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Review

Addressing the Early-Successional Habitat Needs of At-Risk Species on Privately Owned Lands in the Eastern United States

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Abstract: Public lands alone are insufficient to address the needs of most at-risk wildlife species in the U.S. As a result, a variety of voluntary incentive programs have emerged to recruit private landowners into conservation efforts that restore and manage the habitats needed by specific species. We review the role of one such effort, Working Lands for Wildlife (WLFW), initiated by the Natural Resources Conservation Service in partnership with the U.S. Fish and Wildlife Service. Using two at-risk species in the eastern U.S. (where private lands dominate), we show the substantial potential that WLFW has for restoring and maintaining needed habitats. Monitoring how effective these efforts are on populations of the target species has been challenging, and both monitoring and implementation are being modified in response to new information. Identifying landowner motivations is essential for developing long-term relationships and conservation success. As WLFW projects develop, they are moving toward a more holistic ecosystem approach, within which the conservation goals of at-risk species are embedded.

Keywords: at-risk species; golden-winged warbler; landowner incentives; New England cottontail; Natural Resources Conservation Service; U.S. Department of Agriculture; Working Lands for Wildlife

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1. Introduction

As human populations and their influence expand, the challenge of maintaining adequate habitat for species that are threatened with extinction has become urgent. In the United States, just over 13% of the terrestrial land area is protected (e.g., designated as national parks, wilderness areas, permanent conservation easements, state parks, national wildlife refuges, and national monuments) [1]. As a result, privately owned lands are especially important when addressing the needs of at-risk taxa because these lands support populations of more than two-thirds of the species listed under the U.S. Endangered Species Act, with 10% of the listed species occurring only on private lands [2]. Additionally, hundreds of species that are in documented declines occur on private lands [2]. Because rates of habitat destruction within the range of imperiled species are greater on private lands than protected lands [3], it is clear that efforts to maintain at-risk taxa require working on both public and privately owned lands [4–7].

Although some landowners consider their conservation responsibilities as a priority [8,9], others may perceive wildlife as a liability [10]. Because economic concerns affect decisions made by private landowners, incentive programs have been developed by state and federal agencies or non-governmental organizations to encourage landowner participation in conservation actions. These programs are intended to benefit a range of taxa from

popular game species to at-risk plants and animals. They include monetary grants, cost sharing, incentive payments, rental contracts, and conservation easement purchases [2]. Grants or cost-share programs pay all or part of the costs associated with restoration or enhancement of habitats for specific species or communities. For example, a cost-share program in the state of Wisconsin provides funds to landowners to manage, restore, and preserve woodlands, savannah, wetlands, and prairie. That program provides funds for the cost of labor for prescribed burning, as well as in-kind materials, such as burning equipment and grass seed. A 10-year commitment is made by participating landowners, and the cost-share funds come from the sale of turkey and pheasant hunting permits purchased by hunters [11].

At the national level, several agencies are involved with the conservation of important vegetation communities on private lands. The Natural Resources Conservation Service (NRCS) within the U.S. Department of Agriculture (USDA) was established over 80 years ago as the Soil Conservation Service to address soil conservation needs in response to the Dust Bowl of the 1930s. Today, the NRCS works with private landowners to conserve soil, water, air, plants, and animals that contribute toward productive lands and healthy ecosystems [12]. In 2012, NRCS and the U.S. Fish and Wildlife Service (USFWS) developed a partnership to provide long-term predictability in regulation of the Endangered Species Act (ESA) for farmers, ranchers, and forest landowners who voluntarily participate in Working Lands for Wildlife (WLFW) projects [12]. Specifically, participating landowners in WLFW are in compliance with ESA regulations as long as they follow their NRCS-approved conservation plans.

A substantial portion of the needed funds is provided through the U.S. Farm Bill, legislation that covers most federal government policies related to agriculture in the United States. Conservation programs within the Farm Bill are the largest single federal source of funding for private land conservation. It is renewed approximately every 5 years [13], and support for conservation efforts on private lands has grown. The 1985 Farm Bill included the Conservation Reserve Program (CRP), which provided rental payments and cost-share assistance to establish grass or tree cover on environmentally sensitive croplands. Following the passage of the 2002 Farm Bill, the Conservation Effects Assessment Project (CEAP) was created by multiple agencies within the USDA to document the benefits of conservation practices and programs and to provide the science and education base needed for effective planning, implementation, management decisions, and policy [14]. In the 2018 Farm Bill, funding for the Environmental Quality Incentives Program (EQIP), the primary program for funding conservation practices on working lands, increased to $9.2 billion for the years 2019 to 2023, with the expressed goal of maximizing the environmental benefits of conservation funding [15]. In the 2018 Farm Bill, WLFW was codified by the U.S. Congress as a permanent mechanism of the NRCS for directing EQIP and other Farm Bill program funds toward strategic conservation initiatives. WLFW is not a funded program itself; instead, it is an approach used to target and measure both outputs (e.g., area affected) and outcomes (e.g., threats mitigated or species recovered) across landscapes using Farm Bill funds and NRCS staff expertise. Initial efforts were targeted to benefit specific at-risk species [2]. So far, WLFW projects have affected more than 4 million hectares in 48 states [16]. Herein, we review WLFW efforts to aid in the recovery of two at-risk species in the eastern United States where private lands dominate the region and partnerships with landowners are essential for achieving habitat goals. Both species were among the first to be included in WLFW efforts and therefore may provide insights into the effectiveness of this approach.

