HABITAT, BEHAVIOR, AND SPRING MIGRATION OF CERULEAN WARBLER IN BELIZE

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THE CERULEAN WARBLER (*Dendroica cerulea*) is a species of special conservation concern because it has apparently suffered a long-term population decline at numerous localities on the breeding grounds in the eastern United States (Robbins *et al.*, 1992). Presumably this stems from habitat destruction at both ends of its extensive geographic range. The species appears to be especially susceptible to the ongoing fragmentation and isolation of large tracts of mature deciduous forest throughout its breeding range, but has no doubt also suffered as a result of widespread deforestation within its narrow elevational range (of *ca.* 600–1400 M) on the eastern slopes of the Andes from Venezuela to southern Peru (Robbins *et al.*, 1992) and northern Bolivia (Remsen and Traylor, 1989). The former authors provide an excellent summary of the habitat preferences, ecology, distribution, and probable causes for the decline in this species. Despite the fact that Cerulean Warblers breed within a few miles of many of North America's largest cities, details of their nesting behavior and food habits are sketchy at best. Similarly, knowledge of the behavior and ecological distribution of this species away from the breeding grounds is fragmentary and confined primarily to the recent observations of a handful of neotropical ornithologists who work in remote parts of the Peruvian Andes (Robbins *et al.*, 1992). Furthermore, almost nothing has been published on the migratory routes or behavior of Cerulean Warblers during their spring and fall migration. In this and most other long-distance neotropical migrant landbirds, the shape, geographic position, and orientation of migratory routes and potential staging areas have not been delimited. In this paper, I provide a summary of my own observations on the habitat, behavior, and status of this threatened species during its spring migration through the Maya Mountains of southern Belize. I also discuss the conservation implications of these observations, and I suggest ways to obtain additional, much-needed information on the distribution of this and other poorly known neotropical migrants that use the highly threatened evergreen forests of Middle America.

Study area and habitat of Cerulean Warblers in the Maya Mountains

Between April 3–13, 1992, while undertaking a biological assessment of the Columbia River Forest Reserve in the Maya Mountains of southern Belize, I was afforded an unexpected opportunity to observe large numbers of migrant Cerulean Warblers. The Columbia River Forest Reserve encompasses more than 100,000 acres of old-growth forest on rugged limestone hills and low mountains within an elevational range of 300–900 M. Most of my field effort was concentrated at 600–750 M in subtropical lower montane wet forest (*sensu* Holdridge 1967) in a remote portion of the reserve south of Little Quartz Ridge along an infrequently used trail that leads to the Mopan Maya village of San Jose. Our primary study site was Union Camp, a small clearing to which we were transported *via* helicopter by the British Forces of the Belizean Air Force. We also spent several days in particularly tall forest near a small spring known as La Gloria.

Most tall evergreen forest in the low mountains of this region receives about 2500 MM of rainfall each year, although the windward, Caribbean-facing slopes may get up to 4000 MM (Hartshorn *et al.*, 1984). The wetter ravines and slopes are covered by a magnificent, epiphyte-laden forest of 25–35 M tall trees. This forest is characterized by the presence of numerous chicle trees (*Manilkara zapota*), which in some areas form impressive stands of giant individuals more than 40 M tall and 200 CM around. Chicle sap was harvested in the region until the early 1960's, after which time many of the trees were apparently tapped out (Matola 1990). Similarly, many of the valuable hardwoods,

such as mahogany (*Swietenia macrophylla*), were cut out many decades ago. Most of the trails cut by chicleros and logging roads utilized until about 20 years ago are now overgrown. Other dominant, large trees throughout the area where Cerulean Warblers were observed include *Dialium guianense* and *Pithecellobium arboreum* (Leguminosae), *Calophyllum brasiliense* and *Symphonia globulifera* (Guttiferae), *Erblichia odorata* (Turneraceae), *Euterpe macrospadix* (Arecaceae), *Ficus* spp. (Moraceae), *Guarea glabra* (Meliaceae), *Hirtella triandra* (Chrysobalanaceae), *Sebastiana longicuspis* (Euphorbiaceae), and *Terminalia amazonia* (Combretaceae). Palms are conspicuous and diverse, especially numerous were small understory species of *Chamaedorea* (6 spp.), as well as *Crysophila argentea, Calyptogyne ghiesbreghtiana,* and *Synechanthus fibrosus.* The middlestory is well developed and comprised of numerous small- to medium-sized trees such as *Rinorea guatemalensis* (Violaceae), *Guatteria amplifolia* (Annonaceae), and *Guarea macrophylla* (Meliaceae). For a more detailed description of the area and its plant and vertebrate communities see Parker *et al.* (1993).

