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Conservation Plan for the Cerulean Warbler on its nonbreeding range

Plan de conservación para la Reinita Cerúlea sobre su rango no reproductivo

Fundación ProAves – American Bird Conservancy – El Grupo Cerúleo

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2. PREFACE

Truly collaborative conservation requires interchange among all concerned individuals and entities. When the species of interest ranges over most of a hemisphere, as in the case of Cerulean Warbler, the stakeholders are very numerous and forging the collaboration is a long and intense process. In 2001, scientists and land managers alarmed by the steep decline in breeding populations of Cerulean Warblers formed the Cerulean Warbler Technical Group. Subcommittees were established to address particular issues of concern, including the lack of information on the nonbreeding distribution, ecology, and migrations of the birds. The nonbreeding subcommittee named itself El Grupo Cerúleo.

Tasks for El Grupo Cerúleo were to assemble, assess, refine, and analyze existing information on nonbreeding biology of the Cerulean Warbler. El Grupo Cerúleo members aggressively pursued a variety of tracks to further survey and study the species, model its nonbreeding range, and test their findings in rigorous ways. A hallmark of this process has been the persistent effort, despite the differences of language, culture, and nationality, to increase the network of collaborators and cooperatively to develop a common base of information. Thanks to many funders, principally the National Fish and Wildlife Foundation and U.S. Forest Service, members met in Ecuador and Colombia and reported the results of their efforts at meetings in the US, Chile, Venezuela, and Mexico. Active participation by El Grupo Cerúleo members has been a dependable part of the efforts of the Cerulean Warbler Technical Group to assist the U.S. Fish and Wildlife Service (USFWS) to assess the status of the species and to share information at regularly held Cerulean Warbler Summits. The group won the prestigious Wings Across the Americas International Cooperation award in 2008, sponsored by the U.S. Forest Service's Office of International Programs.

In October 2008, members of El Grupo Cerúleo hosted the most recent Cerulean Warbler Summit in the headquarters of the Colombian National Coffee Federation in Bogotá, and in San Vicente de Chucurí, Colombia, where El Grupo Cerúleo member Fundación ProAves has established the first conservation reserve outside North America for a migratory songbird, la Reserva Natural Reinita Cielo Azul. A vital part of that Summit was the recognition that the time has come to pass the baton of energy from the scientific community to the conservation community to implement recommendations arising from the work conducted to date.

Prepared by Paula Caycedo for El Grupo Cerúleo members Fundación ProAves and American Bird Conservancy, this conservation plan for the Cerulean Warbler's nonbreeding season has been reviewed extensively by members of the Cerulean Warbler Technical Group and El Grupo Cerúleo. Their views are incorporated into the document. This document is a blueprint that addresses the challenging issues involved in collaborative conservation of a species whose range encompasses so many geographic and political boundaries. The Cerulean Warbler Technical Group enthusiastically endorses this plan and, through its subcommittee El Grupo Cerúleo, urges all who read it to find a task outlined in Chapter 12 that fits within their individual interest or agency mission, adopt it as their own, and implement it as expeditiously and effectively as they can.

***T. Bently Wigley,* NCASI & *Deanna K. Dawson,* U.S. Geological Survey**

Co-Chairs, Cerulean Warbler Technical Group

2.1 PREFACIO

La verdadera colaboración para la conservación requiere de una retroalimentación entre todas las entidades y personas interesadas. Cuando la especie de interés abarca más de un hemisferio, como en el caso de la Reinita cerúlea, los tomadores de decisiones son muy numerosos y lograr la cooperación entre ellos es un proceso largo e intenso. En 2001 un grupo de norteamericanos alarmados por el dramático declive de las poblaciones reproductoras de la Reinita Cerúlea decidieron agruparse y formar el Grupo Técnico de la Reinita Cerúlea. Las subcomisiones se establecieron para tratar temas específicos de interés, incluyendo la falta de información sobre la distribución no reproductiva, ecología, y migración de estas aves. El subcomité para las áreas no reproductivas se autodenominó "El Grupo Cerúleo".