2. Case Studies

2.1. New England Cottontails

2.1.1. Status and Habitat Needs

The New England cottontail (*Sylvilagus transitionalis*, here abbreviated as NEC) is a medium-sized lagomorph (1–1.4 kg, Figure 1) and is the only rabbit native to the New

England region of the United States [17]. NECs are restricted to sites with dense understory vegetation, including native shrublands, beaver (*Castor canadensis*) flowages, old fields, and early-successional forests [18–20]. Its historic range extended throughout much of the six New England states and eastern New York (Figure 2), a region that has experienced substantial land-use changes since European colonization [21].

Figure 1. New England cottontails are dependent on dense understory vegetation that provides food and cover. Such vegetation has become rare in recent decades. Photo courtesy of Linda Cullivan.

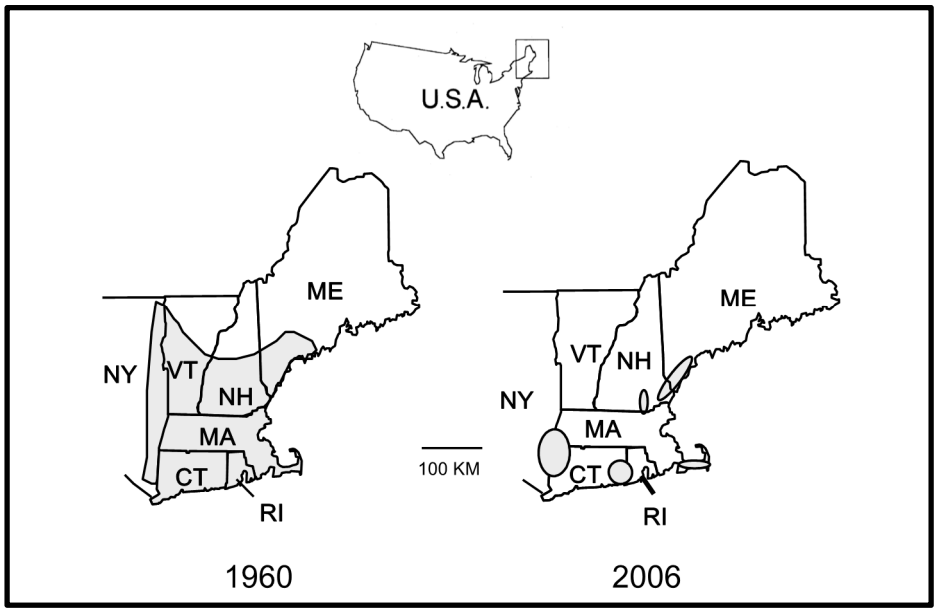

Figure 2. Historic and estimated range of New England cottontails in seven states within the northeastern United States. Populations in Vermont (VT) have been extirpated [22].

Initial subsistence agriculture expanded to widespread clearing of forests until the mid-1800s, when transportation corridors made more productive farmlands in the midwestern states available to eastern markets [21]. Widespread farm abandonment throughout New England during the late eighteenth and early twentieth centuries then resulted in a large increase in early-successional forests, with a concurrent increase in NEC populations [21]. However, this vegetation is ephemeral and is only occupied by cottontails until second-growth forests mature and the understory cover thins [23].

Since the 1960s, NEC populations have been declining. Although a number of factors have been implicated in the decline, including competition and hybridization with non-native eastern cottontails (*S. floridanus*), habitat loss via forest maturation and fragmentation seems to be the most parsimonious explanation for the range-wide decline [24]. The remaining habitats are often small, isolated patches of shrublands or young forests. Combined, populations of NEC are now restricted to five geographically disjunct locations that collectively occupy <15% of the historic range (Figure 2) [22]. Small patches of habitat support few rabbits that are exposed to high rates of predation [18], and these habitats are embedded in substantially modified landscapes [25,26]. The abundance of early-successional forests and shrublands in the region continues to decline [27,28], so without intervention, the long-term viability of NEC populations is unlikely [29–31]. As a result, the NEC was listed in 1989 as a candidate species for threatened or endangered status [32].