Cerulean Warbler

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Behavior and population

During our stay in the Columbia River Forest Reserve, I recorded Cerulean Warblers daily in moderate to relatively large numbers (10–20 per day). In fact, this species was the fifth most numerous neotropical migrant (among >40 species) recorded during the period, being outnumbered in my daily field notes only by Black-and-white Warbler (*Mniotilta varia*), Wilson's Warbler (*Wilsonia pusilla*) Magnolia Warbler (*Dendroica magnolia*), and Swainson's Thrush (*Catharus ustulatus*). As many as 20 Cerulean Warblers were noted in one morning (April 8) along *ca.* 2 km of trail through tall forest at Union Camp, and at least 100 different individuals were observed during the period. All records were of birds in the canopy or upper middlestory of tall forest more than 100 m from edges of any kind. The species seemed to be equally numerous April 3–10, but thereafter numbers appeared to decrease, although this may have been due to the more difficult viewing conditions at the second camp (e.g., higher canopy and denser intervening vegetation). The birds were always inconspicuous, but could be located rather easily by finding mixed-species flocks in the canopy and then by scanning the preferred foraging areas within the taller trees for rather sluggish warblers. Due to its highly arboreal habits, the species would almost certainly not be caught in mist-nets placed in the understory. It has no doubt been frequently overlooked in the tall, dense forests that characterize most areas along its spring migratory path.

Foraging birds moved about rather slowly, usually spending many minutes within one portion of a tree. Most individuals were noted in the crowns of tall middlestory trees, or in the lower parts of emergent trees (see above). They typically worked their way out along slender branches towards the outermost foliage, pausing briefly to scan the under surfaces of leaves and stems, and then flew slightly higher and in towards the trunk before once again moving towards the tips of branches. They occasionally made chipping notes, but were more silent than most transient and resident species with which they associated. No songs were heard. At Gloria Camp during the early afternoon, I observed a male and a female (separately) descend from the upper middlestory to bathe in a small pool of water frequented by a large number of resident and migrant bird species.

Foraging Cerulean Warblers were observed from *ca.* 9–25 m above the ground. Mean foraging height for both sexes was very similar, at *ca.* 16.6 m (in 26 males, x=16.60, SD=4.13; in 17 females, x=16.55, SD=4.20). I recorded 80 foraging maneuvers of 45 individuals (29 males, 16 females). They most frequently gleaned the undersides of green leaves (77% of observations), usually reaching to pull a prey item from the base of a leaf. They less often made short, upward sallies to leaves (10%), and one individual gleaned a small prey item by hovering at the tip of a leaf. Foraging substrates included green leaves (71%), leaf stems (15%), a slender branch (1), and a dead leaf (1). The average size of

green leaves searched for prey was about 15 CM × 5 CM. Observed prey items (71 obs.) included unidentified small arthropods (69%), caterpillars (11 green, 4 brown; 21%), small green, katydid-like orthopterans (4%), a spider (1), a small roach (1), and a moth (1). No fruits were taken.

All Cerulean Warblers were observed in small to large mixed-species flocks containing from five to as many as 25 species. At least 40 bird species were recorded in association with Cerulean Warblers in the Columbia River Forest Reserve. Regular associates in 18 different mixed-species flocks included the Gray-headed Greenlet (*Hylophilus decurtatus*; in 12 flocks), Black-and-white Warbler (12), Wilson's Warbler (10), Tennessee Warbler (*Vermivora peregrina*; 7), Russet Antshrike (*Thamnistes anabatinus*; 6), Magnolia Warbler (6), and Golden-winged Warbler (*Vermivora chrysoptera*; 6). Less frequent associates included a variety of resident species, such as Smoky-brown Woodpecker (*Veniliornis fumigatus*), Ivory-billed Woodcreeper (*Xiphorhynchus flavigaster*), Olivaceous Woodcreeper (*Sittasomus griseicapillus*) Ochre-bellied Flycatcher (*Mionectes oleagineus*), Green Shrike-Vireo (*Smaragdolanius pulchellus*), Black-throated Shrike-Tanager (*Lanio aurantius*), and White-winged Tanager (*Piranga leucoptera*). On successive days, I regularly relocated what were assumed to be the same Cerulean Warblers in flocks that spent all of their time within relatively small areas of forest (*ca.* <2 hectares). Up to six individuals (3 males, 3 females) were observed in the same flock, but most sightings involved one (18 times) or two individuals (both males, five times; male and female, three times). Males regularly foraged within a few meters of each other.