Las tareas del Grupo Cerúleo eran compilar, evaluar, perfeccionar y analizar la información existente sobre la biología no reproductiva de la Reinita Cerúlea. El Grupo Cerúleo se comprometió intensamente a realizar muestreos y estudiar la especie en detalle, a modelar su rango de distribución durante la temporada no reproductiva, y verificar sus hallazgos de una forma muy rigurosa. Una característica distintiva de este proceso ha sido el esfuerzo persistente, a pesar de las diferencias de idioma, cultura y nacionalidad, por aumentar la red de colaboradores y desarrollar en forma conjunta una base de información común. Gracias a muchos donantes principalmente la Fundación Nacional de Pesca y Vida Silvestre (USFWS, por sus siglas en inglés) y al Servicio Forestal de EE.UU. los miembros se reunieron en el Ecuador y Colombia para divulgar los resultados de sus investigaciones en diferentes reuniones en los Estados Unidos, Chile, Venezuela y México. La fuerte participación de los miembros de El Grupo Cerúleo ha representado una parte importante de los esfuerzos del Grupo Técnico de la Reinita Cerúlea para asesorar al Servicio de Pesca y Vida Silvestre a evaluar el estado de la especie y compartir información en la Cumbres de Reinita Cerúlea que se realizan periódicamente. El grupo ganó el prestigioso premio de Cooperación Internacional *Wings Across the Americas* en 2008, patrocinado por la Oficina de Programas Internacionales del Servicio Forestal de los EE.UU.

En octubre de 2008, los miembros de El Grupo Cerúleo patrocinaron la última Cumbre de la Reinita Cerúlea en la sede de la Federación Nacional de de Cafeteros de Colombia en la ciudad de Bogotá y en el municipio de San Vicente de Chucurí. En esta última localidad la Fundación ProAves, miembro del Grupo Cerúleo, estableció la primera reserva fuera de Norteamérica para la conservación de un ave migratoria, la Reserva Natural Reinita Cielo Azul. Una parte vital de esta Cumbre fue el reconocimiento de que es el momento de pasar de ser testigo de la comunidad científica a la comunidad conservacionista para que implementen las recomendaciones surgidas del trabajo realizado hasta la fecha.

El plan de conservación de la Reinita Cerúlea para la temporada no reproductiva preparado por Paula Caycedo de la Fundación ProAves y American Bird Conservancy para el Grupo Cerúleo, ha sido examinado de forma exhaustiva por los miembros del Grupo Técnico de la Reinita Cerúlea y el Grupo Cerúleo. Sus opiniones se han incorporado en el documento. Este proyecto es una guía que aborda los difíciles asuntos relacionados con el trabajo cooperativo de conservación de una especie que no respeta fronteras políticas ni geográficas. El Grupo Técnico de la Reinita Cerúlea respalda con entusiasmo este plan y a través de su subcomité el Grupo Cerúleo, anima a todos los que lo lean a encontrar una tarea descrita en el capítulo XX que se ajuste a su interés individual o a la misión de su organización, la adopte como propia y la ponga en marcha de la forma más rápida y eficaz posible.

***T. Bently Wigley,* NCASI *y Deanna Dawson,* U.S. Geological Survey**

Co-Presidentes, Grupo Técnico Reinita Cerúlea

3. SUMMARY

The Cerulean Warbler is one of the most threatened migratory birds in America. A great part of the ecological knowledge we have of its annual cycle is from late April to July, when the birds establish territories, mate and raise young on their breeding grounds. Some studies have been done in the nonbreeding grounds about its geographical distribution, survival, and ecology. The Cerulean Warbler has one of the longest migrations of the warblers that breed in eastern North America and therefore may be particularly vulnerable to changes at sites used during migration. On the nonbreeding grounds, the species inhabits one of the most threatened ecosystems of the world, the Andean montane forest of northern South America. Fortunately, however, Cerulean Warblers also commonly use shade-grown coffee plantations.