2.1.2. Conservation Strategy

Rather than delay recovery until a listing decision was made, several governmental (USFWS, NRCS, and state fish and wildlife agencies within the current range of the NEC) and non-governmental organizations initiated efforts to restore and expand habitats for NECs [33] and prepared a conservation strategy [34]. These efforts included plans to systematically develop and maintain habitat for NECs on public and private lands [34], and were considered sufficient enough that in 2015, the USFWS decided not to list the NEC as threatened or endangered under the ESA [35].

The strategy for NECs has specific goals for habitat and populations [34]. Initially, the USFWS established a range-wide restoration goal of approximately 11,000 ha of young forests or shrublands to support 13,500 rabbits. Subsequently, states within the current range of NECs collectively established a more ambitious goal of 17,200 ha of habitat for 21,650 rabbits [34]. To achieve these targets, the NEC Technical Committee (a group of wildlife biologists from all the states within the current range of the NEC and federal agencies) delineated focus areas for restoration activities (Figure 3). Focus areas were based on specific criteria (e.g., soils capable of supporting dense woody vegetation) within landscapes that supported or recently supported the NEC [34]. Each focus area has 11 or more planned or existing patches of suitable habitat with a combined capacity to support 80 metapopulations of NECs and is considered sufficient for long-term viability of the NEC [34]. Of the approximately 940 planned management operations, half were identified as suitable for creating patches greater than 10 ha (minimum habitat patch size) and over 40% of these are planned to be on private lands [34].

To initiate the recruitment of private landowners, NRCS staff met with biologists from state and federal agencies, university researchers, and other non-governmental organizations familiar with the status of the NEC within specific focus areas. Efforts were localized to landscapes where ownership patterns and land-use activities were amenable to conservation actions. These landscapes presented many complexities regarding the size of land parcels, socioeconomic conditions, and land ownership. Challenges exist in much of the range of the NEC, especially where the parcel size is small, land values are high, and there is a general unwillingness among landowners to engage in government programs and perceived regulation risk. In these instances, suitable patches were assembled into anchor parcels and steppingstones. Anchor parcels are large and instrumental to NEC persistence in a landscape and are considered "source habitats" within a metapopulation [36]. From our experience, the owners of such parcels are landowners with legacies in a particular town and their land has been handed down through generations. These landowners have an appreciation of working the land, and WLFW participation places a premium on "keeping working lands working." As a result, it is important that managing for the NEC will not impede any future decisions on the uses of their land. Candidate conservation agreements [37] aid in assuring the landowner that they maintain control of

their land. Building trust is a main focus during the development of management plans, so that the landowner is confident that other goals and objectives are considered.

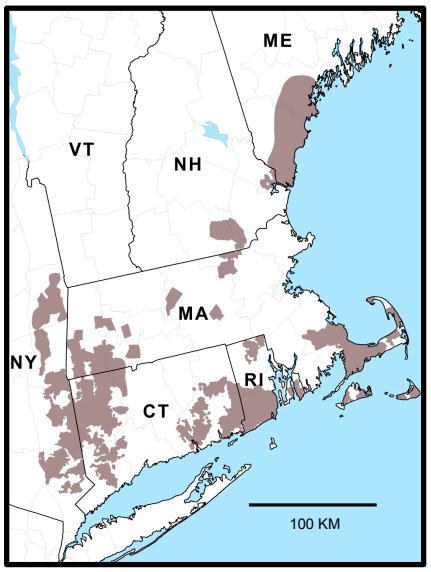

Figure 3. Focal areas where managed habitats for New England cottontails are prioritized within the species' historic range [34].

Landowner recruitment is challenging. Often, the most successful approach is to identify a local conservation commission member or other resident that is familiar with key landowners and can reach out and initiate engagement. Less personal approaches, such as mailings or phone calls, have mixed results and are less effective unless carefully managed. It is especially important to avoid the threat of future regulation as a motivator for the landowners to participate.

Once a landowner's goals and objectives are clear, next comes the discussion of funding. Although landowners are willing to host a project on their property, they are generally unwilling to spend their own money on implementation. The NRCS provides financial assistance based on various metrics, especially the size of the area being managed. Cost-share payments from the NRCS to landowners enrolled in NEC projects are typically 75% or 90% of the project costs and cover actions that promote early-successional vegetation (e.g., brush mowing, tree removal, and herbicide treatments). Where landowners are unwilling to pay for the costs, matching grants are often necessary and are brought in by a third party.

