



Original research article

An evaluation and comparison of conservation guidelines for an at-risk migratory songbird



Darin J. McNeil^{a,i,*}, Kyle R. Aldinger^b, Marja H. Bakermans^c,
Justin A. Lehman^d, Anna C. Tisdale^e, John A. Jones^e, Petra B. Wood^f,
David A. Buehler^d, Curtis G. Smalling^g, Lynn Siefferman^e, Jeffery L. Larkin^{a,h}

^a Department of Biology, Indiana University of Pennsylvania, PA, USA

^b West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, WV, USA

^c Department of Biology and Biotechnology, Worcester Polytechnic Institute, MA, USA

^d Department of Forestry, Wildlife and Fisheries, University of Tennessee, TN, USA

^e Department of Biology, Appalachian State University, NC, USA

^f U.S. Geological Survey, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, WV, USA

^g Audubon, NC, USA

^h American Bird Conservancy, VA, USA

ⁱ Department of Natural Resources & Lab of Ornithology, Cornell University, NY, USA

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ABSTRACT

For at-risk wildlife species, it is important to consider conservation within the process of adaptive management. Golden-winged Warblers (*Vermivora chrysoptera*) are Neotropical migratory songbirds that are experiencing long-term population declines due in part to the loss of early-successional nesting habitat. Recently-developed Golden-winged Warbler habitat management guidelines are being implemented by USDA: Natural Resource Conservation Service (2014) and its partners through the *Working Lands For Wildlife* (WLFW) program. During 2012–2014, we studied the nesting ecology of Golden-winged Warblers in managed habitats of the eastern US that conformed to WLFW conservation practices. We evaluated five NRCS “management scenarios” with respect to nesting success and attainment of recommended nest site vegetation conditions outlined in the Golden-winged Warbler breeding habitat guidelines. Using estimates of territory density, pairing rate, nest survival, and clutch size, we also estimated fledgling productivity (number of fledglings/ha) for each management scenario. In general, Golden-winged Warbler nest survival declined as each breeding season advanced, but nest survival was similar across management scenarios. Within each management scenario, vegetation variables had little influence on nest survival. Still, percent *Rubus* cover and density of >2 m tall shrubs were relevant in some management scenarios. All five management scenarios rarely attained recommended levels of nest site vegetation conditions for Golden-winged, yet nest survival was high. Fledgling productivity estimates for each management scenario ranged from 2.1 to 8.6 fledglings/10 hectares. Our results indicate that targeted habitat management for Golden-winged Warblers using a variety of management techniques on private lands has the capability to yield high nest survival and fledgling productivity, and thus have the potential to contribute to the species recovery.

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* Correspondence to: Cornell University, 111A Fernow Hall, 226 Mann Dr., Ithaca, NY 14853, USA.

E-mail address: djm462@cornell.edu (D.J. McNeil).

1. Introduction

Increasing anthropogenic stressors on at-risk wildlife populations present growing challenges for biologists and land managers worldwide (Madden, 2004; Heller and Zavaleta, 2009). Implementation of science-based management and subsequent evaluation efforts are critical steps for adaptive-based recovery programs (Bottrill et al., 2011). Although direct management is the primary pathway between scientific recommendations and a biological response by the target species, it has been argued that true conservation remains incomplete without monitoring to understand that response (Satereson et al., 2004; Ferraro and Pattanayak, 2006). Effective adaptive management processes involve compliance with recommendations (Ellefson et al., 2001), while allowing evaluation of successes and failures within management framework (Gibbs et al., 1999; Stem et al., 2005). Using data derived from monitoring, researchers can refine and improve management guidelines, thus making conservation strategies more efficient (Salafsky et al., 2002; Stem et al., 2005).

