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Source: Southeastern Naturalist, 19(4): 627-636

Published By: Eagle Hill Institute

URL: https://doi.org/10.1656/058.019.0402

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Incidence of Invasive Privet (*Ligustrum* spp.) on Swainson's Warbler Breeding Territories in the Gulf Coastal States

Gary R. Graves*

Abstract - Limnothlypis swainsonii (Swainson's Warbler) readily colonizes novel habitat formations that meet basic requirements for understory stem density and visual screening. Little is known about the warbler's behavioral response to naturalized populations of introduced plants. I surveyed the incidence of introduced invasive *Ligustrum* spp. (privet) and native *Arundinaria* spp. (cane) on breeding territories (n = 590) of Swainson's Warbler in the southeastern United States. Privet occurred frequently on territories in Mississippi (65.0%), Alabama (55.7%), Louisiana (52.8%), and Texas (39.5%). Territories with privet (49.6% of total) were observed in 90 counties and parishes. The survey revealed numerous instances of warbler territories located in near-monocultures of *Ligustrum sinense* (Chinese Privet). Territories with cane (33.1% of total) were observed in 72 counties and parishes. In a broader context, the survey data suggest that Swainson's Warbler populations have rapidly adapted to invasive privets, which are physiognomically similar to several native thicket-forming shrubs.

Introduction

The perplexing scarcity and habitat requirements of Limnothlypis swainsonii (Audubon) (Swainson's Warbler, hereafter also "warbler"), the rarest songbird breeding in the southeastern United States (Partners in Flight 2020), have intrigued naturalists since the species was discovered in 1833 by the Reverend John Bachman. This sparsely distributed warbler was once thought to be closely associated or even obligately linked with canebrakes (Brewster 1885, Howell 1911, Meanley 1945). Field studies sparked by Meanley's (1971) monograph have shown that it breeds in habitats varying from regenerating clear cuts in alluvial bottomlands to rhododendron thickets in the Appalachian Mountains (see references in Anich et al. 2019). The warbler is most common in early seral hardwood forests on the coastal plain (Anich et al. 2019, Graves 2002, Graves and Tedford 2016, Meanley 1971), although a nontrivial fraction of the global population now breeds in young *Pinus* (pine) plantations (Graves 2015). Breeding territories in all habitat types are characterized by visual screening in the understory stratum, high stem density, and abundant leaf litter (Bassett-Touchell and Stouffer 2006; Bishop et al. 2012; Brooks and Legg 1942; Brown et al. 2009; Chartier 2014; Eddleman et al. 1980; Graves 1998, 2001, 2015; Henry 2004; Lanham and Miller 2006; Peters et al. 2005; Sims and DeGarmo 1948; Somershoe et al. 2003; Thomas et al. 1996). Warblers appear

Manuscript Editor: Jason Davis

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to cue on habitat physiognomy rather than floristics during selection of breeding sites (Graves 2002, 2015; Graves and Tedford 2016).

Forest ecosystems in eastern North America have been infiltrated by hundreds of non-native plant species during the past 2 centuries (Miller 1998, Reichard and White 2001, Schmitz et al. 1997). A significant number of non-native trees and shrubs identified as severely invasive (Miller et al. 2013) are widespread in the core breeding range of Swainson's Warbler in the Gulf coastal states. The warbler's behavioral response to invasive plants is largely unexplored. Although adaptation to non-native plant species may be difficult to tease out in the speciose floras typical of breeding habitat, it is easier to demonstrate if territories are established in near monocultures of an invasive species (Graves 2019). McNair (2019) reported breeding territories dominated by Ligustrum sinense Loureiro (Chinese Privet) in bottomland forest along the Great Pee Dee River, NC. Several earlier studies noted the presence of Chinese Privet in breeding territories in Louisiana (Bassett-Touchell and Stouffer 2006, Henry 2004) and Georgia (Somershoe et al. 2003, Wright 2002). It is unclear, however, if these reports represent isolated occurrences or signal a regional trend in adaptation to privet-dominated habitats in the southeastern United States. Here I report a high incidence of introduced *Ligustrum* spp. (privet) on breeding territories of Swainson's Warbler in the Gulf coastal states from Texas to Alabama and discuss the implications of invasive privet on the warbler's conservation.

Background

At least 8 species of Asiatic and European privets were introduced as garden plants in the southeastern United States during the 19th century (Cothran 2003, Dirr 1975, Miller et al. 2013). Several species escaped cultivation and became regionally naturalized (Small 1933) decades before introduced privets were acknowledged to be a conservation problem (Miller 1998, Urbatsch and Skinner 2000, Ward 2002). Today, introduced privets are classified as one of the principal invasive species threats in the southeastern United States (Arevilca et al. 2016; Greene and Blossey 2012; Hanula et al. 2009; Hart and Holmes 2017; Kuebbing et al. 2014; Maddox et al. 2010; Merriam 2003; Merriam and Feil 2002; Wang and Grant 2014, 2017). Invasive privets are currently estimated to cover 1.29 million ha with an average annual rate of spread >9500 ha in the southeastern United States (Miller et al. 2013) the absence of control programs, could cover 1.76 million ha by 2060.