2.1.3. Positive Outcomes and Potential Concerns

By 2020, nearly 6500 ha had been managed for NECs within focal areas [38]. CEAP-funded projects produced a suitability model to monitor progress in generating and maintaining habitats for the NEC [39] and was subsequently modified for rapid assessments [40]. A sample of managed sites was evaluated in 2017 and 2018, and included sites in all six states in the current range of the NEC (J. A. Litvaitis, unpublished data). This evaluation was based on features associated with NEC occupancy [39], especially understory density. The majority of sites evaluated were enrolled in WLFW and were visited once every 1–5 growing seasons after a management action (e.g., removal of overstory trees or brush mowing). The intent of the rapid assessment was to gauge progress toward achieving NEC suitability and identify any limitations that could be addressed with additional actions [40]. Of the 55 sites visited, 11 were considered "rabbit ready" (considered suitable for NECs), 12 were "moving toward suitability", 18 were "too soon to project suitability", 13 were "unlikely to develop essential features required by NEC", and one was not designated because of varied conditions. Sites designated as "unlikely to develop essential features" did not seem capable of supporting dense understory vegetation and were often characterized

by poor, thin soils. Such sites, however, may function as steppingstones between source habitats [29]. However, it is important to acknowledge that the inclusion of small or low-quality parcels is, at least partly, a consequence of the difficulty of recruiting landowners in some areas.

In southwestern focus areas, the creation of open early-successional shrublands may be inadvertently promoting non-native eastern cottontails. Management to benefit NEC populations has primarily focused on clearcutting forest stands, mowing, or burning sites to promote dense understory vegetation. Cheeseman et al. [41] suggested that these management actions may result in vegetation that is not structurally equivalent to what is generated by natural disturbances, such as beaver activity, wind-generated canopy gaps, or wildfires. Additionally, human disturbances can facilitate the spread of invasive plants [42]. Some invasive shrubs have been shown to support higher tick abundances than native shrub cover [43], and tick burden may affect the survival of NECs, especially juveniles [41]. Partners acknowledge that challenges remain [38]. A recent range-wide survey revealed a 50% decline over the last decade in the number of sites known to be occupied by NECs [44]. As a result, modifications of the conservation strategy may be needed.

2.2. Golden-Winged Warblers

2.2.1. Status and Habitat Needs

The golden-winged warbler (*Vermivora chrysoptera*, here abbreviated as GWW) is a migratory songbird that breeds in young forests and shrublands of eastern North America (Figure 4; [45]). In its breeding grounds, the species' distribution is largely restricted to the Great Lakes and Appalachian Mountains [46]. There, GWWs nest within early-successional communities situated within otherwise heavily forested landscapes [47]. Within appropriate landscapes, GWWs nest on the ground, where their nesting cycle is completed in about 25 days [45]. After the young leave the nest, adults provide parental care for an additional 4 weeks within densely stocked stands of woody vegetation, such as regenerating forests or older forests with taller canopies and well-developed understories [48]. In most of their range, the nesting habitat is ephemeral (e.g., regenerating forests that occur following disturbance events), rarely remaining suitable for nesting beyond 15 growing seasons [49]. Like the NEC, the GWW initially benefitted from widespread abandonment of farmland across the northeastern United States [50]. However, regenerating forests matured and natural disturbances (e.g., beavers and wildfire) were not sufficient to reverse the decline of GWW populations [50,51]. Although more persistent nesting habitats exist (e.g., shrub wetlands), the availability of these communities is restricted mostly to the Great Lakes Region or very locally in the Appalachian Mountains (e.g., Pocono Plateau) [45,52].

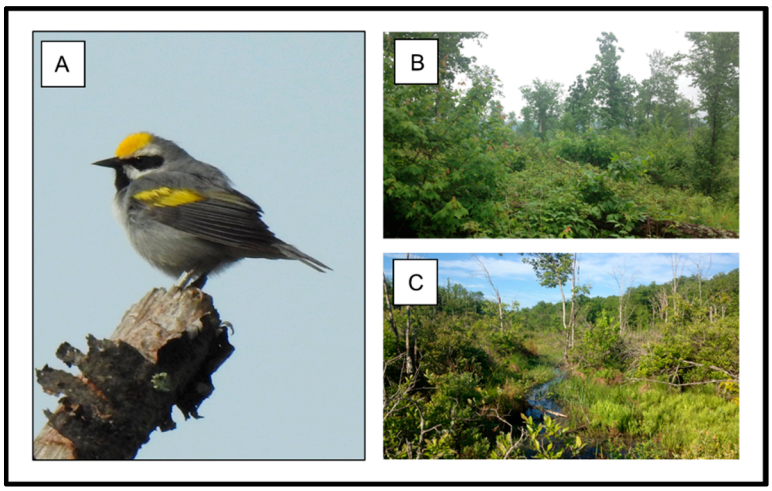

Figure 4. Golden-winged warblers (**A**) are dependent on early-successional communities with a mix of trees, shrubs, saplings, and herbaceous plants such as those provided by regeneration after timber harvests (**B**), and shrublands (**C**) that provide nesting and foraging resources. (Photos by D.J. McNeil).

