Is Management for Golden-winged Warblers and Cerulean Warblers Compatible?[1]

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Abstract

Conservation of species with high Partners in Flight concern scores may suggest management for apparently conflicting habitat needs on a given property or specific site, such as birds requiring early-successional vs. later-successional broadleaved forests. Two species of concern with distinctly different habitat needs provide a case study for consideration. Declining populations of Golden-winged Warbler (*Vermivora chrysoptera*), which require early successional habitats, and Cerulean Warbler (*Dendroica cerulea*), a mature-forest breeder, each experience difficulties related to breeding habitats. Concern exists for Cerulean Warbler wintering habitat as well. Our responsibility for the conservation of both species includes resolving the dilemma of providing for their simultaneous occurrence in space or time. Approaches to this resolution are instructive for developing conservation strategies for these as well as other species. The questions (and their short answers) are: Are the habitat requirements of Cerulean and Golden-winged warblers compatible within the same property where their ranges overlap? (Yes) What role does disturbance play in the creation and maintenance of habitat for each species? (Its important role is better understood for Golden-winged Warbler.) Can we mimic beneficial forms of disturbance for these species through direct management? (Yes, and anthropogenic disturbance may substitute for "natural.") Is management of this sort compatible with commercial forestry and other ongoing forms of land use? (We believe it is.) Could events outside that region overwhelm conservation action within it? (Unfortunately, yes.).

Key words: adaptive management, deciduous forests, *Dendroica cerulea*, forest ecology, habitat management, management conflicts, Parulidae, rotation length, successional stages, *Vermivora chrysoptera*.

The Charge

Partners in Flight (PIF; Pashley et al. 2000) began in 1990 in response to a need to address reported declines of populations of some migratory birds in North America (Robbins et al. 1989, Terborgh 1989). Initial concern was focused on neotropical migratory birds because clear evidence existed of decline for species such as the Cerulean Warbler (*Dendroica cerulea*; CERW; Robbins et al. 1992). An apparent mechanism precipitating these declines was forest fragmentation on some of the breeding grounds (Robinson et al. 1995). But most initial concern was focused on tropical wintering grounds in recognition that, overall, eastern North America had experienced an increase of forest cover during the period of decline for many forest-associated species (Robbins et al. 1989, Terborgh 1989). As declining numbers of songbirds became a cause celébre to be fought vigorously in the conservation arena (Terborgh 1989, Hamel 1990), substantial gains in understanding (Carter et al. 2000) ensued over the subsequent decade (Bonney et al. 2000, Pashley et al. 2000).

Despite an initial focus on forest-interior species, an increasing awareness developed within PIF that among declining bird species in eastern North America, the greatest number were species of grasslands and other early-successional habitats (Robbins et al. 1989, Vickery 1992, Franzreb and Rosenberg 1997, Askins 2000, Hunter et al. 2001). This number included species dependent on a variety of shrub-scrub habitats, such as Golden-winged Warbler (*Vermivora chrysoptera*; GWWA). Increased attention to declines in shrub-nesting species led to the recognition that a common process defining the habitat occupied by many species of highest concern was vegetation disturbance (Hunter et al. 2001).

The combination of declines in population among species of mature forest (e.g. CERW), as well as those of earlier successional stages (e.g., GWWA) creates a potential for conflict in developing conservation goals for properties in which both groups of species occur. Mature forest birds often are flagships of efforts to protect aesthetically pleasing older forests (e.g., Rosenberg et al. 1999), whereas shrub-scrub species may be less appealing because they require habitats subject to frequent disturbance (Askins 2001). What will happen when species of relatively high concern occupy similar

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[1]A version of this paper was presented at the **Third International Partners in Flight Conference, March 20-24, 2002, Asilomar Conference Grounds, California.**
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landscapes, forest types, and geographic ranges, but require habitats of different successional stages? Our response to this dilemma is a barometer for our ability to approach conservation of species and their habitats, because it requires balancing the particular needs of multiple species. Both temporal and spatial scales are important in this balancing.

The goal of this paper is to explore, on a landscape or habitat-scale, how to reconcile the needs of two extremely high priority birds and the suites of co-occurring species they represent. We focus this charge in the form of four questions: (1) At what scale are the habitat requirements of CERW and GWWA compatible within their areas of range overlap? (2) What role does disturbance play in the creation and maintenance of habitat for each species? (3) Can we mimic beneficial forms of disturbance for these species through direct management? And (4) is this type of management compatible with commercial forestry and other ongoing forms of land use? We also briefly address what is known about the relative importance of breeding versus wintering habitat to population trends of the two species.