Discussion

The presence of large numbers of Cerulean Warblers at 600–750 M in the Maya Mountains of Belize during clear weather in the first two weeks of April suggests that lower montane forests in this portion of Middle America may serve as a staging area for this species. It is perhaps not coincidental that lower montane forests in this region appear to be structurally similar to those used by this warbler on its wintering grounds in the Peruvian Andes (*pers. obs.*; J. Fitzpatrick, *pers. comm.*).

Based on the above observations, I hypothesize the following scenario for spring migration of Cerulean Warblers: In mid-March, most individuals move north along the eastern slopes of the Andes to northern Colombia, whereupon they fly more than 1500 KM across the western Caribbean, moving northwest until reaching land somewhere over the coast from Nicaragua north to Belize. They then continue inland to suitable lower montane forest habitat in low mountains facing the Caribbean coast, where they pass the next three weeks (late March to mid-April). I suggest that this potential staging area encompasses a relatively small portion of the Middle American highlands, from the low ridges in extreme southeastern Chiapas (e.g., Montes Azules), Mexico, southeastward through the Caribbean-facing mountains of Guatemala (e.g., the Sierra de las Minas) into Honduras and perhaps Nicaragua. The paucity of spring records for Cerulean Warblers in the relatively well-studied lowlands (and drier forests) of the Guatemalan Peten and adjacent southeast Mexico (including the Yucatan peninsula) further suggest that, after staging in the above area, the species flies over this region without stopping to reach the Gulf coast of the United States by mid- to late-April.

There are surprisingly few published records of Cerulean Warblers from northern Middle America in spring or fall. Robbins *et al.* (1992) could locate only 15 Central American specimens of this species in the major North American collections Russell (1964) considered it to be a rare spring migrant in Belize and listed only three records for the country. Only a handful of additional records are mentioned for Guatemala (Land 1970, Smithes 1966), and Honduras (Monroe 1968). More recent summaries of the status of this species from farther south indicate that it is uncommon or rare during spring (March–April) in Panama (Ridgely 1991) and Costa Rica (Stiles and Skutch 1989), although the statement that it is occasionally encountered "in small waves" in Panama (Ridgely 1991) raises the possibility that many individuals pass through the Caribbean-slope highlands south of Honduras without being detected. This could be the case because: 1) the migratory period is presumably only a few days or weeks in duration, and 2) the species may occur primarily in lower montane forests above or below the areas most frequented by birders (e.g., La Selva in Costa Rica, or the Canal Zone in Panama). It seems more likely that small numbers trickle north through Panama and Costa Rica from northwesterly wintering areas in the Colombian Andes, or that they are occasionally blown inland while migrating across the western Caribbean, whereas the bulk of the population makes the over-water flight described above. If the majority or all Cerulean Warblers migrated through southern Central America in spring, they would be detected in moderate to large numbers regardless of their behavior or habitat preference.

During my review of the literature on Cerulean Warblers, it quickly became clear that almost nothing is known of migratory routes (or wintering areas) of this or any other long-distance migrant that winters south of Panama. For example, the fall migration of Blackpoll Warblers (*Dendroica striata*) has been described, but spring records in Middle America or the Greater Antilles are almost non-existent This would suggest that, in con-

trast to Cerulean Warblers, Blackpolls undertake an amazingly long spring flight over the western Caribbean without making a landfall until they reach the Gulf coast of the United States. It seems doubtful that Blackpolls make a continuous flight from their known wintering areas in Amazonia, so the question arises, do they stage somewhere in the more seasonal and (now) badly cutover forests of coastal Colombia and Venezuela? Similarly, do Bay-breasted Warblers (*Dendroica castanea*) that winter in Panama and northwestern Colombia migrate overland through Central America, stopping for just a few days or a week in a small geographic area in Belize or Guatemala? Or do they, too, make one long flight from Panama (where they are known to fatten up on small fruits, and are common until late April; R. Greenberg, *pers. comm.*, Greenberg 1984) to the Gulf coast? As in the Blackpoll, the relative paucity of Bay-breasted records for northern Middle America suggests the latter strategy. Gray-cheeked Thrushes (*Catharus minimus*) and Veeries (*Catharus fuscescens*) may also overfly the Caribbean and Middle America during their spring migration from Amazonia, but their departure points in northern South America are unknown. If any of these species regularly used forests in northern Middle America during the spring, one would expect to find many thousands of individuals within small areas during April and May, especially in those regions that have been relatively well-surveyed for birds in recent years (*e.g.*, the Peten and Yucatan). The literature suggests that this is not the case.