GWW populations have been declining for at least the past 50 years (2.57%/year) and these declines have been more pronounced in the Appalachian Mountains (7.82%/year) than in the Great Lakes region (e.g., state of Wisconsin: 2.57%/year [53]; Figure 5). Several factors are likely to contribute to the decline, including the range expansion of and hybridization with blue-winged warblers (*Vermivora cyanoptera*), nest parasitism by brown-headed cowbirds (*Molothrus ater*), and loss of non-breeding habitats [45]. However, the loss of breeding habitat is considered the most important threat [47]. In 2010, the species was petitioned for listing under the ESA, and the USFWS found that the petition was substantial enough to warrant further review [54].

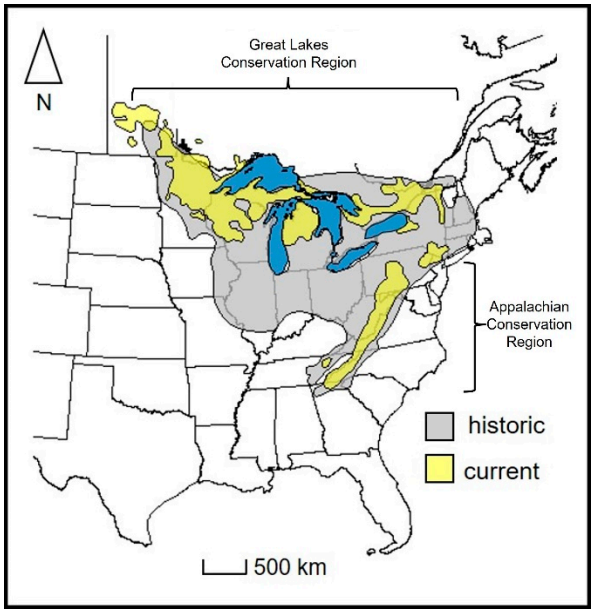

Figure 5. Historic and current estimated range of golden-winged warblers within eastern North America. The range has contracted by approximately 66% over the past 50 years.

2.2.2. Conservation Strategy

To understand the drivers of population decline and develop a conservation strategy, a group of government agencies, conservation organizations, and academics formed the Golden-winged Warbler Working Group in 2004. This group prepared a status review and conservation plan [47] that included three primary goals: (a) increase the range-wide breeding habitat by 400,000 hectares, (b) stabilize the Appalachian Mountains population by doubling the number of breeding adults, and (c) grow the range-wide population by 50% by 2050. The plan also identified focal areas for implementing vegetation management. Focal areas are defined as places where the maintenance of core breeding populations will be important for sustaining and expanding the species' current distribution, and their boundaries were delineated based on expert opinion, remote sensing data (elevation and percent forest cover), and distance to blue-winged warbler breeding populations. At the same time, habitat management guidelines were developed to provide landowners and managers with descriptions of actions for creating and enhancing habitats for GWW [47,49,55].

In 2012, the inclusion of the GWW by the NRCS as one of nine target species for the WLFW partnership added considerable funding and momentum toward efforts on private lands in several Appalachian states (Figure 6). Landowners interested in participating in the WLFW GWW program first contacted their local NRCS office to determine if their property met the general requirements for enrollment in the initiative (i.e., it fell within the initiative's boundary and was within a local landscape dominated by forest cover). If a property met these initial screening criteria, a partner forester and/or biologist conducted a site visit to discuss the landowner's stewardship objectives and to identify areas that have potential for habitat management. If it was determined that a property was a good fit for

the WLFW GWW program, the landowner completed an NRCS application which included a conservation plan that was prepared by the partner staff. All applications for a given fiscal year are ranked based on a set of criteria that considers each application's potential for success. The NRCS provides cost-share funding to the highest ranked applications until all available funding has been obligated.

