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NOTES

ORIENTAL BITTERSWEET IN GRASSLANDS NEAR EASTERN BLUEBIRD NEST BOXES

Oriental bittersweet (*Celastrus orbiculatus* Thunb.; hereafter OB) is an invasive, woody vine that has been expanding its range westward in North America since its introduction from East Asia in the mid-1700s for horticultural purposes (Albright et al. 2009, United States Department of Agriculture [USDA] 2012). Although typically a woodland problem in the United States (McNab and Meeker 1987), OB can invade grassland habitats (Fike and Niering 1999), likely sprouting from seeds dropped by birds and mammals (McNab and Meeker 1987, Greenberg et al. 2001, Sarver et al. 2008) and often developing into large, shrub-like tangles of intertwining stems (Fike and Niering 1999). Once established, OB can easily out-compete native plants because of its superior growth rate, high seed production, and high rates of seed dispersal and germination (Greenberg et al. 2001, Leicht and Silander 2006, Leicht-Young et al. 2007a, b).

Oriental bittersweet was first reported in Minnesota in 2010, although it likely was present previous to that date (Minnesota Department of Agriculture [MDA] 2012, USDA 2012). Oriental bittersweet occurs mainly along highway corridors and has converted the forest-grassland edge habitat into OB monoculture jungles, overrunning and killing shrubs and trees. In many areas in southeastern Minnesota, OB has invaded deeper into grasslands along fence lines and around isolated shrubs and artificial nest boxes placed for eastern bluebirds (*Sialia sialis*; N. D. Mundahl, Winona State University, unpublished data).

I have erected and maintained nest boxes for bluebirds in southeastern Minnesota for over 20 years. In recent years, OB appeared in the immediate vicinity of many nest boxes and around trees nearby where bluebirds often perch. I was concerned that my nest boxes and the bluebirds attracted to them were responsible for the spread of OB into new habitats. Consequently, I decided to assess the possible association of OB and bluebird nest boxes. I hypothesized that OB was more likely to occur in habitats near nest boxes than in habitats without nest boxes. I also examined the extent of spread of OB into grassland habitats, hypothesizing that the spread would be greater in association with nest boxes.

My study was conducted in and near a residential subdivision in the city of Winona, Minnesota, USA. The area included developed and undeveloped portions of the subdivision (55 ha combined), an adjacent non-mowed section of parkland (1.5 ha), and grassland bordering a nearby cemetery (2 ha). All sites were old-field habitats bordering deciduous forests. Bluebird nest boxes (mix of wood Peterson nest boxes and Gilbertson PVC nest boxes, in pairs or as individual boxes) had been placed in the undeveloped portion of the subdivision and the non-mowed park in 1991. Bluebird nest boxes were located in open fields at varying distances (10

to 50 m) from forest edges. Additional nest boxes had been added over time by individual homeowners (in both mowed and non-mowed yards) and by the owners of an adjoining horse farm (nest boxes placed along pasture fence lines). Oriental bittersweet became common around several nest boxes in the study area in 2006, necessitating regular (twice yearly) pruning and removal from around these boxes.

Old-field habitats in the study area (valley floor and lower side hills) were dominated by smooth brome (*Bromus inermis*), goldenrod (*Solidago* spp.), Queen Anne's lace (*Daucus carota*), and rough bedstraw (*Galium asprellum*), with small (<5 to 20 m²) patches of reed canarygrass (*Phalaris arundinacea*). Upper hillsides were covered in oak-basswood forests (red oak [*Quercus velutina*], American basswood [*Tilia americana*], black walnut [*Juglans nigra*], paper birch [*Betula papyrifera*]), although European buckthorn (*Rhamnus cathartica*), tartarian honeysuckle (*Lonicera tatarica*), black locust (*Robinia pseudoacacia*), box elder (*Acer negundo*), and OB were common in the forest edge understory.

I used two approaches to examine the possible association of OB with bluebird nest boxes within developed and undeveloped sections of the subdivision. First, I compared OB presence-absence at forest edge sites with and without nest boxes nearby (nest box sites = 20, non-nest box sites = 29; sites separated by >50 m, non-nest sites selected at random), using a Chi-square contingency table test to analyze the data. Second, I used a qualitative rating system to examine the severity of OB infestations at these same sites where:

- 0 = no OB present
- 1 = few OB plants, not growing on most shrubs
- 2 = OB growing on most shrubs, not in canopy
- 3 = OB on all shrubs and into canopy trees

I conducted ratings during March 2012 and again during January 2013 to reconfirm ratings. I used a Mann-Whitney test to compare the qualitative ratings of nest box sites and non-nest box sites.

I assessed the spread of OB into grasslands within the subdivision where nest boxes were present and in the cemetery field where no nest boxes were located. To standardize comparisons, I selected only sites where OB infestations in the forest edge rated a 3 on the rating scale described above (nest box sites = 13, non-nest box sites = 7). After searching to locate the OB plant at each site most distant from the forest edge, I measured that distance perpendicular to the forest edge with a meter tape. These encroachment distances were compared between nest box and non-nest box sites with a t-test. Statistical analyses were conducted using VassarStats (Website for statistical computation; <http://vassarstats.net/>).

