In the Thick of It

How Invasive and Exotic Shrubs Affect Breeding Birds

Not long ago, I opened my e-mail to find an urgent request from a relative. "Help! Can you please help us to stop our neighbor from destroying our bird habitat?" My relative described how a neighbor with aims to "restore" the natural area behind his backyard was removing nearly all of the vegetation. The neighbor had recently implemented similar management nearby that looked, to my relative, like a ravaged and barren landscape. No shrubs, no birds—nothing seemed to use the restored areas.

When confronted, the neighbor explained how the recently removed vegetation had been dominated by plants that were *invasive*, referring to species that can take over and threaten ecosystems by virtue of their high numbers, and *exotic* (or *non-native*), referring to species not originally from a particular area. Removing those plants, the neighbor explained, would allow native plants to reestablish, which ultimately would provide better habitat for birds. With city permits in hand, the neighbor removed the exotic plants and completed what he considered to be a successful restoration. But to my relative this was no success story. Instead of the usual hustle and bustle of birds, the area was still and silent.

You may have encountered similar situations, either firsthand or relayed through friends and family. Even when one knows the threats of exotic species, there can be tension between the temporary losses from short-term disturbance and the long-term gains of restoring native ecological communities. Among scientists and managers, there is a growing dialogue about *restoration*. Should we be so quick in condemning all exotic species as harmful and unwanted? Several ecologists have challenged the conservation community to consider possible positive effects of exotic species, or, at the very least, to ask whether the benefits of their removal justify the investments those efforts demand. Others remind us that invasive organisms represent one of the leading threats to biodiversity around the world, especially on islands.

What is best for birds? If we see birds using exotic plants, does that mean that those exotics benefit birds? Are habitats dominated by invasive plants necessarily worse than suboptimal habitats with native plant species? Those questions are not rhetorical. They are precisely the sorts of questions facing birders and habitat managers alike. As with any complex issue, there is no simple answer.

In this article, I share several lessons that my students and I have learned by studying the interactions between birds and a common exotic shrub in eastern North America, Amur honeysuckle (*Lonicera maackii*). Amur honeysuckle was introduced to the U.S. from Asia in the late 1800s and quickly became

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This **Gray Catbird** is eating the fruits of a non-native ("exotic") white mulberry (*Morus alba*). Are mulberries "good" for catbirds? Are they "bad"? And what about their effects on other bird species? This article describes an ongoing study in Ohio that looks at the direct and surprising indirect effects that exotic and invasive plants have on native bird populations and communities. *Galveston, Texas; April 2008. Photo by © Alan Murphy.*

a popular ornamental plant for landscaping because of its lush vegetation, fragrant flowers, and abundant fruit. Unfortunately, the attractive, animal-dispersed fruits of honeysuckle make it easy for the plant to invade natural areas to the point where honeysuckle can dominate the understory of many habitats. Ecologists have long known that the bush honeysuckles, including Amur, Tartarian (*L. tatarica*), and Morrow's (*L. morrowii*) honeysuckle, can have devastating consequences for native plants, including the spring wildflowers that briefly grace our forests before most other plants have leafed out (Gould and Gorchov 2000, Collier et al. 2002, Gorchov and Trisel 2003, Miller and Gorchov 2004). Honeysuckle also can negatively impact native amphibians (Watling et al. 2011) and ecological services such as pollination (McKinney and Goodell 2010), and it can even promote tick-borne disease (Allan et al. 2010).

But what about the birds? An astute observer may notice the absence of sensitive plants from areas heavily invaded by honeysuckle, but the full range of consequences for birds is more nuanced and can be easily obscured by the sheer number of birds seen using honeysuckle. When I walk through the forest parks near my Columbus, Ohio, home in early spring, I am struck by how readily birds nest in honeysuckle. Some birds, like Northern Cardinals, actually prefer nesting in honeysuckle to many other native plants (Leston and Rodewald 2006). When I tour the same forests in autumn, there are times when the shrubs are in constant motion as birds eat the abundant berries. Does that mean that honeysuckle is good for birds?

As a starting point, let's first ask, what is "good" for birds? Birds need habitat that provides food, water, cover from predators and exposure, and areas for nesting that allow them to reproduce successfully. If we view honeysuckle through this lens, we find some interesting and sometimes surprising patterns.

