity. With the construction of a habitat corridor to allow wolves to move through the golf course, the elk population was forced to move to other, less-developed areas (Shepherd and Whittington 2006). Each of these studies illustrates how understanding animals movements within the golf course can help inform management decisions in ways that benefit golfers and wildlife.

Researchers at the College of William and Mary have been studying eastern bluebirds on golf courses in southeastern Virginia since 2003 and have shown that bluebirds can nest successfully on golf courses (LeClerc et al. 2005). However, until now there has been no information on what happens to the nestlings once they leave the nest. During this stage of their development, called the fledgling period, young birds must learn to find food and avoid predators. Their parents

Study examines home ranges and movements of Eastern bluebird fledglings

By Allyson K. Jackson and Daniel A. Cristol

Continued on page 40

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One of the authors, Allyson K. Jackson, holds an Eastern bluebird fledgling.

Ad Index

Advertiser	Page No.
Agrium Adv. Tech.	22-23
Andersons	28, 37, CV4
BASF	17, 27, CV3
Bayer Environmental	43
Becker Underwood	34
Bell Labs	2
Champion Turf	19
DuPont	5
FMC	12-13
Jacobsen	29
John Deere	6-7
Kochek	36
Linear Rubber	36
Nature Safe	21
NuFarm	32, 33
Pasteuria Bioscience	26
PBI/Gordon	18
Phoenix Environmental	38
Rain Bird	9
Sto-Cote	20
Syngenta	11
Toro	CV2
Turfco Mfg.	2

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Continued from page 39

help them for several weeks after leaving the nest, but then the fledglings are on their own (Gowaty and Plissner 1998). The fledgling period is not well documented, because they are secretive and have a low survival rate, and nothing was known about the fledgling period of birds on golf courses.

Comprehensive studies on fledgling movements have been lacking in the literature, as it has been nearly impossible to follow these cryptic birds, which have no fixed home range or territories. With the invention of radio transmitters that can be safely carried by small songbirds, fledgling studies have increased dramatically in the last five to 10 years (Brown and Roth 2004; Cohen and Lindell 2004; Yackel-Adams et al. 2006; Berkeley et al. 2007; Suedkamp Wells et al. 2008; Rush and Stutchbury 2008; Whittaker and Marzluff 2009, Moore et al. 2010). Through these studies, ornithologists have gleaned much new information about the habitat requirements of fledglings. Many studies have demonstrated that fledglings require different habitat than their parents, as they need more cover to hide from predators and food that's easy to find (King et al. 2006). This means that for baby birds to survive, they need to have multiple habitat types

in close proximity — first the nesting habitat used by the parents and then nearby fledgling habitat that they can use once they leave the nest. Fledglings that must travel further to get to suitable fledgling habitat are more likely to encounter dangerous circumstances than those that don't have to move very far.

Few studies attempt to estimate fledgling home range size, as it is complicated to analyze in fledglings because they usually don't set up or defend a territory. However, home-range analysis can be extremely useful in understanding how the fledglings use their space. The objectives of this study were to document the movement of eastern bluebird fledglings from the time that they fledged from the nest to approximately 40 days later. We will test whether home-range size differed between golf course and reference sites. If the habitat on golf courses isn't sufficient to support the fledglings' needs, we would predict larger home ranges.

Methods and study sites

We monitored eastern bluebird nests on three golf course and four reference sites in Williamsburg, Va. Golf courses were both public and private, and typical of the style found in Virginia. The reference sites included a wooded state park, two city parks and

one college campus. Eastern bluebirds nest in man-made nest boxes at each of these sites, making their reproductive success easy to monitor.

We attached small (less than 1 gram) radio-transmitters to 156 eastern bluebird nestlings while they were still in the nest. The birds then were allowed to fledge naturally (usually about two to six days later), and we followed their movements for 40 days after they fledged. We relocated each bird at least every other day, until the bird died, the transmitter died, or we lost the signal. Each time a bird was relocated, we took a global positioning systems (GPS) point to use for future analysis. Like the GPS system in automobiles, this provided us with spatial information accurate to a few meters. Fledglings suffer high mortality during this period, since they aren't yet proficient at flying (and so are easily caught by predators) and not yet good at foraging (and so starve if food is not abundant). Because of high mortality and transmitter loss due to other causes, we were able to track a total of 83 fledglings to 40 days postfledging.