By addressing these questions, we assess whether the arguments presented by pro- and anti-management interests are consistent with existing data. We concentrate our discussion on the oak-hickory (*Quercus-Carya*) dominated broadleaf forests of the Appalachian Mountains and southern Great Lakes regions, where the needs of *V. chrysoptera* are competing for conservation attention with those of *D. cerulea*. The majority of our suggestions can be tested experimentally.

The Species

The GWWA is a ground nesting, dead-leaf foraging, occupant of old-fields and other shrubby habitats that winters in Central and northern South America (Confer 1992). Although the historic range is poorly understood, GWWAs have occupied most of the Appalachian region, northeastern states, and southeastern Canada in a dynamically shifting pattern of expansions and retractions over the past century or more. Today, this species occurs primarily in two largely disjunct regions: along the length of the Appalachian Mountains, concentrated at higher elevations from southeastern New York to northern Georgia, and in a band across the Great Lakes region from northern New York and southern Quebec, west to northern Minnesota and southeastern Manitoba (Golden-winged Warbler Atlas Project; Rosenberg and Barker, unpubl.).

GWWAs have been replaced at lower elevations west of the Appalachians and south of the Great Lakes by an expanding population of Blue-winged Warblers (*V. pinus*). Blue-winged Warbler expansion continues to displace the GWWA range farther north and west. Throughout their range, GWWAs are capable of occupying small patches of suitable habitat (10 ha), which can include small natural or man-made openings in forest. Suitable habitats include alder (*Alnus*) swamps, tamarack (*Larix laricina*) bogs, beaver (*Castor canadensis*)-created wetlands, abandoned farm fields, regenerating clearcuts, and reclaimed surface mines. A century and more ago, GWWAs occurred in open oak woodlands with grassy understories as well (Brewster 1886). Common features of these habitats include dense shrubs as well as herbaceous growth, scattered small trees, and a forest edge (Confer 1992). Area sensitivity of the species is uncertain, as the birds may occupy a small patch of early-successional forest in a large forest, but will not use the central portion of large openings in the forest, absent extensive edge vegetation.

The CERW is a canopy-nesting, leaf-surface foraging, mature-forest denizen that winters in South America (Hamel 2000). CERWs have a patchy distribution throughout much of the eastern United States, with populations contracting in the Midwest and Southeast, while expanding generally toward the northeast. Conventional wisdom states that CERWs typically do not occupy habitat patches smaller than some minimal size characteristic of the region, from 1,000 ha in heavily forested regions to larger, perhaps 10,000 ha, in primarily agricultural landscapes (Hamel et al. 1998, Hamel 2000). A recent rangewide survey has caused us to question this dogma, however, as many CERWs were found in smaller patches of forest, especially in the Northeast (Rosenberg et al. 2000). Habitats used throughout the range form a largely bimodal distribution, with a majority of populations occupying either sycamore (*Platanus occidentalis*)- and cottonwood (*Populus deltoides*)-dominated riparian bottomland forests, or oak-hickory dominated upland forests, primarily on ridge tops (Rosenberg et al. 2000). High densities also occur in mixed-mesophytic forests in coves or slopes, and often on basic soils (Nora Murdock, pers. comm.) in the Southern Appalachians. A common feature of all CERW habitats appears to be a mature, but broken or layered, canopy formed by emergent canopy trees, forest gaps or edges, or steep slopes (Hamel 2000, Rosenberg et al. 2000, Jones et al. 2001).

Despite these differences in habitat, geography, lifestyle, and taxonomy, populations of both birds are declining, and the CERW is under consideration for candidate status under the Endangered Species Act (U.S. Department of the Interior, Fish and Wildlife Service 2002). Modest attention has been paid to each in different studies, primarily on the breeding grounds. Little is known of their biology during migration or on the winter quarters in tropical and subtropical habitats. Both species occur in a broad range of physiographic provinces in the eastern deciduous forest biome (*table 1*). Regions of current sympatry, however, are confined to the Appalachian ridges and plateaus, including the Cumberland Mountains, and in a narrow band across the Great Lakes. Breeding Bird Survey results (Sauer et al. 2001) indicate consistent declines for both species in some common landscapes, e.g. the Cumberland Plateau (*fig. 1*). Both species have been recorded together on a modest number of Breeding Bird Census plots (*fig. 2*). Highest common density was achieved on a plot in cut-over oak-hickory forest (Thacker et al. 1966).