Increased interest exists internationally to protect this species; an effective way to achieve this goal is to enhance the availability and quality of habitat at the regional level. As the Cerulean Warbler's winter distribution overlaps with the distribution of other threatened species, it can be used as an umbrella species in order to protect the ecosystems they share.

The Cerulean Warbler is considered Vulnerable by the IUCN on the basis that it has undergone a very rapid population decline in the last few decades. This long term decline (-3.2%/year) is one of the primary reasons for a high level of concern for this species. The population decline has been attributed to habitat loss and fragmentation across its entire geographical range. The clearing of forests for agriculture and cattle pasture, as well as conversion of traditional shade-grown coffee plantations to sun coffee plantations, are the main threats in the nonbreeding range.

To address and reverse the decline of the Cerulean Warbler, many institutions and individuals through the Cerulean Warbler Technical Group (CWTG) have been working since 2001 to increase our understanding of the warbler's ecology, promote its conservation, and protect those habitats central to its survival. El Grupo Cerúleo, a subcommittee of the CWTG, focuses on the nonbreeding period of the Cerulean Warbler life cycle.

Keeping in mind that habitat loss is one of the most significant threats to Cerulean Warbler survivorship, a hemispheric conservation plan is necessary to provide for the continuance of adequate habitat in the entire geographical range of the Cerulean Warbler. A conservation plan developed by the U.S. Fish and Wildlife Service (USFWS 2007) was used as the basis for this Plan, which addresses the Cerulean Warbler on its nonbreeding range.

We identify key nonbreeding sites for the Cerulean Warbler across the Northern Andes using different models of potential distribution and taking into account protected areas that currently exist. The historical landscape transformation and the coffee landscapes are discussed in order to give background for the Cerulean Warbler Conservation Plan. In addition, we provide a general overview about social and political conditions of the Northern Andes as context for the use of existing environmental laws for the benefit of the Cerulean Warbler.

Planning for the conservation of the Cerulean Warbler is a large task involving NGO partners, national institutions, and governments from each country involved. During 2008, two meetings were held (in Texas and Bogotá) to discuss and develop the conservation plan for the nonbreeding range. The main goals of this plan are to promote a protected areas network using this warbler as an umbrella species and to use diverse economic and ecological tools such as certification and economic incentives to reduce the loss of shade-grown coffee farms and assist with habitat restoration. Because Cerulean Warblers reside in the tropics for seven to eight months a year (i.e., two thirds of the annual cycle), it is critical that Venezuela, Colombia, Ecuador and Peru, the countries they inhabit, work towards guaranteeing the necessary conditions for the species' survival.

3.1 RESUMEN

La Reinita Cerúlea es una de las aves migratorias más amenazadas en América (BirdLife International 2008). Gran parte de los conocimientos ecológicos que tenemos de su ciclo anual proviene de su época reproductiva, desde finales de abril a julio, cuando las aves establecen territorios, se aparean y crían sus polluelos. Adicionalmente se han realizado algunos estudios acerca de su distribución geográfica y ecología migratoria en las áreas no reproductivas. La Reinita Cerúlea tiene una de las migraciones más largas entre las reinitas que se reproducen al este de Norteamérica y por lo tanto pueden ser particularmente vulnerables a los cambios que se producen en los sitios utilizados durante la migración. En los territorios no reproductivos la especie habita uno de los ecosistemas más amenazados del mundo, el bosque montano andino.

Hay un interés cada vez mayor de proteger a esta especie a nivel internacional; una forma eficaz de lograr este objetivo, es a través del aumento de la disponibilidad de hábitat a nivel regional y el mejoramiento de la calidad del mismo. Debido a que la distribución durante la temporada no reproductiva se solapa con la distribución de otras especies amenazadas, la Reinita Cerúlea se puede utilizar como una especie sombrilla con el propósito de proteger los ecosistemas en peligro.

