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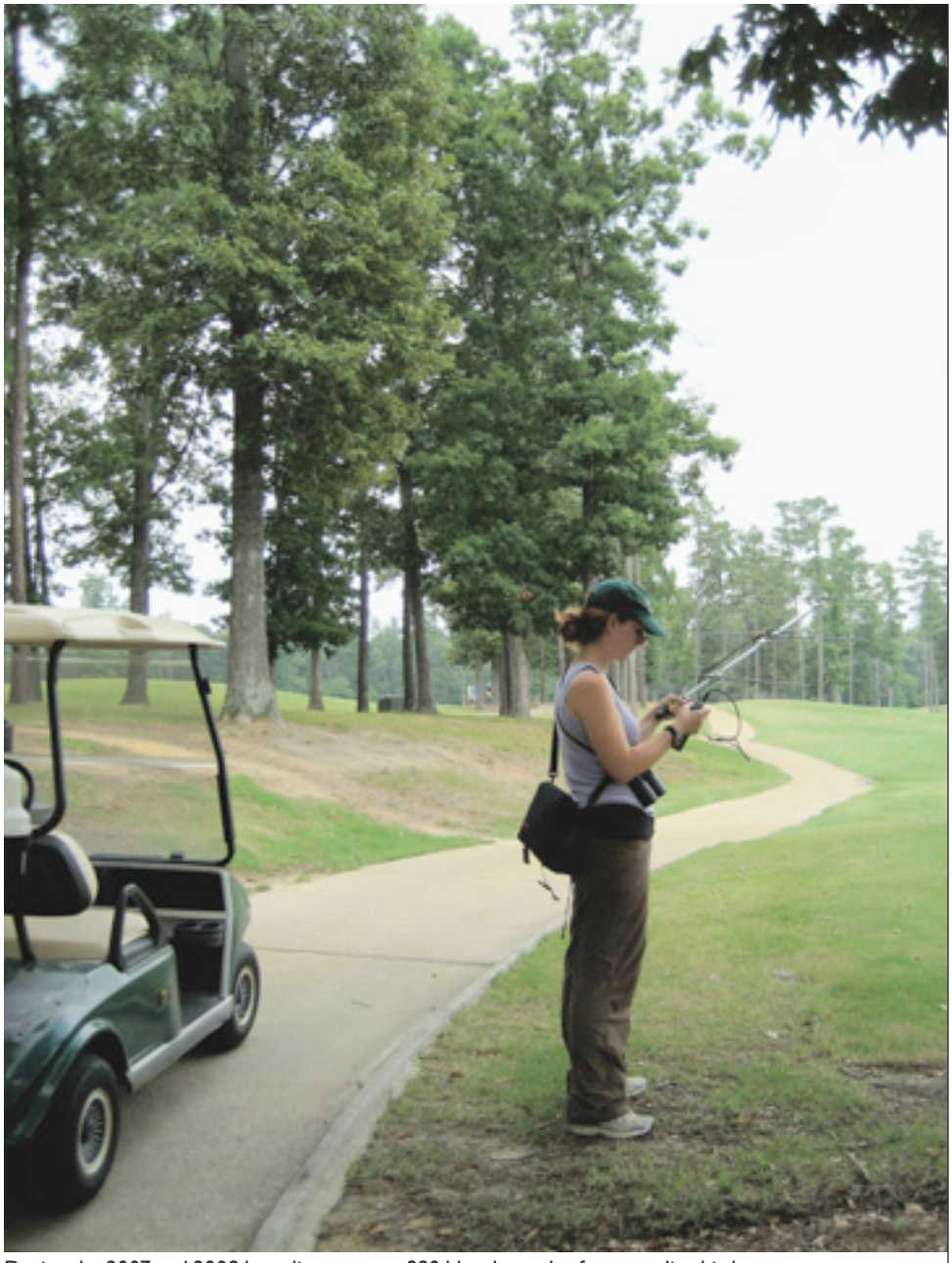
Bird Pesticide Exposure on Golf Courses

Scientists of The College of William and Mary track the success of eastern bluebirds on pesticide-treated golf courses.

BY RYAN B. BURDGE AND DANIEL A. CRISTOL



During the 2007 and 2008 breeding seasons, 290 blood samples from nestling birds were collected and analyzed.

OBJECTIVE

To determine the extent of pesticide exposure in nesting bluebirds and to determine if these insect-eating songbirds are able to obtain sufficient food on golf courses treated with insecticides.

Start Date: 2007
Project Duration: One year
Total Funding: $27,500

Several studies have illustrated the abundance and diversity of birds that can be found at golf courses, but less is known about nesting success. In addition, the chemicals often employed by golf course managers are known to negatively affect wildlife, including reproductive and behavioral impairments, yet the extent of avian (bird) exposure on golf courses remains largely unknown.

