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Invasive shrub species as nest substrates do not appear to impact nest failure for Yellow Warblers (*Setophaga petechia*)

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ABSTRACT—The Yellow Warbler (*Setophaga petechia*) is a Neotropical migratory passerine that breeds in riparian and other wetland habitats across North America. Yellow Warblers use several woody plants as substrates to build nests on, including both native and invasive species. We monitored Yellow Warbler nests from 2018 to 2021 in east-central Illinois, USA, and observed similar numbers of nests in invasive and native plant substrates. We also documented qualitatively lower nest mortality for nests placed in invasive plants compared to native plants. The patterns documented here could suggest that for Yellow Warblers, invasive plant encroachment in riparian habitat may not have strong negative repercussions on their reproductive success. *Received 26 April 2023. Accepted 26 December 2023.*

Key words: invasive species, nest substrate, nest survival.

Especie invasiva de arbusto como sustrato de nido no parece impactar el fracaso del nido para reinita amarilla (*Setophaga petechia*)

RESUMEN (Spanish)—La reinita amarilla (*Setophaga petechia*) es un passerino migratorio neotropical que se reproduce en hábitats riparios y en otros humedales en Norteamérica. Las reinitas amarillas usan varias plantas leñosas como sustrato sobre los cuales construir sus nidos, incluyendo tanto especies nativas como invasoras. Monitoreamos nidos de reinita amarilla del 2018 al 2021 en la región centro-este de Illinois, Estados Unidos, y observamos números similares de nidos en sustratos de plantas nativas y no nativas. También documentamos una mortalidad de nidos cualitativamente menor para nidos colocados sobre plantas invasoras que sobre plantas nativas. Los patrones documentados aquí podrían sugerir que para la reinita amarilla, la llegada de plantas invasoras en hábitats riparios podría no tener fuertes repercusiones negativas en su éxito reproductivo.

Palabras clave: especies invasivas, sustrato del nido, sobrevivencia del nido.

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The Yellow Warbler (*Setophaga petechia*) is a Neotropical migratory passerine that breeds in

riparian and other wetland-edge habitats across North America and uses several woody plant substrates for nest building (Lowther et al. 2020). Yellow Warblers place their nests in native mesic shrubs such as dogwoods (*Cornus* spp.), willow saplings (*Salix* spp.), and grape vines (*Vitis* spp.), as well as mature native trees in riparian habitat such as oaks (*Quercus* spp.) and sycamores (*Platanus* spp.) (Knopf and Sedgwick 1992, Tonra et al. 2009, Latif et al. 2011a, Lowther et al. 2020). Yellow Warblers also commonly use exotic, invasive plants as nest substrates, including Japanese honeysuckle (*Lonicera japonica*), autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), and hawthorns (*Crataegus* spp.) (Schlossberg and King 2010, Lowther et al. 2020).

For North American passerines, invasive shrubs as nest substrates can reduce, increase, or have neutral effects on nest survival (reviewed in Nelson et al. 2017). For example, nests of Northern Cardinals (*Cardinalis cardinalis*; Rodewald et al. 2009) and Veeries (*Catharus fuscescens*; Meyer et al. 2015) are more likely to fail when placed on invasive substrates compared to native substrates, likely due to higher nest predation rates in the former. In contrast, a study on 17 shrub-nesting passerines found that invasive plant substrates only negatively influenced nest survival for one species, the Gray Catbird (*Dumetella carolinensis*; Schlossberg and King 2010). Given the mixed published impacts of invasive plants on avian nest success, it is important to assess species-specific responses to invasive plant encroachment to better inform the conservation and management of avian habitats.

From 2018 to 2021 we studied nest defense behaviors of Yellow Warblers breeding in east-central Illinois, USA (Lawson et al. 2021, 2023), during which we also monitored nests and determined their fates. In our study system, we detected half of the Yellow Warbler nests having been placed on invasive plants (52%; Fig. 1). We report here on patterns suggesting that invasive plants may not negatively impact Yellow Warbler reproductive success when used as nest substrates, which is counter to some other published studies on other North American passerines (Schlossberg and King 2010, Gleditsch 2017, Nelson et al. 2017).



Figure 1. A Yellow Warbler (*Setophaga petechia*) chick in a nest in Siberian elm (*Ulmus pumila*), a shrubby invasive nest substrate.

Methods

Study sites

All data were collected from sites located in Champaign County ($n = 3$), Vermilion County ($n = 3$), and Iroquois County ($n = 1$) in Illinois, USA. All sites contained riparian habitat with isolated shrubland patches dominated by dogwoods and willows for native species, and by Japanese honeysuckle, autumn olive, and multiflora rose for invasive species. Shrubland patches were adjacent to upland

grasslands and interspersed with an open tree canopy of oaks (*Quercus* spp.) and cottonwoods (*Populus* spp.). We did not collect vegetation data to formally assess if native and invasive shrubs' relative composition and their respective distributions differed across Yellow Warbler territories. Anecdotally, however, all territories appeared similar in vegetation characteristics and the presence of both native and invasive shrubs. We recognize that vegetation data are important to consider in studies on nest site selection and return to this point in the Discussion.