The Golden-winged Warbler (*Vermivora chrysoptera*) is a neotropical migrant songbird that has shown population declines since at least the 1960's (Sauer et al., 2014) or perhaps as early as the 1930's (Hill and Hagan, 1991). Although Golden-winged Warblers breed throughout both the Great Lakes and Appalachian regions, rates of decline are significantly more rapid in the Appalachian portion of the species' range. Golden-winged Warbler population declines are driven by a suite of population stressors (Roth et al., 2012), for example, Brown-headed Cowbirds (*Molothrus ater*) are a species of brood parasite which directly reduces the nesting success and fecundity of Golden-winged Warblers and other small passerines (Confer et al., 2003). Another challenge faced by Golden-winged Warbler populations is competition and hybridization with their closest congener, the Blue-winged Warbler (*V. cyanoptera*, Gill, 1980; Frech and Confer, 1987). Gill (1980) found that Golden-winged Warbler subpopulations become locally extirpated within 50 years of exposure to breeding Blue-winged Warblers. Moreover, conservation of the species' nonbreeding habitat in Central and South America remains imperative to this species conservation (Buehler et al., 2007). Even considering this diverse array of threats, it is thought that breeding habitat loss may be one of the primary drivers behind population declines (Hunter et al., 2001; Buehler et al., 2007; Roth et al., 2012). In fact, many species of shrubland birds are declining due to the loss of early-successional communities throughout eastern North America (Askins, 2001; Hunter et al., 2001).

Extensive management efforts are currently underway throughout much of the Golden-winged Warbler's range to stem the decline of this at-risk species. The losses of early-successional breeding habitat for Golden-winged Warblers are driven by human development, regeneration of forests on abandoned farmland, and changes in timber harvesting practices (Hunter et al., 2001; Buehler et al., 2007; Rosenberg et al., 2016). The Golden-winged Warbler Breeding Season Conservation Plan (hereafter, Conservation Plan; Roth et al., 2012), and guidelines by Bakermans et al. (2011) were developed as first steps to increase the availability of nesting habitat and to ultimately reverse population declines. These habitat guidelines provide detailed descriptions of a variety of context-specific management practices that can be used to create or maintain Golden-winged Warbler nesting habitat. Furthermore, some management agencies have adopted the habitat guidelines as direction for targeted conservation efforts across the species' two primary population segments: the Appalachian Mountain and Upper Great Lakes Regions.

Working Lands For Wildlife (WLFW) is a conservation program that targets the implementation of Golden-winged Warbler habitat guidelines on private lands within the species' Appalachian Mountains breeding range (Ciuzio et al., 2013). This cost-share program was initiated in 2012 and is directed by USDA-Natural Resource Conservation Service (NRCS) in partnership with the US Fish and Wildlife Service. Private land management efforts like WLFW are a critical component of wildlife management in North America, as most manageable land area across the continent is privately owned (Scott et al., 2001). Because Golden-winged Warbler conservation is intimately tied to creating and maintaining nesting habitat through active land management, NRCS selected the Golden-winged Warbler as one of seven focal species targeted by WLFW (Ciuzio et al., 2013).

Pre-defined "conservation practices" are the foundational units of many NRCS conservation programs, including WLFW. NRCS conservation practices are individual activities (i.e., herbicide application, prescribed fire, forest stand improvement) that can be used singularly or in combination when developing conservation plans for landowners. As such, one of the first steps necessary for including Golden-winged Warbler as a focal species under WLFW was to identify those NRCS conservation practices that were likely to best achieve habitat conditions recommended in the habitat guidelines for Golden-winged Warblers (Bakermans et al., 2011; Roth et al., 2012). Herein, we evaluate what groups of NRCS conservation practices (hereafter termed "management scenarios") were most effective at creating high-quality Golden-winged Warbler nesting habitat. Specifically, we (1) evaluated the ability of five management scenarios to attain nest site vegetation conditions recommended in the Golden-winged Warbler habitat guidelines; (2) compared Golden-winged Warbler nest survival among five NRCS management scenarios; (3) quantified the effects of vegetation features on nest survival for each management scenario; and (4) estimated and compared production of young (fledglings/ha) for each management scenario.

2. Methods

2.1. Study area

We examined Golden-winged Warbler nesting ecology across 45 study sites in North Carolina, Pennsylvania, Tennessee, and West Virginia (Fig. 1). All sites surveyed had recently been created or maintained using NRCS conservation practices and

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