La Reinita Cerúlea es considerada vulnerable por la UICN debido a la drástica disminución de su población en las últimas décadas. Este continuo descenso (-3,2%/año) es una de las principales razones del gran nivel de preocupación que existe por esta especie. La disminución de la población se ha atribuido a la pérdida y fragmentación de su hábitat a lo largo de todo su rango geográfico. La deforestación por la agricultura y la ganadería, así como la conversión de las plantaciones tradicionales de café con sombrío en plantaciones de café a libre exposición, son algunas de las principales amenazas en las áreas no reproductivas.

Para abordar y revertir la disminución de la población de la Reinita Cerúlea, muchas instituciones y personas a través del Grupo Cerúleo han estado trabajando desde principios del año 2000 con el fin de aumentar nuestro conocimiento acerca de la ecología de la reinita, promover su conservación y proteger los hábitats fundamentales para su supervivencia. Este documento examina un aspecto particular del ciclo de vida de la Reinita, el período no reproductivo.

Teniendo en cuenta que la pérdida de hábitat es una de las amenazas más importantes para la sobrevivencia de la Reinita Cerúlea, es necesario un plan de conservación hemisférico con el fin de proporcionar la continuidad de un hábitat adecuado en toda su área de distribución. El plan de conservación desarrollado por el USFWS (2007) se utilizó como base para este Plan.

Se identificaron los hábitats clave para la Reinita Cerúlea en los Andes del Norte utilizando diferentes modelos de distribución potencial y teniendo en cuenta las áreas protegidas que existen actualmente. Se abordó el tema de la transformación histórica del paisaje y los paisajes de café con el fin de dar el marco necesario para el Plan. Además, se da una visión general sobre las condiciones socio-políticas del Norte de los Andes con el fin de utilizar esta información y encontrar la forma de utilizar las leyes ambientales en beneficio de la Reinita Cerúlea.

La Planificación para la conservación de la Reinita Cerúlea es una tarea larga que implica a ONGs, instituciones nacionales y los gobiernos de cada país en todo en su rango de distribución. Durante el año 2008, llevamos a cabo dos reuniones, en Texas y Bogotá, para discutir y establecer el plan de conservación. El objetivo principal de este plan es el de promover una red de áreas protegidas usando esta Reinita como una especie sombrilla, así como incentivar las plantaciones de café con sombrío mediante el uso de diversos instrumentos económicos y ecológicos tales como certificaciones e incentivos económicos para detener la pérdida de cafetales con sombrío y asesorar la restauración del hábitat. Debido a que la Reinita Cerúlea reside durante siete a ocho meses del año en los trópicos –lo que representa las dos terceras partes de su ciclo anual–, es muy importante que Venezuela, Colombia, Ecuador y Perú trabajen de forma conjunta para garantizar las condiciones necesarias para la supervivencia de esta especie .

4. SCOPE OF THE REPORT

In the fifth chapter of this document, we introduce the Cerulean Warbler, present an overview of the ecological problems that the species currently faces on the nonbreeding grounds, and indicate the conservation efforts that have been undertaken to date.

The sixth chapter summarizes available records of Cerulean Warbler observations, reviews potential distribution models than have been prepared for the nonbreeding grounds, and presents an update of a potential distribution model that incorporates recent observations in the Northern Andes and the remaining natural Andean forest.

The seventh chapter reviews all studies that have been done about the ecology and biology of Cerulean Warbler in the nonbreeding grounds.

The eighth chapter is a review of current knowledge of Cerulean Warbler stopover areas during the spring migration.

Chapter nine focuses on the limiting factors that the species faces on its nonbreeding grounds, and reviews coffee production systems and history.