This Greenbrier Co., West Virginia, plot was harvested

Table 1— *Simultaneous occurrence of Golden-winged and Cerulean Warblers in the Breeding Bird Survey (BBS), 1966-2000 (Sauer et al. 2001). Values in the table represent mean annual population trends and associated statistics for the two species in physiographic areas where at least one of them was abundant enough to report a trend. Trend is the trend value. P is probability that the trend = 0. N is the number of routes on which the estimate is based. Low 95 and High 95 indicate the endpoints of the 95 percent confidence interval about the mean value. Region is the physiographic, geographic, or political division by which the BBS reports results. For each region and each species, concerns about the adequacy of sampling or the abundance of the species in that region are marked by asterisks in the Data Quality column, indicating * - deficiency, and ** - serious deficiency in estimation for the respective species (Sauer et al. 2001).*

Golden-winged Warbler							Cerulean Warbler					
Trend	**P**	**N**	**Low 95**	**High 95**	**Data Quality**	**Region**	**Trend**	**P**	**N**	**Low 95**	**High 95**	**Data Quality**
						Upper Coastal Plain	-11.6	0.23	5	-26.9	3.7	**
						Northern Piedmont	7.6	0.18	6	-1.8	17	**
						Southern Piedmont	-45.1	0.31	2	-91.2	1.1	**
-21.3	0.07	6	-25.8	-16.8	**	Southern New England	10.9	0.34	2	-1.9	23.8	**
-5.1	0.05	39	-10	-0.3	*	Ridge and Valley	-1.8	0.35	23	-5.7	2	*
						Highland Rim	-5.3	0.03	27	-9.7	-0.9	*
						Lexington Plain	-11.4	0.05	6	-19.4	-3.5	**
-7.3	0.02	7	-9.2	-5.3	**	Great Lakes Plain	-2	0.65	10	-10.4	6.4	**
-3.7	0.43	3	-11	3.6	**	Driftless Area	-7.7	0.28	3	-18.1	2.7	**
4.5	0.15	17	-1.2	10.2	**	St. Lawrence River Plain						
						Ozark-Ouachita Plateau	-9.5	0.03	9	-15.9	-3.1	**
-2	0.14	45	-4.7	0.6		Great Lakes Transition	-7.3	0.04	6	-11.5	-3.1	**
-7.4	0.23	9	-18.2	3.3	**	Cumberland Plateau	-3.5	0	22	-5.4	-1.7	
-10.5	0	18	-13.5	-7.6	*	Ohio Hills	-2.7	0	56	-4	-1.4	
-4.3	0.38	5	-11.8	3.2	**	Blue Ridge Mountains	2.9	0.23	4	0.8	5.1	**
-8.3	0	47	-11.3	-5.2	*	Allegheny Plateau	-4.7	0.03	41	-8.9	-0.5	*
-6	0.32	2	-12.6	0.6	**	Adirondack Mountains						
-8.7	0.31	3	-17.7	0.3	**	Northern New England						
0.9	0.6	62	-2.5	4.3	*	N. Spruce-Hardwoods						
						Till Plains	-15.5	0.03	6	-23	-8	**
-2.5	0.01	263	-4.2	-0.7	*	Eastern BBS Region	-4.2	0	222	-5.5	-2.9	*
						Central BBS Region	-10	0.01	13	-15.5	-4.5	**
-1.4	0.06	100	-2.9	0	*	FWS Region 3	-5.7	0	67	-7.6	-3.8	*
-5.5	0.22	9	-13.2	2.3	*	FWS Region 4	-5.4	0	48	-8.5	-2.3	*
-8.1	0	126	-10	-6.2	*	FWS Region 5	-3.4	0	117	-5.1	-1.7	*
-3.5	0	235	-5.1	-1.9	*	United States	-4.3	0	233	-5.6	-3	*
5.4	0.16	28	-1.9	12.7	**	Canada						
-2.5	0.01	263	-4.2	-0.7	*	Survey-wide	-4.2	0	235	-5.6	-2.9	*

five years before the census was conducted, leaving about 10 percent of the original canopy cover, composed of trees 20 cm dbh and less, up to 10 m tall. Dominant overstory was oak-hickory, with dense understory of *Rubus* sp. (Thacker et al. 1966).