There is no question that some birds—Northern Cardinals, American Robins, and Gray Catbirds among them—heavily use honeysuckle for nesting and foraging. In general, species that heavily use honeysuckle are *ecological generalists* that occur in a wide range of habitats (Leston and Rodewald 2006, McCusker et al. 2010, Rodewald in press). *Ecological specialists*, in contrast, require very specific habitat features. Unlike many generalist species, specialists are more likely to decline in areas dominated by honeysuckle due to changes in the structure of habitat and the resources provided. One example is the Acadian Flycatcher, a neotropical migratory species that is declining in many parts of the U.S. Acadian Flycatchers prefer to breed in forests with fairly open and spacious understory vegetation, not the dense thickets that honeysuckle tends to create. Not surprisingly, then, Acadians avoid areas dominated by honeysuckle (Bakermans and Rodewald 2006, Rodewald in press; A. D. Rodewald, unpublished data).

You might be wondering, isn't it sufficient to know that at least *some* birds like honeysuckle? Does it really matter which ones? It does. From a conservation perspective, generalists tend to be of lower priority than specialists, as indicated by scores assigned by Partners in Flight, a public–private partnership that aims to conserve birds in the Western Hemisphere. Specialists also are more featured in management plans

Changing patterns of abundance and availability of fruit-bearing plants can induce large-scale shifts in the geographic distribution of native bird populations. A recent study <tinyurl.com/7gxlfhk> has shown a shift in the northern limits of the wintering range of the **American Robin,** a result thought to be due in part to increased availability of native and exotic fruits on the wintering grounds. *Franklin County, Ohio; January 2009. Photo by © Robert Royse.*

The **Acadian Flycatcher,** an ecological specialist, prefers to nest in forests with relatively spacious shrub layers. Invading honeysuckle quickly fills in the shrub layer, however, and Acadian Flycatchers decline or disappear. *Norfolk County, Ontario; August 1996. Photo by © Michael Patrikeev–VIREO.*

developed by conservation groups, including plans developed as part of the North American Bird Conservation Initiative. Even though generalist bird species undeniably contribute to our enjoyment, serve as good focal species for environmental education, and play important roles in ecosystems, they are usually not as important for regional or global conservation as specialist bird species that are negatively impacted by honeysuckle and other invasive plants.

Another issue is that simply counting birds does not provide enough information to evaluate the ecological consequences of an invasive or exotic plant. That's because human activities can change the environment in ways that contribute to the formation of *ecological traps*. An ecological or evolutionary trap results when a cue that once could be used reliably to indicate quality of a habitat, resource, or mate no longer conveys the correct information; as a consequence, organisms using the cue have lower performance, reproduction, and/or survival. Abundance of a bird or other animal population may actually be higher in ecological traps.

The presence of certain exotic shrubs, like common buckthorn (*Rhamnus cathartica*) and honeysuckle, can increase the risk of nest predation, especially early in the season before other plants have leafed out (Schmidt and Whelan 1999, Borgmann and Rodewald 2004, Rodewald et al. 2010). Nest predation is the primary cause of nest failure in most songbirds. Although many species attempt to nest again after failure, renesting may not compensate for lost productivity. For example, Northern Cardinals that nest in honeysuckle for their first nesting attempt produce 20% fewer young over the entire breeding season and across all of their subsequent nesting attempts compared to birds that place their nests in other plants (Rodewald et al. 2010).

Why does honeysuckle increase the risk of nest predation? Originally, my students and I suspected that the greater vulnerability to nest predation was a byproduct of plant architecture—for example, branching pattern. Nests in honeysuckle are usually closer to the ground than nests in native plants. Lower nests should be more accessible to predators, especially mammals like raccoons and domestic cats. The branching pattern of honeysuckle also would seem to facilitate climbing for certain predators. Our subsequent work, however, has shown that the risk of nest predation in honeysuckle lessens over the course of the breeding season, despite no change in nest height.

What does change is the vertical distribution of nests in the forest. Early in the season, before leaves of most native plants and canopy trees have emerged, the majority of open-cup nests in our forested sites are located in low shrubs, especially honeysuckle and multiflora rose (*Rosa multiflora*). If many birds nest in similar places, then it can be easier for predators to locate nests. Later in the season, when nests occur over a much wider range of heights and in a greater diversity of plants, predators cannot follow such simple *search rules* to locate nests. So it turns out that nests in honeysuckle are especially vulnerable to predation early in the breeding season, a time widely considered to be the most favorable for raising young.