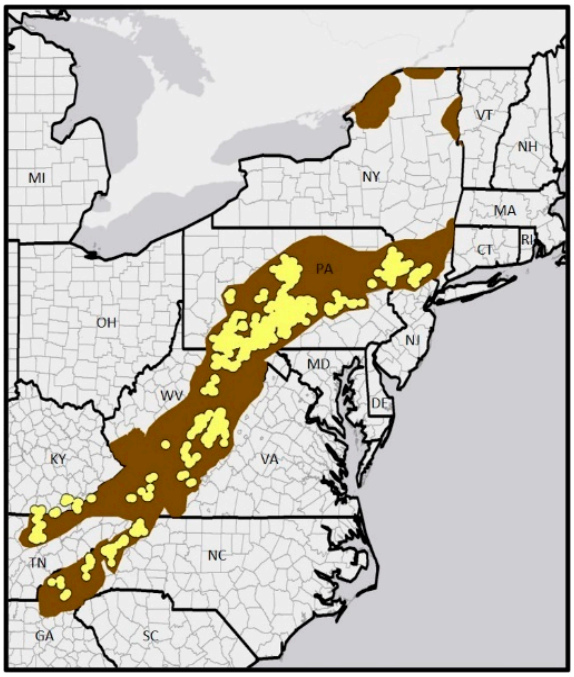

Figure 6. The Working Lands for Wildlife golden-winged warbler initiative's boundaries (brown shading) and priority areas for conservation (PACs; yellow shading). All private landowners within the initiative's boundaries are eligible to receive financial and technical assistance to create or enhance nesting habitats for this declining species, but properties within a PAC are ranked higher. Note: PAC boundaries were not delineated for NY, as they joined this effort in a later year.

To guide delivery and set benchmarks for success, NRCS staff completed a conservation strategy that set a goal of creating approximately 6400 hectares of nesting habitat on private lands across several Appalachian states over a 5-year period (2017–2021). The goal was reached a year early and a new 5-year goal will be set in 2022. Outreach activities directed toward private landowners including targeted mailings, seminars, webinars, and field tours proved effective in attracting participants. Additional efforts were made to stress economic advantages, forest health, ecosystem services, and game management as co-benefits. Important to achieving WLFW goals was the availability of funds to employ conservation planners, biologists, and foresters to assist the NRCS field offices with various components of program delivery, including landowner outreach, assistance with the application process, conducting site visits, drafting conservation plans, and site preparation (i.e., marking project boundaries and residual trees).

After private landowners enroll in WLFW and management actions are completed, do warblers respond to the habitat created? From 2012 to 2014, a CEAP-funded monitoring team evaluated the GWW's responses (i.e., density, nest success, fledgling survival) to management actions throughout the Appalachian breeding range [48,52,56–59]. In 2015, CEAP again funded a multi-year effort to monitor GWW occurrence across hundreds of properties enrolled in WLFW [60]. Collectively, the monitoring results from CEAP were used to assess program success [60], revise species-specific vegetation management guidelines [47,57], and to further inform where to target the delivery of WLFW efforts [61].

2.2.3. Positive Outcomes and Potential Concerns

More than 450 private landowners across 10 Appalachian states have enrolled >9400 ha in WLFW during 2012–2020. These hectares were administered through 580 contracts totaling $14.4 million in financial assistance to participating landowners. Most of these landowners have or will implement conservation practices that result in young forests, with the remaining implementing practices associated with old-field management and prescribed grazing.

During the 2015–2017 breeding seasons, monitoring teams conducted 1145 point count surveys across 459 managed sites (n = 267 on WLFW lands and n = 192 on comparable nearby public lands). GWWs were detected on 26% (121/459) of all sites monitored, with GWWs detected on 17% and 39% of the WLFW and public land sites, respectively [60]. Across all 459 sites, the mean probability of GWW occupancy was 0.22 [60]. Sites that had at least eight growing seasons after management had the highest probability of occupancy (0.77; 95% CI 0.66-0.85). In addition to within-stand characteristics, occupancy was strongly driven by metapopulation dynamics and local landscape composition, whereby managed sites with low proportions of mixed and coniferous forest cover that were <15 km from other known GWW subpopulations were most likely to be occupied. Colonization of restored habitats was especially pronounced within areas of moderate to high breeding output (>1.6 juveniles/pair/year) [62]. Although a 22% mean occupancy rate in the managed sites is not an overwhelming success, it is substantial, given the current status of the GWW in the Appalachians. Moreover, it is promising that GWWs were detected on 39% (75/192) of public land sites during CEAP monitoring (2015–2017), which is nearly double the rate (22.5%; 50/222 sites) for public land sites monitored in this region prior to WLFW in 2010–2011 [49]. It is also important to note that monitoring is essential to guide future management actions to increase occupancy rates as conservation efforts advance.

Boundaries for the Appalachian conservation region and focal areas associated with the Golden-winged Warbler Working Group's status review and conservation plan [47] were used for targeting implementation efforts during the initial years of the WLFW GWW partnership. However, CEAP-generated monitoring data combined with those from other agency-led efforts and a citizen science program [46] enabled the NRCS and its partners to identify portions of the GWW Appalachian Conservation Region where responses to management (i.e., successful occupancy) were rare. Using this data-driven approach, the NRCS refined its boundaries, delineating where best to prioritize program delivery. Specifically, Priority Areas for Conservation (PACs) were identified by using GWW occurrence data and information on the associated vegetation to generate spatially explicit models of GWW occupancy [61]. As a result of the increased spatial focus resulting from the PACs, program success (occupancy) is expected to increase as resources are concentrated within sites in landscapes with high-ranked suitability (Figure 6), thus better contributing to the population goals outlined in the GWW status review and conservation plan. PAC boundaries are re-evaluated periodically, which is important for data-driven expansion of PAC footprints as GWWs colonize restored habitat in the peripheral portions of PACs, thus increasing the likelihood of colonizing sites beyond the original PAC footprints.