Both GWWAs and CERWs have benefited from the abandonment of farmland in the northeastern US and southeastern Canada (Confer 1992, Oliarnyk and Robertson 1996, Rosenberg et al. 2000). Appropriate conditions for both of these species to breed have existed in the eastern North American breeding grounds for centuries, clearly longer than the current modifications brought about by settlement since colonial times. At the landscape scale, then, the two species have been sympatric for a long time.

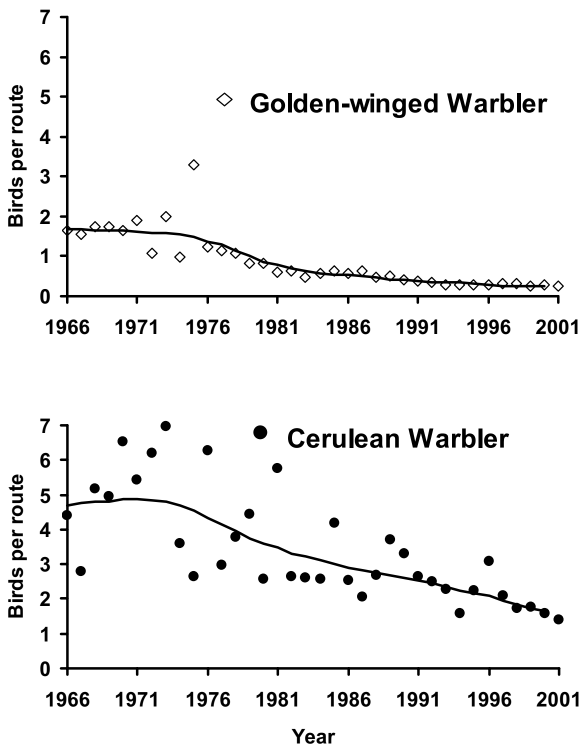

Figure 1— Numbers of Golden-winged and Cerulean warblers recorded on Breeding Bird Survey routes in the Cumberland Plateau. Counts are the mean number of birds recorded per route. Serious deficiency in data quality is indicated for Golden-winged Warbler data set (Sauer et al. 2001). Redrawn after Sauer *et al.* (2001).

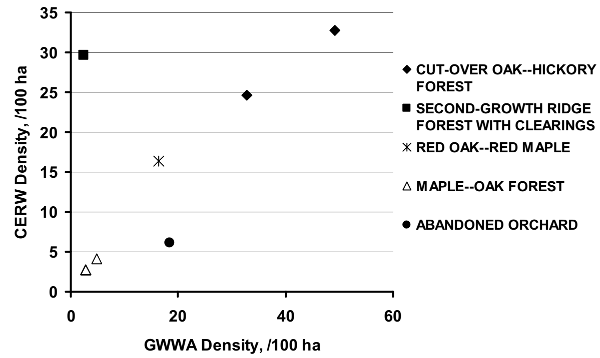

Figure 2— Occurrence of Golden-winged Warbler (GWWA) and Cerulean Warbler (CERW) on common plots in the Breeding Bird Census. Density is expressed as breeding pairs/100 ha ($r = 0.35$, $N = 5$ plots, $P = 0.56$).

Demographic study of each species has indicated that reasonably high reproductive success and productivity can be achieved in stands growing as secondary succession on abandoned farmland. Confer (1992) reported an average of 2.0 young/pair yr-1 produced by GWWAs in shrubby fields occurring early in secondary succession on abandoned farmland in north-central New York. Confer et al. (2003) note that the birds' reproductive success is higher in younger stands. Oliarnyk and Robertson (1996) reported CERWs to produce an average of more than 3 fledglings/successful nest in mature upland hardwood forest growing in secondary succession on abandoned farmland in Ontario. Jones et al. (2002) suggest that this number may not represent sufficient productivity to maintain that population, however. In their demographic study of GWWA in managed forest, Klaus and Buehler (2001) reported 3.7 fledglings/successful nest in recently harvested forest in North Carolina. Similar demographic data are lacking for CERW in relation to forest management practices.