Other species that winter primarily south of Panama may share the Cerulean Warbler's apparent propensity for making shorter flights and stopping over for days or weeks in Middle American forests. Additional examples include Acadian Flycatcher (*Empidonax virescens*), Swainson's Thrush (*Catharus ustulatus*), and Golden-winged Warbler, all of which were also numerous (and obvious transients) in the Maya Mountains of Belize during April 1992.

Clearly, there is an urgent need to determine the migratory patterns, potential staging areas (and habitat preferences within such areas) for the large number of neotropical migrant landbirds that winter primarily in South America. Although most neotropical migrants winter in Central America, the entire populations of 40 out of 160 neotropical migrant landbirds winter primarily south of Panama (see Finch 1991 for species list), with most occurring on the slopes of the Andes or in Amazonia. The winter ranges of most of these species are unknown or at best very poorly delimited. These include many of our best-known breeding species in the eastern United States, such as Yellow-billed Cuckoo (*Coccyzus americanus*), Common Nighthawk (*Chordeiles minor*), Chimney Swift (*Chaetura pelagica*), and Veery. Similarly, the degree to which the survival of these and other long-distance migrants depends on staging or stopover areas is unknown.

Answers to such questions are needed before we can determine where our conservation efforts in the neotropics should be focused.

Conservation importance of the Maya Mountains

Large tracts of relatively undisturbed evergreen forest in the mountainous parts of Middle America, such as the Maya Mountains of Belize and Guatemala, will become increasingly important to neotropical migrants as the few remaining areas of lowland forest become reduced to small and widely scattered patches. Although much emphasis has been placed on the fact that many migrants use second-growth forest or edge habitats, perhaps even preferring these to older and less disturbed forests, I was impressed by the number and diversity of migrants present in the interior of old-growth forest in the Maya

Mountains during the first two weeks of April. Although our study areas were more than 10 KM from the nearest large clearings (>*ca.* 2 HA), we found 43 species of migrants, only six of which were restricted to shrubby vegetation around Union Camp. All others were encountered in the interior of tall forest from one to many kilometers from second-growth vegetation (except for small forest treefalls). More extensive studies of neotropical migrants in forests such as this may reveal them to be even more important (especially to transients) than previously thought. The survival of some long-distance migrants, such as the Cerulean Warbler, may depend on the continued maintenance of existing protected areas such as the Columbia River Forest Reserve (*ca.* 100,000 acres), and on the identification and establishment of new reserves, especially in Guatemala, Honduras, and Nicaragua.

In addition to migrants, *ca.* 160 forest-based bird species are resident in the Reserve, about 20% of which are restricted to Middle America (Parker *et al.*, 1993). At least 15 species occur only within evergreen forests in the fragmented and highly threatened moist and wet forests between southeast Mexico and northwest Costa Rica; these include the endangered Keel-billed Motmot (*Electron carinatum*), which is fairly numerous in higher parts of the Columbia River Forest Preserve, and others such as Stub-tailed Spadebill (*Platyrinchus cancrominus*), Northern Nightingale-Wren (*Microcerculus philomela*), and Black-throated Shrike-Tanager. Thousands of additional species (especially invertebrates and plants) are undoubtedly confined to the foothill and lower montane forests in this portion of the neotropics.

Throughout Middle America the remaining native forests are being destroyed at an alarming rate. Their protection—either through watershed management, sustainable forestry, ecotourism—or a mix of these and other alternatives is essential if the rich biological diversity of this part of the neotropics is to be preserved beyond this century.

The Belizean government manages a surprisingly large and diverse complex of protected areas. Together these reserves represent one of the largest continuous expanses of tropical forest left anywhere in Middle America. One can only hope that those fighting for the continued protection of these forests (*e.g.*, the Belize Center for Environmental Studies) will receive the necessary technical assistance and financial support of the international conservation community. Without the dedicated efforts of those national, non-governmental organizations, the future of evergreen forests in Middle America would appear bleak.