Nest searching and monitoring

During breeding seasons (early May through mid July; Lawson et al. 2021, 2023) of 2018–2021, we systematically searched for Yellow Warbler nests at all sites 1–2 times a week, focusing efforts on territories of known breeding pairs. For all nests, we recorded the nest substrate type (binary variable, native or invasive). After discovery, we monitored nests every 3–5 d to determine the nest fate (binary variable, fledged or failed). Nests close to predicted fledging dates were monitored every 1–2 d to confirm fate. We labeled nests as failed if contents disappeared before the anticipated fledging date, or if abandonment occurred (no parent present after 2–3 nest checks, eggs cold to the touch).

Using SAS 9.4 (SAS Institute, Cary, North Carolina, USA) with $\alpha = 0.05$, we conducted a Pearson's chi-square test to evaluate if nest fate was influenced by substrate type ($n = 35$ nests in native substrate, $n = 37$ in invasive substrate). We also qualitatively compared nest survival patterns of each substrate type by calculating daily mortality rate (DMR) and associated nest failure percentages for nests in each substrate type ($n = 18$ per native and per invasive) following Mayfield (1975), by dividing the number of failed nests by nest exposure days (a 24 d period from egg laying to fledging for Yellow Warblers; Lowther et al. 2020).

Results

Contrary to published expectations (Schlossberg and King 2010, Gleditsch 2017, Nelson et al. 2017), there was a trend toward more nests failing

in native substrates compared to invasive substrates (88% vs. 70% of nests), but the proportions were not statistically significant (Pearson's $\chi^2 = 3.43$, $P = 0.06$). Daily mortality rate was qualitatively higher for nests placed in native substrates compared to invasive options (0.15 vs. 0.04). Nest failure percentage, estimated from DMR values, was qualitatively lower for nests in invasive substrates compared to native substrates (0.62 vs. 0.98).

Discussion

The patterns we observed may suggest that Yellow Warblers are not susceptible to higher nest failure when using invasive plants as nest substrates, which is counter to the cases for several other passerines in North America (Rodewald et al. 2009, Schlossberg and King 2010, Meyer et al. 2015, Gleditsch 2017, Nelson et al. 2017). It is possible that Yellow Warblers might even benefit from using invasive nest substrates or at most pay no reproductive costs, as we observed qualitative trends toward higher nest survival and lower DMR for nests in invasive plants compared to native species. We suggest these inferences with great caution, however, as our sample sizes were small ($n = 71$), and we lack statistical support at the $\alpha = 0.05$ level for the directional patterns reported here.

Although Yellow Warbler nest survival appeared similar between native and invasive substrates, we cannot tell if Yellow Warblers exhibited adaptive nest site selection as we lack the vegetation data necessary to discern substrate use versus availability at our sites (*sensu* Latif et al. 2011a, 2011b). Along this line, we also cannot assess if Yellow Warblers experienced ecological traps (Schlaepfer et al. 2002) with nest site selection, whereby individuals prefer to build nests on a substrate type despite lower nest survival in these plants compared to other options (Gleditsch 2017, Nelson et al. 2017). We must also consider structural characteristics of the substrate independent of type, such as stem count, vegetation density, and surrounding shrub cover, all of which can positively correlate with Yellow Warbler nest survival (Knopf and Sedgwick 1992, Latif et al. 2011b, Quinlan and Green 2012). Indeed, these characteristics are

known to improve nest concealment and reduce nest predation risk for Yellow Warblers (Latif et al. 2011a), as well as many other passerine species (Martin 1993). Nonetheless, our study is the first step to determine whether invasive plant species impact nest survival for Yellow Warblers. Future studies could expand the scope of patterns reported here by collecting additional vegetation characteristics to formally test for adaptive nest site selection and potential ecological traps.

Our observations also provide evidence that Yellow Warblers use several different nest substrates and likely are not “substrate specialists,” which is consistent with other studies on microhabitat selection by this species (Latif et al. 2011a, Quinlan and Green 2012, Lowther et al. 2020). Of the 71 nests we monitored, 27% were placed in invasive autumn olive, 14% in invasive Japanese honeysuckle, 19% in native deciduous trees, 19% in native dogwoods, and the remainder in other various substrates. Notably, we found 2 nests in native eastern red cedar (*Juniperus virginiana*), which to our knowledge has not yet been documented as a nest substrate for Yellow Warblers. Paired with the nest survival patterns we observed, it is possible that Yellow Warbler breeding populations may be robust to plant invasions in riparian habitat, which is not the case for nest substrate specialists in riparian bird communities. For example, a study from New Mexico, USA, found that invasive Russian olive (*Elaeagnus angustifolia*) and saltcedar (*Tamarix* spp.) did not provide nest substrate for riparian birds closely linked to native cottonwood (*Populus* spp.), such as Cassin’s Kingbirds (*Tyrannus vociferans*) and Spotted Towhees (*Pipilo maculatus*) (Smith and Finch 2014).

In conclusion, Yellow Warblers could be resilient to reduced nest survival that invasive plants cause in some other passerines (Nelson et al. 2017). Riparian ecosystems in North America are predicted to be dominated by invasive plant communities within the next century (Poff et al. 2011). Documenting breeding behaviors and subsequent reproductive consequences, such as those reported here, will be important to help predict which riparian birds are especially vulnerable to exotic plant invasions, and which may be able to persist in novel plant communities.

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