Chapter ten provides background on the socio-political frameworks in the Northern Andes with regard to environmental policies, national systems of protected areas, and biodiversity conservation actions. The legal status of the Cerulean Warbler in the Andes is presented, as well as the protected areas where it may occur.

Chapter eleven reviews some of the innovative conservation efforts already underway to benefit Cerulean Warblers.

Chapters 12 (in English) and 13 (en Español) present the operative framework for the Cerulean Warbler Nonbreeding Conservation Plan that incorporates ideas developed during the 3rd Cerulean Warbler Summit in October 2008, in Bogotá, Colombia.

5. INTRODUCTION

The Cerulean Warbler, *Dendroica cerulea* (Wilson 1810), is a wood warbler in the Family Parulidae, Order Passeriformes (Hamel 1992, Hamel 2000a). This small neotropical migratory bird weighs 8-10 grams and is 12 cm in length (Hamel 1992, National Geographic Society 2002). Males and females present some phenotypic differences (Hamel 1992).

The Cerulean Warbler breeds in eastern North America, usually in large tracts of mature deciduous forest concentrated in central hardwoods, including less-pristine patches of second-growth and mixed forest. A great part of the ecological knowledge we have of the warbler's annual cycle is from late April to July, when the birds establish territories, mate and raise young on their breeding grounds. During the period from October to March Cerulean Warblers mainly occupy Northern Andean montane forests (cloud forest, Sub-Andean Forest and low montane forest) in Colombia and western Venezuela, but also extending southwards along the eastern slope of the Andes in Ecuador and northeastern Peru. There are several sporadic records from southern Peru and Bolivia (Hamel 2000b, Herzog *et al.* 2009).

Emigration from South America appears to begin in March and last through the first two weeks of April. The distance this species travels between the breeding and wintering grounds, approximately 4,000 kilometers, is long compared to many other warblers (Hamel 2000b). The migration pathway is little known but appears to include a flight across the western Caribbean Sea and Gulf of Mexico in spring, with stops at a limited number of locations in northern Central America (Welton *et al.* 2008a, Hamel 2000a, Parker 1994). Fall migration may take a more easterly path (Dunn and Garrett 1997).

5.1. Population Status and Legal Status

Based on monitoring data from the North American Breeding Bird Survey (BBS), the Cerulean Warbler population has shown an average decline of 4.1% per year over 40 years, from 1966-2007 (Sauer *et al.* 2008). This long-term, steep decline is one of the primary reasons for a high level of concern for this species (BirdLife International 2008, USFWS 2007).

Projections of these historic BBS trends into the future indicate nearly a 90% probability that within 100 years Cerulean Warblers will decline to a population size that is about 10% of its current numbers. These projections assume no change in either the magnitude of threats or success of conservation efforts for the species (USFWS 2007).

Some authors (Botero *et al.* 2008, Parra 2008) report the Cerulean Warbler as a common migratory species in different parts of Colombia, such as the municipalities of San Gil and San Vicente de Chucurí in Santander and Tamesis Municipality in Antioquia, but others list it as an uncommon, scarce, or rare migratory species in South America (Clements and Shany 2001, Hilty and Brown 2001, Ridgely and Greenfield 2001). Nevertheless, no historical monitoring information from the nonbreeding grounds exists; current population trend estimates are based on surveys conducted on the breeding grounds.

The Cerulean Warbler has been listed as Vulnerable by the International Union for Conservation of Nature (BirdLife International 2008), based on its criteria A2c + 3c+4c. These codes indicate that the species has undergone a reduction in population size of ≥30% within the last 10 years or three generations, where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on a decline in area of occupancy, extent of occurrence and/or quality of habitat (BirdLife International 2008).

The Cerulean Warbler is not federally listed under the Endangered Species Act in the United States. The USFWS was petitioned to list it as Threatened, but a decision to not list the species was released in November 2006 (USFWS 2006).