Recommendations for future research and conservation action

Whereas much attention is currently being focused on the need for long-term, quantitative studies on neotropical migrant landbirds on their wintering grounds and along their migratory routes, most fieldwork on migrants has been carried out in just a few areas (*e.g.*, the Tuxtla Mountains, Mexico) and has focused on only a handful of species, such as Wood Thrush (*Hylocichla mustelina*) and Hooded Warbler (*Wilsonia citrina*). To gain an accurate understanding of the migratory routes and winter ranges of the many species that remain unstudied, we must marshal a near-herculean effort along broad geographic fronts throughout the neotropics. For example, we must rapidly identify and survey the remaining lower montane forests in Middle America for Cerulean Warblers and the many additional neotropical migrants they support, and should simultaneously extend such efforts to the lower Andean cloudforests from Venezuela to Bolivia [also for Canada Warbler (*Wilsonia canadensis*) and Scarlet Tanager (*Piranga olivacea*)], to the dry forests of Bolivia [for Yellow-billed Cuckoo and Alder Flycatcher (*Empidonax alnorum*)], and the evergreen and dry forests of Mato Grosso and Para, Brazil [for Veery and Connecticut Warbler (*Oporornis agilis*)]. The latter two regions remain biologically unexplored and gravely threatened by mechanized agriculture and cattle ranching.

To answer many of the questions posed in this paper, I suggest that we organize multi-year efforts that would place experienced birders at numerous points, perhaps 25–50 KM apart, from say, the mangrove forests along the coast of Belize westward across montane forests in the Maya Mountains, through lowland forests in the Peten, Guatemala to foothill and montane evergreen forests in southeastern Chiapas, Mexico. Observers should be constantly present at all survey sites along this *ca.* 500 KM-long east-west transect, at least from mid-March to late-May, and again from mid-August to late-November. This would allow us at least a glimpse of the magnitude and composition of migration through the evergreen forests of northern Middle America, and would after just a few years result in a much clearer understanding of 1) the position, orientation, and width (shapes?) of migratory paths, 2) centers of abundance of migrants within these areas, 3) short-term and long-term changes in abundance, 4) habitat preferences, and 5) ecology and behavior of migrants. Such studies could be carried out in concert with badly needed preliminary surveys of the diverse resident avifaunas at survey sites. In addition to the transect described above, I suggest that similar efforts be undertaken in spring, winter, and fall at accessible sites along a number of east-west and north-south transects, such as 1) across the Greater and Lesser Antilles, 2) along the coasts of Colombia, Venezuela, and the Guianas, 3) down the eastern slopes of the Andes from Venezuela to cen-

tral Bolivia, and 4) from the base of the Andes out across Amazonia at a number of points from Colombia-Bolivia east into Brazil. Unless we rapidly undertake surveys of neotropical migrants across broad geographic areas such as these, we will not—in our lifetimes—obtain a sufficiently clear picture of the scope and complexity of the problems that face migrant landbirds in the neotropics.

Such surveys should involve mist-netting, but I recommend that emphasis be placed on visual searches (and the use of tape-recordings) to find and census the many species that occur primarily in the canopy or middlestory of tall forests. Standardized census methods should also be employed, but the gathering of so-called anecdotal information by larger numbers of observers over much wider geographic areas would lead more quickly to an understanding of where neotropical migrants occur from September to March, which in turn would enable us to focus more in-depth research and conservation priorities within the proper geographic regions. We can no longer afford to use the results of studies on a handful of species to plan conservation strategies for the vast majority of neotropical migrants that remain essentially unstudied on their wintering grounds or migratory routes. If we do not quickly and collectively focus more attention on the neotropics, many species such as the Cerulean Warbler will disappear before we have a chance to save them.

On a final note, it is essential that field studies on migrant landbirds in the neotropics be carried out jointly with counterpart non-governmental conservation organizations and academic institutions (e.g., national museums, universities) so that the results of such research can be communicated directly and more clearly to the government agencies and officials who ultimately make decisions regarding land-use practices. Such relationships also result in an infusion of badly needed research materials (e.g., books, binoculars) and financial assistance. Even more importantly, cooperative efforts serve to heighten our awareness of environmental problems, economic realities, and politics at both ends of the migratory route and everywhere in between.

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