Winter biology of both species deserves additional study. Confer (1992) devotes a single short paragraph to the topic of GWWA winter habitat, noting it to be "Woodland canopy, semi-open or less dense forests and forest borders or gaps." While CERW winter habitat is often considered to be primary forest (references in Hamel 2000), the lone published study of the winter ecology of the species was conducted in shade-coffee plantations (Jones et al. 2000). Both species appear to join mixed-species flocks of resident birds, primarily at middle elevations on humid, subtropical or temperate forested slopes (K.V. Rosenberg, pers. obs.). Although CERW is generally considered to be threatened in winter, Confer (pers. comm.) does not believe this to be the case for GWWA, pointing out that major range contractions have corresponded with changes in temperate breeding habitat conditions and occurred long before winter habitat alterations were a major factor influencing population size.

The Questions

(1) At what scale are the habitat requirements of Cerulean and Golden-winged warblers compatible within their areas of range overlap?

Our knowledge of CERW breeding habitat selection comes from descriptive studies across the range (e.g., Oliarnyk and Robertson 1996, Hamel 1998, Hamel et al. 1998, Rosenberg et al. 2000, Jones and Robertson 2001, Nicholson 2003). These are birds that use large trees for their breeding habitat requirements, often within a structurally diverse forest canopy. Descriptive work also characterizes the habitats of GWWAs (Will 1986, Confer 1992, Klaus and Buehler 2001, Confer et al. 2003). These birds breed in openings in which herbaceous vegetation, shrubs and small trees grow in close proximity to one another.

It is informative to consider anecdotal evidence from real situations in which these two species co-occur in close proximity within tracts in the same landscape. The first example comes from Sterling Forest State Park and vicinity in the Hudson Highlands region of southeastern New York (J. Confer pers. comm; K.V. Rosenberg, pers. obs.). This largely forested area supports one of the largest populations of CERWs in the state, primarily on oak-dominated slopes and uplands. This same area is dotted with natural openings in the form of alder swamps, and these support a large and important population of GWWAs. GWWAs also nest in a series of narrow power line rights-of-way that cross the forested park. In this region, CERW often occurs at the edge of forests. In at least one location, CERWs have nested for four years in a small forest isthmus with GWWA territories on both sides. In Sterling Forest State Park, CERWs nest in forest adjacent to a utility right-of-way and along roadsides. Management plans for the state park focus on maintenance of continuous forest, but ignore the disturbed habitats that support GWWAs and other species. Clearly the long-term persistence of both warblers is possible in this landscape with proper attention to the needs of each.

A very similar situation exists in northwestern New Jersey at High Point State Park and adjacent Delaware Water Gap. Here CERWs occupy both oak-dominated forests at higher elevations and sycamore-dominated riverine forest in the valley. As in nearby New York, GWWAs occur in alder wetlands and stream corridors at higher elevations, as well as in power-line corridors and abandoned farm-fields on the slopes and along the Delaware River. It is not uncommon to find both species in close proximity, especially because CERWs often sing from patches of tall trees at the edge of clearings. Whereas CERWs have increased in this area as forests matured, GWWAs are threatened by loss of early-successional habitat, incompatible management of utility corridors, and recent invasion by Blue-winged Warblers.

Further south, both CERW and GWWAs occur at high density throughout the large landscape of southern West Virginia (R. Canterbury, pers. comm.), with CERWs concentrated along forested ridges and GWWAs concentrated at abandoned surface mines intermingled among dense forest. Here too, it is not uncommon to find both warbler species in close proximity near the edges of forest. Finally, in the Cumberland Mountains of Tennessee, CERWs occur across a range of mid-successional forest conditions, including on the edges of old strip-mine benches, with GWWAs occupying the early-successional habitats on the benches (C. Nicholson and D. Buehler, unpubl. data).

These examples suggest that at the landscape scale, where separate patches of habitat may be managed specifically to produce habitat for each of the species, management for the two species appears to be possible. It may be possible, therefore, to create or maintain GWWA habitat in predominantly forested landscapes without seriously reducing quantity or quality of habitat for CERWs. For example, creation of small openings or narrow corridors will not result in negative effects normally attributed to forest fragmentation, and could actually enhance local CERW density by providing locally more diverse canopy structure. Another strategy would be to manage aggressively and repeatedly those disturbed or early-successional habitats that already exist and support GWWAs to ensure their continued presence, without affecting nearby CERW habitats. Additional monitoring of such approaches will be necessary to evaluate the success of any management strategy and to evaluate how other priority species respond to prescriptions designed for CERW and GWWAs. Thompson and Angelstam (1999) stress the importance of care in conducting management for special species such as these two birds.