Even for species that avoid nesting in honeysuckle, there can be reproductive consequences. Although Acadian Flycatchers seldom construct nests in honeysuckle plants, the number of young fledged by breeding pairs over the breeding

Supposed benefits of exotic and invasive fruit-bearing shrubs and trees may be more than offset by insidious indirect negative consequences. **Cedar Waxwings,** for example, are well known to flock to ornamental plantings; what is less widely known is that waxwing morphology and physiology are affected by what waxwings eat, in ways that are not necessarily beneficial for individuals and populations (see *Birding*, September/October 2007, pp. 62–68). *Kern County, California; February 2009. Photo by © Bob Steele.*

season declines with increasing amounts of honeysuckle in a forest patch (Rodewald in press). This pattern may be related to the observation that honeysuckle is associated with increased risk of brood parasitism by Brown-headed Cowbirds for Acadian Flycatchers (Rodewald 2009). Cowbirds lay their eggs in the nests of other species, which then raise the cowbird young as their own. The problem is that cowbird nestlings are more vocal, get fed more often, and grow faster than flycatcher young. Consequently, brood parasitism can lead to complete reproductive failure for the flycatcher.

Our recent work also shows that honeysuckle can affect the "information" that ornamental traits, such as feather color, convey about an individual bird's "quality." The brilliant red color of cardinals is produced by carotenoid pigments, which cannot be synthesized by the bird but must be consumed. Carotenoids from berries and other foods are best known for giving red, orange, and pink birds their colors; another important function of carotenoids is support of immune function. Thus, coloration in many bird species is a good indicator of diet, condition, territory quality, parental investment, and reproductive success (Hill 1991, Hill and Montgomerie 1994, Mougeot et al. 2010).

While this pattern is generally true for cardinals in the rural landscapes of central Ohio, our ongoing research shows that color is a less-useful indicator of condition for male cardinals in honeysuckle-dominated urban forests. In urban forests, the birds in the best condition have duller plumage than expected, whereas birds in poorer condition have brighter plumage than expected. We have also found that, for male cardinals in urban forests, plumage brightness is not related to territory quality (dense understory shrubs are best), timing of breeding (the best birds typically breed earliest in the spring), or reproductive success (the number of young produced over the breeding season). Overall, plumage brightness is a less-reliable signal of male quality for cardinals in urban than rural forests (Jones et al. 2010). Over time, this could result in *relaxed selection* for bright color. In other words, the proliferation of honeysuckle in the environment could trigger an evolutionary change in cardinals—a hypothesis that remains untested.

The widespread availability of "birdseed" and honeysuckle fruit may contribute to the disconnect between male color and condition. Honeysuckles, as a group, offer a rich source of carotenoids, but the genus tends to produce fruit that is lower in fat and protein content than many native fruits (Herrera 1987, Witmer and Van Soest 2002). In this respect, honeysuckle could be considered a carotenoid-rich but nutrient-poor food. Birdseed, in contrast, tends to be nutrient-rich but carotenoid-poor.

In another interesting twist, although honeysuckle is less dense in rural landscapes, it seems to create an evolutionary

Columbus, Ohio; May 2010. Photo by © Desiree Narango.

Against a backdrop of honeysuckle in early spring, Ohio State undergraduate Sammi Stoklosa handles a male **Northern Cardinal** that has been fitted with color bands, weighed and measured, and sampled for feathers. Students like Stoklosa build field skills while experiencing the pleasure (right) and pain (left) of ornithological research.

Columbus, Ohio; April 2011. Photo by © Laura Kearns.

Honeysuckle produces fruit in late summer and fall. The fruits in turn provide carotenoids, which are pigments that birds can use for both coloration and immune function. The catch is that most honeysuckles provide less nutrition than many native fruits. *Columbus, Ohio; September 2004. Photo by © Daniel Shustack.*

The characteristic red plumage of adult male **Northern Cardinals** is obtained from carotenoids in the birds' diet. Under normal circumstances, the brightness of a male's plumage is an accurate signal of male "quality." In honeysuckle-dominated urban forests, however, plumage brightness is a less-reliable signal of male quality; see text for details. *Columbus, Ohio; April 2005. Photo by © Daniel Shustack.*

trap in those areas. Our research has shown that in forests within rural landscapes, the brightest male cardinals are in the best physical condition, secure the most highly preferred territories, and breed earliest in the season. However, despite these seemingly good indicators of high-quality males, the brightest males ultimately produce the fewest young over the course of the breeding season. Why?