To this end, while sites managed outside the PACs have a much lower likelihood of becoming occupied by GWWs due to the strong metapopulation structure of the species' Appalachian range, implementation of management practices within the larger WLFW boundary supports overall forest health and provides much needed early-successional communities used by many other declining taxa [63]. Moreover, as GWW subpopulations grow in response to conservation actions inside PACs, the availability of sites outside the PACs will help facilitate population spread by providing areas to host dispersing pairs. In the meantime, all landowners within the larger project area are eligible to participate in WLFW, but properties within PACs are ranked highest for receiving finite financial and technical assistance for implementing conservation practices.

3. Discussion

Given the distribution of at-risk taxa and the limitations of relying exclusively on public lands, engagement with private landowners is essential for creating adequate amounts of the needed habitat. Opportunities exist in other countries to increase participation by private landowners. For example, landholders in Australia are invited to submit a bid to carry out conservation work on their property. Bids are then ranked according to the best financial value for conservation benefit [64].

3.1. Not Waiting for Endangered Species Act Listing

Although several species aided by WLFW projects have been or are currently being considered for listing under the ESA (including the NEC and GWW), this is not a requirement for WLFW support. Listed species have waited a median of 12.1 years to receive ESA protection [65]. Notably, NEC were first listed as a candidate for listing in 1989 and it was not until 2015 that the USFWS decided not to list them as threatened or endangered, largely because of the recovery efforts that were initiated by the partners and WLFW several years earlier.

Listing under the ESA triggers protection from take and trade, designation of critical habitats, development of a recovery plan, and specific requirements on federal agencies to avoid jeopardizing listed species' persistence or adversely modifying their critical habitat, as well as making species eligible for recovery funding. ESA listings can also have economic effects that are detrimental to the public's competing priorities and create conflict with private landowners, which often dampens willingness to participate in conservation actions. Prior to listing, at-risk species may experience further declines, thus increasing both the cost of recovery and ultimately extinction risk [66–68]. The advantages of WLFW include responding to population declines before federal listing is necessary to avoid both extinction risks and adverse economic impacts.

3.2. Examining Outcomes

WLFW was originally established to focus on large-scale conservation challenges based on a suite of target species that either already had ESA status or were at some risk of being listed as threatened or endangered. Over time, WLFW has expanded to include other species (e.g., the northern bobwhite quail, *Colinus virginianus*) with well-documented habitats and population declines but no ESA implications, and has shifted its emphasis from single target species to a greater emphasis on restoring at-risk ecosystems such as native grasslands and the wildlife communities at large therein. As a result, monitoring and outcome assessments include tracking single-species responses as well as landscape-wide effects.

There are a number of challenges in monitoring the outcomes of WLFW activities. Perhaps the most obvious is the need to communicate individually with hundreds of landowners who expect a level of privacy and coordination. In comparison, monitoring efforts on public lands may require conversations with a small group of individuals. When a species either has or is being considered for ESA listing, private landowners may be reluctant or unwilling to participate in conservation practices or, secondarily, in monitoring due to fear of regulation. The difficulty practitioners experience in contacting and gaining access to private lands for management activities similarly affects monitoring goals. It can take several months for NRCS staff and partners to contact individual landowners to obtain permission for monitoring. Additionally, lands enrolled in WLFW projects are often sparsely spread across large areas and thus require considerable time traveling between sites.

Aligning the timing of monitoring with the target species' response to management is another challenge for assessing WLFW outcomes. For some target species, specific seral stages represent critical habitats, and there may be a lag between management action and when the habitat develops. For example, NECs may not occupy a site until 10 years after management [23] and GWW occupancy was highest 8 years after management [60]. As a

result, it may not be clear for some time if efforts have been successful in increasing the size of imperiled populations. Such relationships can muddle an evaluation of WLFW activities if they are based on responses by a single target species. Therefore, a broader evaluation of the community or ecosystem response is also relevant for evaluating the outcomes of WLFW efforts [69], as well as a proactive approach toward identifying the limitations of management actions [70].