(2) What role does disturbance play in the creation and maintenance of habitat for each species?

Natural or anthropogenic disturbance of the landscape plays an important role in habitats of GWWAs range-wide (Confer 1992). The high reproductive success of the species in clearcuts in the Southern Appalachians, while the species is disappearing from areas without management intervention (Klaus and Buehler 2001), argues strongly for repeated disturbances in these landscapes. Likewise, modest disturbance to the landscape, such as provided by limited area windstorms, and ice storms (Jones et al. 2001), and probably moderate amounts of forest harvest, also may benefit CERW

(Hamel 2000). Evidence to this effect is circumstantial where CERWs have been absent from some areas but have appeared after natural or anthropogenic forces have created canopy openings. Controlled experiments are needed to increase the strength of the inference, but it is clear that disturbance plays an important role in the biology of both of these birds.

(3) Can we mimic beneficial forms of disturbance for these species through direct management?

Because of the numerous examples of sympatric occurrence of the birds at the landscape and even the forest stand level, development of a management system that accommodates the needs of both these birds seems feasible. The most important issue is the temporal and spatial scales at which it is accomplished, leading to several questions. Do we provide habitat for the two species on the same 10 acres, somewhere within the same 10,000-acre landscape, or at another scale? Do we provide habitat for the two species on the same ownership or on different ownerships? What is the appropriate role for different types of landowners in providing habitat for these two species? Private landowners might most easily provide early-successional habitats while public landowners might more easily provide later-successional habitat. What are the particular conditions of soil and bedrock that are most suitable for each or both of these species?

Based on interpretation of habitat studies, we can infer possible management strategies for both species. In areas where habitat is already suitable (i.e., CERWs are already present), forest protection may be the most logical strategy. In areas with potential but unoccupied habitat, a silvicultural treatment may be useful for improving habitat suitability and increasing the likelihood that the birds will occupy the site. Hints that some harvesting may be useful, or at least not detrimental, to CERWs are implicit in Hamel (2000). Specific experiments involving purposeful habitat manipulations designed to test response to those treatments are necessary to assess whether the hypotheses arising from these hints are reasonable (Morrison et al. 2001).

Klaus and Buehler (2001) showed that, for GWWA, productive breeding habitat can result from habitat disturbance by timber harvest. In the Northeast, GWWA habitat is produced by maintenance of powerline rights-of-way (J. Confer, pers. comm.). Studies of Red-cockaded Woodpeckers (*Picoides borealis*; Saenz et al. 2001), and game birds such as Northern Bobwhite (*Colinus virginianus*, Brennan 1999), as well as Black-capped Vireos (*Vireo atricapillus*; Grzybowski 1995), have shown that certain forestry practices, particularly controlled burning, can mimic natural disturbances to a degree sufficient to create favorable conditions for certain wildlife species. In addition, controlled fire can indeed imitate small-scale natural fires in favoring vegetation productive of certain species. Some kinds of disturbances, such as stand-replacement fires, are useful habitat producers for some species, such as Kirtland's Warbler (*Dendroica kirtlandii*, Mayfield 1992). However, use of such fires is less feasible in landscapes increasingly home to numbers of people. Land use conflicts and air-quality issues in this urban-wildland interface will make active management difficult in the future (Smith 2002).

(4) Is this type of management compatible with commercial forestry and other ongoing forms of land use?

Some of the insights gained through descriptive research on the breeding biology of both CERWs and GWWAs have led to the development of silvicultural manipulations aimed at benefiting the species. At Chickasaw National Wildlife Refuge in Tennessee, these insights may find application in an experimental manipulation as part of the forest management plan of the refuge (Hamel, this volume). Similar implementation of insights gained through work on CERW has led to implementation of a comparison of a standard silvicultural prescription with a prescription similar to Hamel (this volume) on property managed by Anderson Tully Co. (P. Hamel, M. Staten, and R. Wishard, pers. obs.). An experimental forest management prescription designed to benefit CERWs and other forest-interior songbirds also has been implemented on Tennessee National Wildlife Refuge (R. Wheat, pers. comm.).