Our work suggests that the brightest-colored males prefer and successfully compete for territories containing dense honeysuckle. As previously noted, nesting in honeysuckle exposes birds to high rates of nest predation in the early season. This penalty for nesting in honeysuckle is greater for bright males because they also breed earliest in the season. Duller males, in contrast, ultimately have the advantage because they are less likely to breed in the dense patches of honeysuckle and breed later in the spring (Rodewald et al. 2011). So, in these rural landscapes, the brightest and otherwise highest-quality males produce the fewest young because they breed the earliest in honeysuckle.

You might wonder what all of this has to do with conservation and management. Without an awareness of the more subtle and indirect effects of invasive and exotic plant species, it is easy to make assumptions or draw simple conclusions that do not reflect the complexity of species interactions. Perhaps you have encountered such headlines as "Invasive Plants Can Create Positive Ecological Change" (Penn State 2011) and "Birds Loving Honeysuckle Invaders" (Wall 2011)?

Those two news releases called attention to a recent study showing high use of honeysuckle by fruit-eating and seed-dispersing birds like cardinals, Cedar Waxwings, and Gray Catbirds during the autumn. The authors interpreted high use as evidence that the birds benefit from and may even depend upon honeysuckle (Gleditsch and Carlo 2011). Because fruit-eating birds can be important seed dispersers, the authors suggested that removal of honeysuckle might not only negatively affect certain birds, but also have undesirable ecological and economic consequences. Not surprisingly, the original article and associated press coverage spurred some well-meaning managers of parks and natural areas to question their local efforts to control invasive plants. Although there may be certain situations in which invasive and exotic plants perform ecological services, the article and related press coverage told only one small piece of the story, one that is easily misinterpreted and taken out of context.

Honeysuckle provides an excellent example of the ways that a single invasive and exotic shrub can have serious, although not immediately obvious, negative effects on birds. By changing the structure of the habitat, honeysuckle can dissuade some sensitive species, such as the Acadian Flycatcher, from occupying habitats. By leafing out in early spring and making it easy for predators to locate nests, honeysuckle can increase the risk of nest predation and depress reproductive output. Honeysuckle also creates a situation in which the best and brightest birds have the lowest reproductive success. Finally, by providing abundant carotenoid-rich, but nutrient-poor fruits, honey-

A **Brown-headed Cowbird** nestling (right) develops faster than its **Northern Cardinal** brood-mate (left). Researchers are trying to work out the complex ways in which cowbird parasitism and honeysuckle invasion interact to affect bird populations. *Columbus, Ohio; June 2011. Photo by © Linnea Rowse.*

suckle might relax selection for the bright plumages of some of the most colorful birds that frequent our cities and gardens.

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Literature Cited

Allan, B. F., H. P. Dutra, L. S. Goessling, K. Barnett, J. M. Chase, R. J. Marquis, G. Pang, G. A. Storch, R. E. Thach, and J. L. Orrock. 2010. Invasive honeysuckle eradication reduces tick-borne disease risk by altering host dynamics. *Proceedings of the National Academy of Sciences of the United States of America* 107:18523–18527.

Bakermans, M. H. and A. D. Rodewald. 2006. Habitat selection by the Acadian Flycatcher: A hierarchical approach. *Auk* 123:368–382.

Amur honeysuckle is among the first woody plants to leaf out in spring in the Midwest and the East. Honeysuckle affects the timing of breeding not only by providing an early-season nest substrate, but also by changing the structure of the entire forest. In the foreground in this photo is an experimental plot from which honeysuckle has been removed. *Columbus, Ohio; April 2010. Photo by © Amanda Rodewald.*

Borgmann, K. L. and A. D. Rodewald. 2004. Nest predation in an urbanizing landscape: The role of exotic shrubs. *Ecological Applications* 14:1757–1765.

Collier, M. H., J. L. Vankat, and M. R. Hughes. 2002. Diminished plant richness and abundance below *Lonicera maackii*, an invasive shrub. *American Midland Naturalist* 147:60–71.