Oriental bittersweet was present at 100% (20/20) of sites with bluebird nest boxes and 93% (27/29) of sites lacking nest boxes. Because of this high rate of occurrence at all sites, there was no difference ($\chi^2_1 = 0.22$, $P = 0.639$) in OB

presence/absence between nest box and non-nest box sites. Ninety percent (18/20) of bluebird nest box sites had OB infestations that covered most woodland edge shrubs and climbed into the canopies of large trees (severity rating = 3), whereas only 55% (16/29) of non-nest box sites had this level of OB infestation. Overall, OB infestations were worse (i.e., ratings were higher; Mann-Whitney $U = 186.5$, $P = 0.018$) for nest box sites than for non-nest box sites.

Oriental bittersweet encroachment into grassland habitats ranged from 18 to 64 m at the sites examined. Oriental bittersweet was common at the forest-grassland boundary, but OB plants also were present far out into the grasslands. Oriental bittersweet plants further from the forest edge often were associated with bluebird nest boxes (entwining the post or growing in the immediate vicinity) or isolated shrubs or samplings. Presence of bluebird nest boxes was associated with greater ($t_{18} = 5.43$, $P < 0.001$) spread of OB into grasslands, with average encroachment distance nearly twice as great at nest box sites (47.52 m, $SD = 9.53$ m) than at non-nest box sites (26.27 m, $SD = 5.25$ m). Indeed, encroachment distances at all nest box sites were greater than the maximum encroachment distance at any non-nest box site.

Oriental bittersweet infestations were more severe in the vicinity of nest boxes than in areas without nest boxes and OB plants spread further into grasslands when nest boxes were present. I suspect that OB became established first near nest boxes, given the heavier, current infestation levels near nest boxes (1 to 2 m immediately around the nest boxes as well as around nearby trees where bluebirds often perched), and subsequently spread to other locations from these first sites (Jones 2012). I also have found mature, seed-producing OB plants within 1 to 2 m of bluebird nest boxes along roadways in Olmsted and Goodhue counties, with no OB beyond a 20-m radius from nest boxes.

It is likely that OB was present in the study area for at least a decade prior to this study (many plants in the study area were determined to be 8 to 12 years old; N. Mundahl, Winona State University, personal observation), giving the species plenty of time to become established and spread from initial colonization sites (Albright et al. 2009, Jones 2012). I have observed OB in many other habitats (e.g., urban lake shore, isolated bluff prairie, fence lines along agricultural fields) within Winona County, as well as several other counties (Olmsted, Goodhue, Rice) in southeastern Minnesota. Many of these sightings are not found in the current "official" distribution records because they occur on private property and cannot be reported without consent of the property owner (United States Department of Agriculture 2012). The westward expansion of OB through Minnesota continues with little publicity or awareness, with its arrival in the prairie region of southwestern Minnesota likely in the near future.

Seeds of OB are dispersed (possibly up to a kilometer or more) primarily by birds and mammals that consume the fruits (McNab and Meeker 1987, Dreyer 1994, Greenberg et al. 2001, Sarver et al. 2008). Oriental bittersweet fruits and

seeds are only available during fall and winter (Greenberg et al. 2001), so they would not be consumed and transported by birds using nest boxes during the summer nesting season. Consumption of seed-containing berries and subsequent seed dispersal most likely occur during mid- to late-winter (Greenberg et al. 2001). Berry-eating birds such as eastern bluebirds, American robins (*Turdus migratorius*), and cedar waxwings (*Bombycilla cedrorum*) all overwinter in the area, and flocks of all three species are sighted frequently in the study area valley during the winter months (December through March). These and other species of birds use the nest boxes as perches during the winter and bluebirds may roost in them during winter nights (Stokes and Stokes 1991), enhancing the likelihood of birds defecating OB seeds around or near nest boxes and thereby allowing OB to more quickly disperse deeper into grassland habitats. Oriental bittersweet berries and/or seeds also may be carried to nest boxes by mice (*Peromyscus* spp.), which often inhabit unopened nest boxes during winter months (N. Mundahl, Winona State University, unpublished data). Nest boxes and nearby forest edges where birds perch and mice forage become the points of OB introduction, with the species gradually spreading to fill the grassland between nest box and forest edge and beyond via vegetative root sprouting (Dreyer et al. 1987) or seed production and germination. Consequently, OB in grasslands is more likely to be associated with nest boxes, OB infestations initially are more severe in the vicinity of nest boxes, and encroachment distance of OB into grasslands is greater when nest boxes are present.

People who erect and maintain nest boxes for bluebirds in areas where OB is present need to be educated about OB and methods for controlling or managing it. Recommendations to place nest boxes in open areas away from woodlots and brushy areas (Stokes and Stokes 1991) can reduce the likelihood of OB becoming established near nest boxes. However, OB has been observed growing around nest boxes hundreds of meters from woods and brush (N. Mundahl, Winona State University, unpublished data), highlighting the need for vigilance by the nest box caretaker and immediate removal of any young OB that might appear in the vicinity of nest boxes. — Neal D. Mundahl, Department of Biology, Winona State University, Winona, MN 55987, USA, Corresponding author email address: nmundahl@winona.edu.

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