Clear association of GWWAs with periodically disturbed and maintained shrubby powerline rights of way indicates that management for that species is critical to habitat maintenance (Confer 1992). Association of GWWAs in the Cumberland Mountains of Tennessee with abandoned strip-mine benches undergoing succession has led to an opportunity to maintain experimentally some of these areas in early-successional habitats and evaluate the population response of the birds to the disturbance of the vegetation (D. Buehler, unpublished work in progress).

(5) What is known about the relative importance of breeding versus wintering habitat to population trends of the two species?

Definitive studies have not been conducted that test the sensitivity of CERW or GWWA populations to limiting factors on breeding vs. wintering grounds. Limited evidence suggests, however, that it is not all one or the other. In expanding CERW populations in Ontario, where reproductive success appears to be good (Oliarnyk and Robertson 1996), breeding ground conditions may be sufficient to overcome whatever limitations in survival being experienced on the wintering grounds. CERW populations in the Cumberland Mountains of Tennessee declined after several years of poor nest success related to cool-wet El Niño springs, again suggestive of sensitivity to breeding grounds effects (Nicholson 2003). Studies on other species, like Black-throated Blue Warblers (*Dendroica caerulescens*) (e.g., Sillett and Holmes 2002), suggest that even within a given species, populations may be limited under some circumstances by breeding grounds events and under other circumstances, by wintering ground events. Historical patterns of GWWA breeding range contraction and expansion correlate closely with documented patterns of human land use practices and changes in those practices (Confer et al. 2003). These changes occurred before recent habitat changes in GWWA wintering grounds.

Some data are beginning to appear on the topic of winter habitat, e.g. Jones et al. (2000) for CERW. Habitat destruction on the winter grounds likely is detrimental to all species of interest, including residents and migrants. This is not always true, however. In Jamaica (Confer and Holmes 1995) as well as other regions, peak densities of Neotropical migratory birds occur in slightly to moderately disturbed sites. Effects of disturbance are species-specific, with carrying capacity for some species enhanced and that for others hurt by habitat modifications. We have little information on the effects of management on bird populations in winter habitats, many of which have in past experienced extreme variations in effects of human populations on the extent of forest in the landscape. We will need such data in the future.

Discussion

Pro- versus anti-management arguments

Central to developing avian conservation strategies is the notion that habitat for each species can be described as a vector of vegetation structural characteristics (James 1971). We assume that structure is a sufficient surrogate for the occurrence of the other needs for food, safety, and space to conduct the actions of life history successfully. In this view, structure proceeds through a dependable sequence as time progresses, with various disturbances or perturbations pushing it back or sideways on the trajectory.

Clearly, early-, and later-successional forest stands cannot occur on the same acre at the same time, so at each instant, a decision to create early-successional habitat on a particular plot retards the development of later-successional conditions, just as a decision to permit the progress of succession precludes the maintenance of early-successional conditions. In general, early-successional habitat can be created in a short time period, whereas later-successional habitat may take many decades to develop. We, then, pose the question, "Can structure for an early-successional species be maintained on the same land that contains habitat structured for a later-successional species?"

Some would answer this question, "No!" and proceed to develop means of providing areas of one successional condition and different areas of another successional condition (e.g., Hamel 1990). Suppose we call these people anti-management. Their belief is that our intervention cannot dependably create such a desired future condition. Providing habitat for an early- and a later-successional species must take place on separate areas in this view.

Others would answer this question, "Why not?" and proceed to develop means of controlling disturbance and perpetrating interventions that maintain that area of land in a combination structure, which includes the elements important to early-successional species and to later-successional species. Such a philosophy is apparent in Hamel (1992), Short et al. (2001), and well illustrated in the diagrams in Staten (1994). Suppose we call these people pro-management. Their belief is that purposeful management action can create a desired future condition that is beneficial to the species in question.

Both anti-management and pro-management viewpoints have merit. Anti-management opinion respects the essential incompleteness of our knowledge of the habitats of species of interest, which may lead to unwanted elimination of desirable species through management action, or to unwanted increase of undesirable species. Pro-management opinion recognizes the inevitability of vegetation change with time (Hamel et al. 2001). In a certain sense, the limitation of each of these viewpoints is the strength of the other. A consideration we offer to the reader is the following. Time will hurt us all if we don't work with it, for vegetation change beyond the conditions suitable for a particular species may be very difficult to reverse. Similarly, time is a major ally when interventions take advantage of what it provides, in a sense harnessing successional processes to achieve specific goals.