Studies indicate that eastern bluebirds can breed successfully in nest boxes installed on golf courses, but there also is evidence that the nestling birds weigh less than same-aged counterparts at suburban sites with no pesticide inputs. Our research objectives were to determine the extent of pesticide exposure in nestling bluebirds and to determine if these insectivorous (insect-eating) songbirds are able to obtain sufficient invertebrate food on golf courses treated with insecticides.

Experimental design consisted of monitoring and comparing breeding activity in more than 500 nest boxes at eight golf courses and seven non-golf

The project monitored and compared breeding activity in more than 500 nest boxes at eight golf courses and seven non-golf course reference sites in Virginia.

course reference sites. Our reference sites consisted of suburban locales with some level of human activity (e.g., local parks), but which were confirmed to not apply pesticides. Participating golf courses shared their detailed chemical application logs, allowing us to know specifically which type, where, and when pesticides were applied.

During the 2007 and 2008 breeding seasons, we collected and analyzed 290 blood samples from nestling birds to assess cholinesterase enzyme activities, the standard method for determining exposure to many common insecticides. These enzymes clear out the neurotransmitters after each nerve firing, so, if they are suppressed by insecticides, the birds' nervous systems would not function as well as they should, and wasting or death may follow. All nestlings were measured and banded during sampling efforts. We collected more than 450 prey items directly from nests through use of esophageal ligatures (a low-impact technique used to sample prey eaten by birds), and an additional 20 insects were collected from turf areas 24 hours after insecticide application. These 20 insects, and 30 insects from nests after pesticide application, were analyzed for pesticide residues.

Lab analyses found no evidence of enzyme inhibition in golf course nestlings, suggesting they had not been exposed to enough pesticide to detect any direct effects. No pesticide residues were detected in 50 prey insects. Nestling diet and parental feeding rates were the same at golf courses and reference sites. However, physical measurements of nestlings revealed that, as previously reported, golf course chicks weighed less than birds at reference sites of the same developmental age.

Much of the application of pesticides occurred after nestlings fledged from nests. Because the nestlings we sampled appear not to have been exposed to pesticides, additional research efforts are underway to track survival of fledgling bluebirds after they leave the nest.

These young, inexperienced birds may be more likely to be exposed to pesticides through ingestion of dead or moribund insects. If these young birds have a low survival rate, it may be that the successful nesting efforts observed for adult birds overestimate the habitat quality of golf courses. Only by measuring condition and survivorship at every stage of the life cycle can we gain confidence that golf courses are not ecological traps.

SUMMARY POINTS

- Nestling eastern bluebirds are at low risk of pesticide exposure on golf courses.
- Eastern bluebirds are able to forage comparable type and amount of insect prey on golf courses compared to other suburban environments.
- Nestling bluebirds on golf courses tend to weigh less than reference birds, potentially affecting post-fledging survivorship.
- Continued research will track survival and pesticide exposure in juvenile birds.
- Additional work is needed to assess pesticide exposure and associated effects in other golf course wildlife and at other stages of the life cycle.

RELATED INFORMATION

http://turf.lib.msu.edu/ressum/2008/76.pdf

http://people.wm.edu/~dacris/Research.php

http://www.wm.edu/news/ideation/current/the-sad-fate-of-bluebird-number-eight-2003.php

http://www.wm.edu/blogs/wmblogs/ideation/tracking-bluebird-number-37.php

RYAN B. BURDGE, *graduate student, Department of Biology, The College of William and Mary, Williamsburg, Va.; and* DANIEL A. CRISTOL, PH.D., *Professor of Biology.*

As nestling chicks were weighed, it was revealed that golf course chicks weighed less than birds of the same age found on reference sites.

CONNECTING THE DOTS

An interview with Dr. Daniel A. Cristol *regarding his and* Ryan B. Burdge*'s research of bluebirds on golf courses.*

Q: *For the golf courses that participated in your study, what were the primary pesticides of interest? Were those golf courses fairly similar in their pesticide products, rates used, and their application areas?*

A: Of the eight golf courses sampled during 2007, six used organophosphate (OP) and/or carbamate insecticides as part of their turf management practices. Of the remaining two courses, one use pyrethroids and one used nicotinyl-based insecticides. Neither of these types of insecticides are cholinesterase inhibitors, so any nestling exposure to these chemicals would have gone undetected in the present study. Insecticides used at the other six courses were the organophosphate chlorpyrifos (trade name Dursban Pro) and the carbamate carbaryl (trade name Sevin). Two of these six courses regularly applied chlorpyrifos at monthly intervals to greens to prevent cutworm outbreaks. The remaining four courses treated turf areas in response to pest infestations, generally in the summer months. As a result of this treatment practice, insecticide applications often occurred on dates when nestlings were older than eight days. Therefore, many blood samples were not collected at highest risk dates.