The aggressively invasive Chinese Privet and *Ligustrum vulgare* L. (European Privet) have been reported on 42% of the statewide forest inventory plots in Mississippi (Oswalt and Oswalt 2011a), 29% of plots in Alabama (C.M. Oswalt and S.N. Oswalt 2012), 11% of plots in eastern Texas (Oswalt and Oswalt 2011b), and 10% of plots in Louisiana (S.N. Oswalt and C.M. Oswalt 2012). Both species spread clonally, germinate easily in disturbed ground, and form dense thickets (3–8 m in height) in the shaded understory of hardwood forests. Impenetrable monocultures establish in full sun along fence lines, vacant lots, utility right-of-ways, stream

margins, and around abandoned homesteads (Maddox et al. 2010, Miller et al. 2013). Although Chinese Privet may be controlled or even eradicated at local scales by mechanical and chemical treatment (Benez-Secanho et al. 2018, Hanula et al. 2009), its continued geographic spread appears inevitable owing to its broad environmental tolerances and bird-dispersed fruits.

Methods

I began to systematically record the presence/absence of privet on Swainson's Warbler breeding territories in 2008 after I encountered several territories situated in extensive privet thickets in eastern Texas. My subsequent surveys of privet incidence were concentrated in Alabama, Mississippi, Louisiana, and Texas, with fewer observations in 9 other states (Fig. 1, Table 1). The field methods and criteria for evaluating territoriality are found in Graves (1996, 2001, 2002, 2015) and Graves and Tedford (2016). This was not a habitat-selection study (Wiens 1989) where the incidence of privet in breeding territories was compared with its occurrence in adjacent unoccupied habitat. Instead, I searched for privet in the core area of breeding territories where singing and terrestrial foraging were observed (see Graves 1998, 2001). Privet searches were not exhaustive, but "absent" meant that none was observed. In general, privet was usually absent or relatively common to abundant. I compared the mean elevation of territories with and without privet with a 2-sample *t*-test ($\alpha = 0.05$).

The majority of privet occurrences in the Gulf coast states was referable to Chinese Privet, but identification of non-flowering specimens was often difficult (Maddox et al. 2010, Nesom 2009). Consequently, I report incidence data as *Ligustrum* spp. For benchmark comparisons, I also recorded presence/absence data for native *Arundinaria* spp. (cane) on the same warbler territories. I was unable to quantify stem density of privet or cane in standardized plots (see Graves 2001, 2002; Graves and Tedford 2016) owing to time constraints.

State	Privet only	Cane only	Both	Neither
Mississippi	58	31	33	18
Louisiana	51	16	16	44
Alabama	31	9	13	26
Texas	16	8	14	38
North Carolina	15	8	7	24
Florida	10	1	1	22
Tennessee	3	13	2	12
Arkansas	7	2	4	13
Georgia	1	3	8	1
South Carolina	2	0	1	0
Virginia	0	3	0	0
West Virginia	0	0	0	3
Missouri	0	2	0	0

Table 1. Number of Swainson's Warbler territories with *Ligustrum* spp. (privet) and *Arundinaria* spp, (cane).

The taxonomy of *Arundinaria* in the southeastern United States is problematic and 1–3 taxa were recognized at either specific or subspecific levels until the revision of Triplett et al. (2006) and Triplett and Clark (2009), which was subsequently adopted by ITIS (Integrated Taxonomic Information System; https://www.itis. gov/). The vast majority of cane encountered in the lower Mississippi Valley and Gulf coast states was referable to *Arundinaria gigantea* (Walter) Muhl. (Giant Cane). I surveyed relatively few warbler territories on the Atlantic coastal plain where *A. tecta* (Walt.) Muhl. (Switch Cane) is common or in the geographic range of the recently described *A. appalachiana* Triplett, Weakley, and L.G. Clark (Hill Cane) in the southern Appalachian Mountains.

Results and Discussion

Privet was observed on 49.6% (293 of 590) of breeding territories (Fig. 1, Table 1). By comparison, native cane occurred on 33.1% (195 of 590) of territories.



Figure 1. Occurrence of introduced *Ligustrum* spp. (privet) and native *Arundinaria* spp. (cane) on Swainson's Warbler territories: privet only (n = 194), cane only (n = 96); privet and cane (n = 99); no privet or cane (n = 201). Territories with privet were observed in 90 counties and parishes. Cane was found on territories in 72 counties and parishes. Gray shading indicates area above 100 m (above sea level). Records in eastern Virginia and North Carolina were cropped from maps.