Davis, M. A., M. K. Chew, R. J. Hobbs, A. E. Lugo, J. J. Ewel, G. J. Vermeij, J. H. Brown, M. L. Rosenzweig, M. R. Gardener, S. P. Carroll, K. Thompson, S. T. A. Pickett, J. C. Stromberg, J. D. Tredici, K. N. Suding, J. G. Ehrenfeld, J. P. Grime, J. Mascaro, and J. C. Briggs. 2011. Don't judge species on their origins. *Nature* 474:153–154.

Gleditsch, J. M. and T. A. Carlo. 2011. Fruit quantity of invasive shrubs predicts the abundance of common native avian frugivores in central Pennsylvania. *Diversity and Distributions* 17:244–253.

Gorchov, D. L. and D. E. Trisel. 2003. Competitive effects of the invasive shrub *Lonicera maackii* (Rupr.) Herder (Caprifoliaceae) on the growth and survival of native tree seedlings. *Plant Ecology* 166:13–24.

Gould, A. M. A. and D. L. Gorchov. 2000. Effects of the exotic invasive shrub *Lonicera maackii* on the survival and fecundity of three species of native annuals. *American Midland Naturalist* 144:36–50.

Herrera, C. M. 1987. Vertebrate-dispersed plants of the Iberian Peninsula: A study of fruit characteristics. *Ecological Monographs* 57:305–331.

Hill, G. E. 1991. Plumage coloration is a sexually selected indicator of male quality. *Nature* 350:337–339.

Hill, G. E. and R. Montgomerie. 1994. Plumage color signals nutritional condition in the House Finch. *Proceedings of the Royal Society of London Series B–Biological Sciences* 258:47–52.

Jones, T. M., A. D. Rodewald, and D. P. Shustack. 2010. Variation in plumage coloration of Northern Cardinals in urbanizing landscapes. *Wilson Journal of Ornithology* 122:326–333.

Leston, L. F. V. and A. D. Rodewald. 2006. Are urban forests ecological traps for understory birds? An examination using Northern Cardinals. *Biological Conservation* 131:566–574.

McCusker, C. E., M. P. Ward, and J. D. Brawn. 2010. Seasonal responses of avian communities to invasive bush honeysuckles (*Lonicera* spp.). *Biological Invasions* 12:2459–2470.

McKinney, A.M. and K. Goodell. 2010. Shading by invasive shrub reduces seed production and pollinator services in a native herb. *Biological Invasions* 12:2751–2763.

Miller, K. E. and D. L. Gorchov. 2004. The invasive shrub *Lonicera maackii* reduces growth and fecundity of perennial forest herbs. *Oecologia* 139:359–375.

Mougeot, F., J. Martinez-Padilla, G. R. Bortolotti, L. M. I. Webster, and S. B. Piertney. 2010. Physiological stress links parasites to carotenoid-based color signals. *Journal of Evolutionary Biology* 23:643–650.

Penn State. 2011. *Invasive Plants Can Create Positive Ecological Change* <tinyurl.com/4sgspwj>.

Rodewald, A. D. 2009. Urban-associated habitat alteration promotes brood parasitism of Acadian Flycatchers. *Journal of Field Ornithology* 80:234–241.

Rodewald, A. D. in press. Evaluating factors that guide avian community response to urbanization. *Studies in Avian Biology*.

Rodewald, A. D., D. P. Shustack, and L. E. Hitchcock. 2010. Exotic shrubs as ephemeral ecological traps for nesting birds. *Biological Invasions* 12:33–39.

Rodewald, A. D., D. P. Shustack, and T. M. Jones. 2011. Dynamic selective environments and evolutionary traps in human-dominated landscapes. *Ecology* 92:1781–1788 <tinyurl.com/cakxyd8>.

Schmidt, K. A. and C. J. Whelan. 1999. Effects of exotic *Lonicera* and *Rhamnus* on songbird nest predation. *Conservation Biology* 13:1502–1506.

Wall, T. 2011. *Birds Loving Honeysuckle Invaders* <tinyurl.com/4hqtyte>.

Watling, J. I., C. R. Hickman, E. Lee, K. Wang, and J. L. Orrock. 2011. Extracts of the invasive shrub *Lonicera maackii* increase mortality and alter behavior of amphibian larvae. *Oecologia* 165:153–159.