The bottom line is that we didn't sample that many nests right after treatments with OPs, but we did sample enough to see that there was not a widespread problem on these courses. Perhaps the best news of all was that there wasn't much overlap between insecticide use and bluebird nesting, which is why we shifted to looking at the fledgling stage after this study.

Q: *What were the most common insect prey on both the golf courses and suburban reference sites on which the bluebirds were feeding? Were you able to document that bluebirds on golf courses were preying on a significantly different combination of insects compared to the suburban reference sites?*

A: The surprise was that the birds were eating almost exactly the same proportion of the same kinds and same amounts of invertebrates on and off golf courses. Four things comprise the bluebird diet — large spiders, caterpillars, beetles of all kinds (including Japanese), and crickets/grasshoppers, including mole crickets. We expected the intensive land management and pesticides on golf courses to shift the prey availability, and it may have, but the birds are able to find what they need on or near the courses, and that is the bottom line.

Q: *How important is the habitat quality of the property immediately surrounding the golf course in affecting a project like yours? Would the results depend greatly on this?*

A: Several studies, our own and others in the U.S. and abroad, have found that the surrounding habitat is extremely important. You need good habitat around a golf course for high biodiversity on the course, and that means a lot of trees here in Virginia. Once houses get built all around the course, the number of species on the course drops. We have not yet completed the GIS analysis to know whether the habitat around courses also affects nestling survival and fledgling survival, but I predict it does, because bluebirds often leave courses to find forest insects, especially when feeding nestlings. Fledglings often leave courses and hang out in nearby pastures or fields also, and this may be important for them, finding different microhabitats throughout the first summer to get enough to eat and to get away from predators. This means that the actual course design and maintenance, while critical to wildlife, are only part of the picture. If wildlife is of concern, then the immediately surrounding habitat needs to be part of the plan as well.

Q: *Did you see a difference in the number of chicks fledged from the golf course sites versus the suburban reference sites?*

A: There is no difference in the number of chicks hatched or fledged, the timing of nesting, or the proportion of boxes occupied. What we have found repeatedly, and we found again in this study, is that golf course nestlings have a lower condition index, that is they are lighter than they should be for their size.This could be due to too little food, the wrong kinds of food, or pesticides, but we have not found any evidence to support these hypotheses.

Q: *Did your analyses showing no evidence of enzyme inhibition of the golf course bluebirds surprise you? What did you expect to see?*

A: Enzyme inhibition is a fleeting state and is tricky to document because of variability in activity with bird age and other variables. Whether we should have been surprised is unclear, but we didn't find any depression of neurotransmitter "cleanup" enzymes, so at least for these five golf courses and five- to eight-day-old bluebirds, we didn't find any evidence that pesticides are harming the breeding birds, which is great news. Yes, I was surprised, because when you see the sprays applied, you naturally think, "This can't be good for the birds . . . . I wouldn't want to touch those bugs, so they probably shouldn't either." For now, it's too soon to conclude that other courses, other birds, other ages of birds are safe, but we picked what we thought was a vulnerable age and species on courses that use reasonable amounts of pesticide, and we didn't find anything negative going on in terms of enzyme inhibition.

Q: *What did your sampling of insects 24 hours after insecticide application indicate as far as pesticide residue?*

A: We collected only 20 insects right off the course after spraying, as this was not in our original plan. We had thought we'd get what we needed from the birds, but there was rarely a spray event that coincided with nestlings of the right ages for collecting food. So for a worst-case scenario we collected dead insects right off of the greens, and even they turned out not to have detectable levels of chlorpyrifos, even though that is what had been sprayed the previous day. They also didn't have any of the following: azinphos methyl, diazinon, dimethoate, ethyl parathion, malathion, methamidophos, naled, phorate, phosmet, profenfos, and terbufos. This is really a preliminary finding and deserves a closer look. Those pesticide-killed bugs have to go somewhere, so we may just not have sampled adequately. But we did not find evidence of exposure in birds through eating recently sprayed insects.

Q: *If the nestling diets and parental feeding rates did not differ between the bluebirds on golf courses versus the suburban reference sites, and you found no evidence of enzyme inhibition in the golf course nestlings, how do you account for the lower weight of the golf course nestlings?*

A: This is still a puzzle and one we've been working on for five years, actually. First we thought it was direct pesticide exposure, then lack of food, and we have ruled those out. It could be that exposure to some other pesticide, perhaps a fungicide that is commonly used in this area, might be having subtle effects on growth or adult behavior. Or the nutrients in the food are different — perhaps the fertilizers in abundant use on the courses cause the food to be richer on golf courses, so nestlings' skeletons grow faster, making them seem too light for their size. I don't know the answer. This is the kind of puzzle that keeps us ecologists up at night. There are so many possibilities when development and growth are involved — hormones, nutrients, parental behavior, temperature, chemicals we didn't measure, etc. Check back in a few years — we'll nail this thing down!

Jeff Nus, Ph.D., *manager, Green Section Research.*