NRCS staff evaluate their efforts on responses by target species, the larger wildlife community, ecosystem health, and economic outcomes for producers and rural communities. Conservation objectives set by WLFW are often a subset of the larger habitat and population goals set by partners, and reaching these is only one marker for success. WLFW effectiveness has, at times, been gauged by the outcomes of ESA listing decisions; certainly, these milestones should be celebrated. However, threats such as disease, climate change, and cultural and socio-economic drivers can all interact to undermine this measure of WLFW outcomes. Often, managers define their goals as returning a species to a stable or common occurrence within historic habitats; but as landscapes change and human populations increase, these goals may not be easily achieved. As a result, examining the responses by other taxa affiliated with the habitats managed for individual target species has become an important approach for understanding the impact of actions taken on private lands. For instance, among a sample of sites managed for or occupied by the NEC, 11 shrubland-affiliated species of birds were detected [71]. These included prairie warblers (*Setophaga discolor*), a species of regional conservation concern [71]. Additional associations between other shrubland birds and herbaceous vegetation and low shrubs indicated that land managed for NECs but not yet suitable for cottontails could benefit an additional suite of birds [71]. Further, abundant and diverse flowering plants within sites managed for NECs and GWWs were also found to attract a substantial group of native bees [72–74]. These observations indicate that species requiring early-successional conditions may benefit from conservation practices, but monitoring is needed to evaluate the effectiveness of the practices for other species.

Nonetheless, quantifying the responses by target species remains a valuable metric beyond amount of land enrolled, as it provides the conservation community an understanding of the extent to which WLFW contributes to achieving population goals and addressing regulatory considerations. Acknowledging the difficulties of monitoring does not dismiss the need for improvement. Collaborative monitoring of management activities and their outcomes among landowners, NRCS personnel, and research scientists could establish information feedback loops between actions taken and conservation outcomes, and subsequently improve outcomes [75]. Although it was not the focus of this study, WLFW also conducts outcomes assessments for the economic impacts of the initiatives on landowners and communities, and this dual focus is key to the conservation of working lands conducted by the NRCS and its partners.

3.3. Landowner Retention

Given the challenges associated with enrolling private landowners in WLFW efforts, it can be advantageous to have previously engaged landowners re-enroll and encourage others to participate in these efforts to maintain positive conservation gains. Recent surveys of landowners participating in GWW initiatives indicated that they did not respond uniformly after their individual contracts ended [76–78]. Several factors seemed to influence their enthusiasm for continued post-program management, including forest health, future timber value, wildlife, and recreational opportunities [77]. Therefore, the degree to which WLFW contributes to achieving GWW habitat goals will likely be driven by outreach and a technical assistance approach that continues to appeal to a broad set of landowner motivations rather than an approach that solely stresses habitats for a single species, and landowner outreach has been adapted accordingly [79].

Landowners' experiences with conservation programs are important in affecting management outcomes [80,81]. Among the landowners involved in the GWW initiative,

those who interacted with monitoring technicians in the field showed a greater level of agency trust than those landowners who did not interact with monitoring technicians [76], suggesting that personnel interactions could bolster program enrollment. Surprisingly, the presence of GWWs had a negative effect on continued management, suggesting that results for the target species may have been outweighed by broader landowner priorities for participation in conservation programs. This is not unusual or to be lamented, as developing a shared vision with landowners is not dependent on shared motivations. Beyond wildlife, other benefits (e.g., enhancing forest health and scenery) could affect landowners' behavior [78].

4. Conclusions

The contributions of WLFW projects for developing and protecting habitats for at-risk species have been substantial, and these efforts are usually nested within larger partnerships with agencies that track population trends as part of their mission. The NRCS itself does not set population goals or track population trends. Instead, the NRCS conducts broader assessments that document priority species' use of implemented projects to meet basic habitat needs, measures and tracks ecosystem health, and assesses local economic benefits to gauge WLFW's effectiveness. Recognizing and appealing to landowner motivations are essential toward developing good relationships. Having a shared vision with private landowners should aid in ensuring the longevity of conservation actions in agricultural or timbered landscapes.

WLFW is built upon a foundational philosophy of encouraging win–win solutions for producers ("Working Lands") and target species ("For Wildlife"). The NRCS develops implementation plans based on threats, conservation actions, and habitat and population goals identified by integrated partnerships of state and federal agencies collaborating with non-government conservation organizations, university experts, and private landowners. WLFW initiative partners strive to incorporate principles from existing conservation frameworks designed to achieve multiple objectives for wildlife, natural resources, and humans (e.g., [82]). In our examples, the conservation strategy for the New England cottontail and the golden-winged warbler's status assessment and conservation plan were developed by technical committees representing each target species' recovery needs. These existing conservation strategies were enhanced by monitoring and modeling to guide the delivery of WLFW [83] using many components of effective conservation planning (e.g., [82]). It cannot be overstated that well-funded conservation efforts such as WLFW have great potential for addressing resource concerns (i.e., forest health, water quality) and recovering declining wildlife populations, but the degree to which such programs are impactful, efficient, and sustained will largely be dependent upon the use of proven conservation frameworks and adaptive management.

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