Cerulean Warblers are protected in the United States, Canada, and Mexico under the Migratory Bird Treaty acts. They are also included in the list of Birds of Conservation Concern maintained by the USFWS. In Canada, the Cerulean Warbler is listed under the federal Species at Risk Act as a species of special concern. Five states in the U. S. list the Cerulean Warbler as either threatened or endangered under

state authorities. Eleven states and the province of Ontario, Canada, identify it as a species of concern or watchlist species. It is also identified as a Species of Greatest Conservation Need within the Wildlife Action Plans of 22 states (USFWS 2007). In South America it is not included on any country's conservation status list.

5.2. Threats

It is believed that the most important cause of Cerulean Warbler declines is the loss and degradation of habitat through land use and land cover change. Conversion of mature deciduous forest to agricultural or urban areas, fragmentation and increasing isolation of remaining forest fragments, the change to shorter rotation periods and even-aged management of commercial forests, and loss of key tree species are all likely breeding season threats to the warbler (Robbins *et al.* 1992). Nonbreeding habitat also is threatened by conversion to other land uses such as pasture and conversion of shade-grown coffee plantations to sun plantations (Hamel 2000a). We will examine this issue in detail in the next chapter.

5.3. El Grupo Cerúleo

Because of the uncertainty about the future of the warbler and the stability of the habitats it uses, the Cerulean Warbler Technical Group was formed in June 2001. Participation in this *ad hoc* group is encouraged among those interested in developing a strong technical basis to support conservation and management efforts directed to this bird and its habitat (Hamel *et al.* 2004).

In December 2002, the Cerulean Warbler Technical Group formed several subcommittees. One of these, El Grupo Cerúleo, focuses on investigations and conservation of the species on the Central and South American nonbreeding grounds. El Grupo Cerúleo members represent a broad range of academic and conservation institutions from almost all the countries within the species' range; its aim is to unify the conservation efforts for this bird and its habitat on its nonbreeding grounds.

El Grupo Cerúleo (www.grupoceruleo.org) promotes a multi-species approach to habitat conservation on the nonbreeding grounds, which includes other at-risk species that co-occur with Cerulean Warblers. Other goals of El Grupo Cerúleo are:

1. to develop a network of observers and a database of documented observations of Cerulean Warblers to better define their nonbreeding range,
2. to assess threats and conservation coverage,
3. to encourage and support field research on Cerulean Warbler nonbreeding ecology and response to land-use changes, and
4. to communicate awareness of nonbreeding ground and migration conservation issues, thereby promoting linkages between countries.

Several investigations have been promoted, coordinated, and carried out by El Grupo Cerúleo. In 2003-2004, El Grupo Cerúleo obtained funding from the U.S. Forest Service, The Nature Conservancy, and the National Fish and Wildlife Foundation to support field research in the Andean region of Venezuela, Colombia, Ecuador, Peru, and Bolivia and in northern Central America. Studies were conducted in the nonbreeding season from October 2005 to March 2008, including expeditions to search for the species and pilot studies of its behavior, ecology, and habitat use.

Of major importance to the efforts of El Grupo Cerúleo was the development of a statistical model that predicts the potential nonbreeding distribution of the species, based on historical and recent observation records and on land cover and elevation data (Barker *et al.* 2006). The model is currently undergoing a rigorous validation test (Colorado *et al.* 2008). This work is part of El Grupo Cerúleo's contribution to the larger effort of the Cerulean Warbler Technical Group, the Cerulean Warbler Conservation Initiative, funded principally through the National Fish and Wildlife Foundation.