Will an integrated, multi-species approach to habitat conservation work?

The integrated, multi-species approach to conservation is at the heart of the PIF process. As a mechanism to coordinate human efforts, such as through the North American Bird Conservation Initiative (U.S. NABCI Committee 2000, Bird Studies Canada 2002), it has already proven its effectiveness. With respect to management action on the ground, a multi-species approach must work as well, because we have no other realistic alternative. Nevertheless, actions directed toward improving habitat for one species do not always produce benefits for other species of similar ecological characteristics (Block et al. 1986).

Absent specific manipulations to create a particular disturbance, natural disturbance regimes will produce changes in vegetation on a haphazard basis at unpredictable times and in unpredictable locations. Natural disturbances affect lands and landscapes irrespective of their community content of birds; all the species are, in a sense, stuck with the results.

Considerable interest in the potential effects of mountain top removal surface mining for coal exists in relation to these two species. Evidence in Tennessee and West Virginia suggests that some successional conditions resulting from older mining practices before the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87; Office of Surface Mining 2002) appear to support CERWs on the slopes and GWWAs on the abandoned benches (Yahner and Howell 1975; Nicholson 1979, 1980; M. Welton, pers. obs.; D. Buehler, pers. obs.). Modern mining practices have not been shown to duplicate these vegetation conditions.

The Take Home Message

Reconciling the needs of early- and later-successional species is a key consideration in conservation planning and action. Management activities for GWWA and CERW might be conducted on the same sites, or perhaps more likely where space is less a limitation, on separate tracts within a larger jurisdictional unit, such as a state park, national forest, or managed industrial forest. The two species provide an opportunity for the bird conservation community to address head-on issues related to management of multiple species, as well as to confront legitimate concerns of stakeholders skeptical of intervention activities in forest habitats. One important consideration in management is that an activity must be clearly defined; otherwise normal humans cannot carry it out. Because this is so, following an adaptive approach to management of habitats for these and other species is a useful course.

Finally, the cost of management must be borne by someone, and this expense often is not trivial. Where it is possible for forest products to underwrite the costs of the habitat improvements obtained in the process, it would appear prudent to promote suitable timber harvest practices.

Summary and Conclusion

Through a series of questions and answers, focused on the conflicting biological and concordant conservation needs of two warblers of high conservation concern, issues related to management of species of high conservation concern are addressed. GWWA and CERW are species of wide distribution, acute conservation concern, and divergent habitat needs.

The modicum of information we have indicates that each of these birds is associated with canopy disturbance in some way. GWWAs are often associated with an opening in the forest, whose dominant vegetation is herbaceous with some woody plants, and trees nearby. Without disturbance, such openings rapidly succeed to forest. CERWs are believed by many to be associated with canopy gaps. These may be natural gaps created by windthrow or storms; or they may be anthropogenic gaps resulting from a harvest manipulation such as shelterwood or group selection harvesting, or some other activity. These openings also close rapidly as the vegetation responds to the increased light levels reaching the lower stories.

Managing both of these warblers on the same acre without intervention of some sort is likely impossible. Without action, the future of the early-successional GWWA is made more uncertain. Lack of experimental evidence of the effect of manipulations on the future development of habitat for the later-successional CERW prescribes caution in conduct of management activities. Following a deliberate middle course between these simultaneous benefits and risks is the essence of adaptive management.

Ultimately, bird conservation in broadleaf forest habitats means more than just locking away expanses of undisturbed mature forest. Temporal as well as spatial dynamics of disturbance are important to bird conservation in forest habitats. How natural and anthropogenic disturbances are managed in the landscape is key to maintaining mature forest as well as early-successional forest in today's landscape.

Acknowledgments

We are grateful to D. Demarest and C. Hunter for their urging that we undertake this task. J. Woehr provided a critical review, which has been an important stimulus to this manuscript. J. Confer has been an insightful participant in the development of this work, both during initial discussions about its form, and later as a reviewer. His contrasting views have made this a better work, even though he does not entirely agree with our approach. T. Dell and B. Wigley provided a critical review of an earlier draft of the work as well. We are indebted to the clear thinking of an anonymous reviewer for pointing out opportunities to clarify a number of points in the manuscript, and to T. Rich for thoughtful and rigorous editing. We must acknowledge gratefully the patience and

attention to detail of those valiant souls who have conducted the Breeding Bird Survey routes.

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