We uploaded our fledgling GPS points into ArcGIS, (the Geographic Information System designed by ESRI Inc.) in order to combine the fledgling points into a home range on a map. In order to fully understand how the fledglings moved around in their environment, we first had to digitize aerial photographs so we could analyze the fledgling movements in terms of what type of habitat they were using. We took aerial photographs of Williamsburg and turned them into a digital map of the following habitat types: forest, park-like forest, impervious (i.e. man-made) surface, mid-level vegetation, short grass and water. We calculated the percentage of each type of habitat type around each nest box, within a 302 millimeter buffer (the size chosen because it encompassed 95 percent of all fledgling movements; Jackson 2010).

We calculated the home-range size for each fledgling, based on a "minimum convex polygon," which is the shape resulting from connecting the outer points among all those for each fledgling. We then compared the home-range size of birds on golf course and reference sites, to test our prediction that golf

course birds required more space than their reference counterparts.

Results and discussion

Home-range size varied considerably between fledglings, with a minimum home-range size of 0.3 hectare (ha) and a maximum of 51.3 ha. The average home range size was 5.9 ha. Fledglings on reference sites averaged larger home range sizes, but not significantly so (independent samples t-test, $t = 1.541$, $p = 0.127$). This could have been driven by a few reference sites with birds that moved much more than birds at other sites. Though no statistical differences were found between golf course and reference birds, there was a trend for larger home ranges in reference birds compared to golf course residents.

When we compared habitat types between each site, we found there was variation in the availability of each habitat type on each site, regardless of whether it was a golf or reference site. This indicates that differences in habitat occurred even among golf course and reference sites, and there was some overlap. In other words, the most naturalistic golf course resembled the most developed reference site.

When home-range size was compared between sites, we found there was variation between sites. The more natural/forested reference sites had the largest home ranges while the more urbanized sites, whether a golf course or a reference site, had the smallest home ranges. Therefore, as an area becomes more forested, the home-range size of eastern bluebird fledglings increases. This correlation could be caused by a combination of two different factors. First, considering that highly forested areas have less of the preferred open habitat that bluebirds use to forage, this may cause increased dispersal to locate suitable habitat. Conversely, urbanized areas may not have enough attractive surrounding habitat for the birds to disperse into and so the fledglings are confined to the area near their nest box.

Interestingly, many of the birds that fledged from golf courses left the site at some point before 40 days post-fledging. At one

Continued on page 42



Little evidence suggests that bluebird fledgling home range differs between golf course and reference habitat.

Continued from page 41

golf course site, almost all fledglings from all parts of the golf course moved onto an adjacent horse pasture. Here they created a large flock of 30 to 50 fledglings and foraged from fence posts and trees lining the pasture. Anecdotal, it appeared that the fledglings were much less disturbed by human activity here and so could concentrate more on learning how to forage on their own. At this site, the birds had a good option of where to go in the space surrounding the golf course. However, at another site there is much less suitable habitat surrounding the golf course, so birds that dispersed away from the golf course spent many days in the grassy area around the off ramp to a major interstate highway (not an idyllic situation).

In conclusion, we found little evidence that bluebird fledgling home range differs between golf course and reference habitat, indicating that bluebirds use the golf course habitat in the same way as reference habitats. However, many birds disperse away from the golf course habitat, indicating that it may be sub-optimal in some ways. We don't fully understand what would happen to these birds had there not been suitable habitat surrounding the golf course (e.g. in a more urban golf course).

This is just the first step in understanding how birds use golf course habitat. Future research should focus on how adult birds use the golf course habitat. For example, do large golf tournaments affect the home range of nesting birds? Do birds that nest on golf courses spend their time foraging on the turf or do they go elsewhere to find food? These questions are very useful to provide us with information about how to better organize golf courses to help wildlife. By setting aside more out-of-bounds areas, managers can provide wildlife the opportunity to avoid the activity and disturbance of the golf course, yet keep them close enough to be enjoyed by golfers.

Allyson K. Jackson and Daniel A. Cristol are from the Institute for Integrative Bird Behavior Studies in the department of biology at the College of William and Mary in Williamsburg, Va.

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