As part of the efforts of El Grupo Cerúleo, American Bird Conservancy (ABC) and Fundación ProAves have undertaken pilot conservation actions on the nonbreeding grounds since 2003 to assess the feasibly of conservation for the Cerulean Warbler. Surveys by ProAves, supported by Neotropical Migratory Bird Conservation Act (NMBCA) funds through the USFWS, had identified a number of key areas for the species that included both primary forest that was unprotected and shade-grown coffee

plantations rapidly being converted to sun coffee. Together, ABC and ProAves implemented a selection of projects, including ecological easements and incentives for shade-grown coffee owners, marketing Cerulean Warbler Conservation Coffee, and establishing the first protected area in Latin America for a Neotropical migrant – the Cerulean Warbler Bird Reserve in San Vicente de Chucurí, Santander Department (American Bird Conservancy 2006).

6. NONBREEDING DISTRIBUTION OF THE CERULEAN WARBLER

6.1. Historical Distribution

Historically, the Cerulean Warbler wintered in the humid foothills and subtropical forests of the northern Andes from western Venezuela through Colombia and Ecuador to northernmost Peru. There were occasional records further south to northernmost Bolivia. The species' range is almost identical to the Tropical Andes Hotspot, an area with exceptional biodiversity and endemism, but over 70% habitat destruction (Rodríguez-Mahecha *et al.* 2005).

6.1.1. General Climatic Conditions in the Andes

The complex topography of the Andes has led to the evolution of multiple ecosystems along its length. In Colombia and Venezuela, both the eastern and western slopes have high levels of precipitation (1,500 to 5,000 mm per year), and generally experience no dry season, or a very short one. The mean temperature of the coldest month is often close to 15°C, but drops to 10°C or lower with increasing elevation. In southern Ecuador there is a contrast between the very wet eastern side of the Andes and the drier Andean valleys and western side. On the eastern slope, the climate is similar to that of the northern Andes. In the inter-Andean valleys, even in Colombia and Venezuela, annual precipitation is generally 1,000 to 1,500 mm and the dry season is two to five months. On the western slope in Peru, annual precipitation is lower (less than 500 mm) and the climate is very dry or semi-arid.

In Peru and Bolivia, the wet eastern slope of the Andes bears Submontane and Montane Forests similar to those of the northern Andes. The drier inter-Andean valleys often exhibit deciduous, even xerophilous, forest. Often the forest in these valleys is very degraded and has been transformed into thicket or scrub. In the very dry climate of the western slopes of the Andes, scrub woodland replaces forest.

6.1.2. Montane Forest of Northern South America

The Northern Andes ecoregion has a total estimated 45,000 to 50,000 vascular plant species or 15 to 17% of the known plants on the planet (Mast *et al*. 1999). The total for Colombia approximates that of the entire region; of these nearly 20,000 are endemic.

Between 1,000 and 1,800 to 2,400 m in the northern Andes many of the lowland taxa persist, such as species in the genera *Licania* (Chrysobalanaceae) and *Eschweilera* (Lecythidaceae), but a number of distinctly highland elements also enter the lower montane forest. For example, in the Colombian Andes, *Alchornea bogotensis* (Euphorbiaceae), *Brunellia comocladifolia* (Brunealleaceae) and *Cinchona cuatrecasasii* (*Rubiaceae*) are present. In Sub-Andean Forest at 1,500 m of elevation the Lauraceae are predominant (Mast *et al*. 1999). The montane or upper montane forest, starting at 1,800 to 2,400 m, may extend in places up to 3,400 m. In the drier parts, montane forests are evergreen seasonal. Above this zone, subalpine forests may extend up to 3,800 m in some places. The characteristic highland flora includes many species of the genera *Befaria* (Euphorbiaceae), *Brunellia* (Apocynaceae), *Clusia* (Clusiaceae), *Gynoxys* (Asteraceae), *Miconia* (Melastomataceae), *Rhamnus* (Rhamnaceae), and *Weinmannia* (Cunoniaceae). On high ridges exposed to wet winds there is montane cloud forest with “elfin woodland" of low gnarled trees with abundant mosses and lichens.

The Andean forests have been subdivided into four general zones:

- Lowland Humid Forest from sea-level to 800-1,000 m;

- Premontane or Subtropical Forest between 800 and 1,800 m;
- Lower Montane, Sub-Andean or Tropical Montane Forest between 1,800 and 2,500 m;
- Upper Montane or Andean Forest between 2,500 and 3,500 m.