Neither privet nor cane were present on 34.1% (201 of 590) of territories. Privet was encountered more frequently than cane in territories in Mississippi (65.0% vs 45.7% of territories), Alabama (55.7% vs 27.8%), Louisiana (52.8% vs 25.2%), and Texas (39.5% vs 28.9%). The mean \pm SD elevation of territories with privet (79.3 \pm 37.4 m) was slightly higher than that of territories without privet (71.0 \pm 35.4 m) in Alabama, Mississippi, Louisiana, and Texas (n = 426; t = 2.36, P = 0.02). The mean \pm SD elevation of territories with privet but no cane (81.8 \pm 37.9 m) was similar to that of territories with cane but no privet (72.5 \pm 32.0 m) in the same Gulf coastal states (n = 131; t = 1.98, P = 0.07).

Does the high incidence of invasive privet on Swainson's Warbler breeding territories represent a causative or fortuitous association? The null hypothesis is that privet is frequent on warbler territories because it is common and geographically widespread in the Gulf coastal states (Miller et al. 2013; C.M. Oswalt and S.N. Oswalt 2012; S.N. Oswalt and C.M. Oswalt 2011a). The alternative hypothesis is that warblers select territories with a substantial privet component because it provides high-quality breeding habitat. McNair (2019) measured understory stem counts in 12 warbler territories located in privet-dominated habitat along the Great Pee Dee River. Chinese Privet was present on all territories (14,881–58,333 stems/ ha; median = 32,539/ha) and accounted for 57.9% of the total small woody stems. Total small woody stem counts (including privet and cane) on territories varied from 34,325 to 75,793/ha (median = 59,325/ha). McNair (2019:521) concluded, "Whereas the presence of Chinese Privet will help restore native forest dynamics and diversity of bottomland hardwood forests."

Median stem counts of privet-dominated habitat reported by McNair (2019) are similar to median small woody stem counts observed on territories that lacked privet in Virginia (40,334/ha), Florida (32,586/ha), Louisiana (34,770/ha), 2 sites in Mississippi (31,593/ha; 48,283/ha), and 3 sites in Arkansas (32,007/ha; 44,905/ha; 72,164/ha)(Graves 2002, Graves and Tedford 2016). Collectively, these data indicate that privet-dominated habitats often exhibit stem densities that are comparable to those observed in warbler territories that lack privet. Comparability may extend to growth traits and overall physiognomy. The small ovate leaves, branching pattern, and thicket-forming growth of Chinese Privet bear a superficial similarity to those of several species of native shrubs (e.g., *Ilex vomitoria* Aiton [Yaupon] and *Gaylussacia* spp. [huckleberry]) that occur often on warbler territories in the Gulf coastal states (Bassett-Touchell and Stouffer 2006, Carrie 1996, Henry 2004). It is possible that invasive privets offer many if not all of the positive attributes of native thicket-forming shrubs perceived by Swainson's Warbler.

Infiltration of forested ecosystems by invasive privets is a fait accompli in many areas of the southeastern United States (Miller et al. 2013, Ward 2002). The window of opportunity to prevent the establishment and spread of Chinese Privet in the core breeding range of Swainson's Warbler likely passed decades ago (Ward 2002). Data presented in this paper indicate that the warbler has behaviorally adapted to the presence of privet in the Gulf coastal states and readily establishes territories

in privet-dominated woodlands and occasionally in privet monocultures (Fig. 2). Whether this association has a negative, neutral, or positive effect on Swainson's Warbler populations will only be determined by studies of fledging productivity and yearling recruitment in privet-dominated ecosystems. In a broader context, the warbler's long-term survival in the fragmented landscapes of the southeastern United



Figure 2. Swainson's Warbler territories are often located in privet-dominated habitat near abandoned homesteads and vacant land near small towns. Top: Male defended territory (song recording GRG 931) in Chinese Privet monoculture (0.15 ha) at the margin of a regenerating clear cut on 5 May 2008 (Sabine Parish, LA; 31°16.41'N, 93°33.16'W). Bottom: Male defended territory (song recording GRG 995) in Chinese Privet thicket and second-growth saplings enveloping a vacant house on 25 May 2008 (Pickens County, AL; 33°14.10'N, 87 52.48'W).

States may well depend on its ability to adapt to invasive plants and novel habitat formations such as young pine plantations and privet monocultures.

Acknowledgments

I thank anonymous reviewers for helpful comments, Brian Schmidt for producing the base map, and the Alexander Wetmore Fund (Smithsonian Institution) and the Smoketree Trust for support.

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