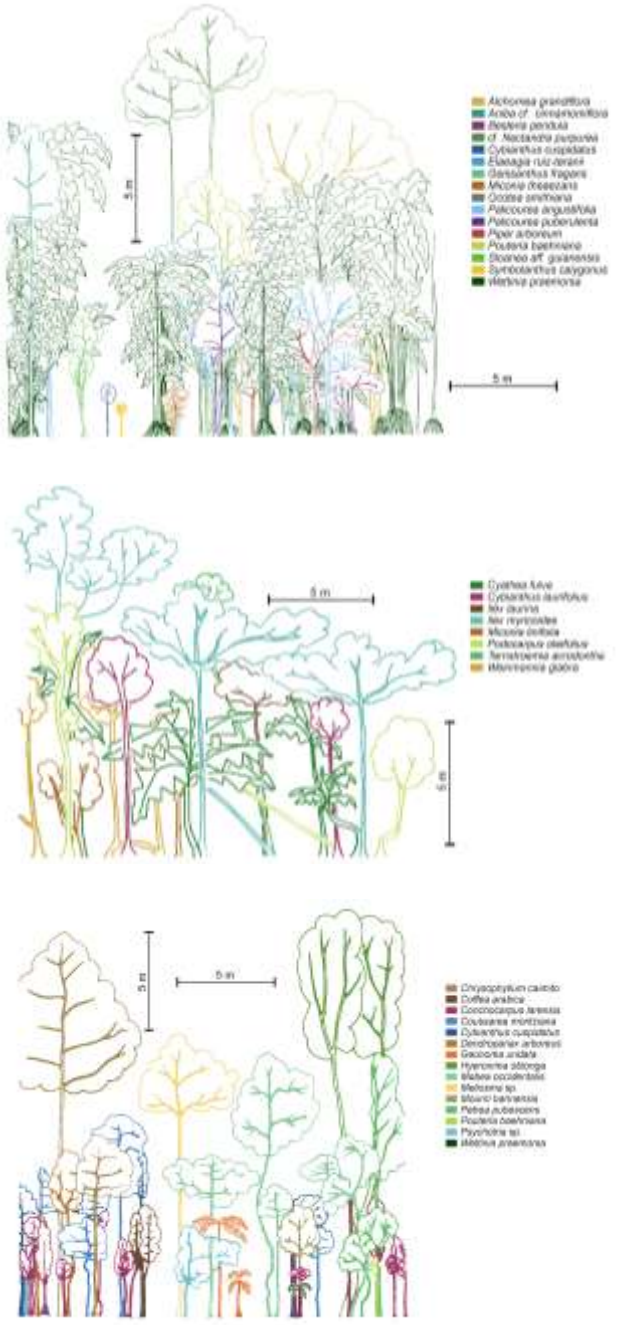


Figure 1. Venezuelan Cloud Forest vegetation profile (Cuello 1999).

One significant aspect of Andean forests is the effect of cloud interception on the forest, which can give rise to "cloud forest" anywhere between 500 and 4,000 m above sea level. Nevertheless, the majority of the cloud-interception forests are between 1,200 and 2,500 m (Kappelle 1996, Stadtmüller 1987), and can been classified as two principal habitat types, Cloud Forest and Sub-Andean Forest.

6.1.2.1. Cloud Forest

The canopy structure and height (20–30 m) of the cloud forest depend on the mountain chain where it occurs (for an example from Venezuela, see Figure 1). Some emergent trees may reach 50 m. The middle stratum is 4 to 6 m tall with shrubs and juvenile trees and herbs. A great richness of ferns makes the forest more complex. The most studied taxa are plants and birds, both with high richness (200 to 300 tree species and 300 bird species; Ataroff 2001).

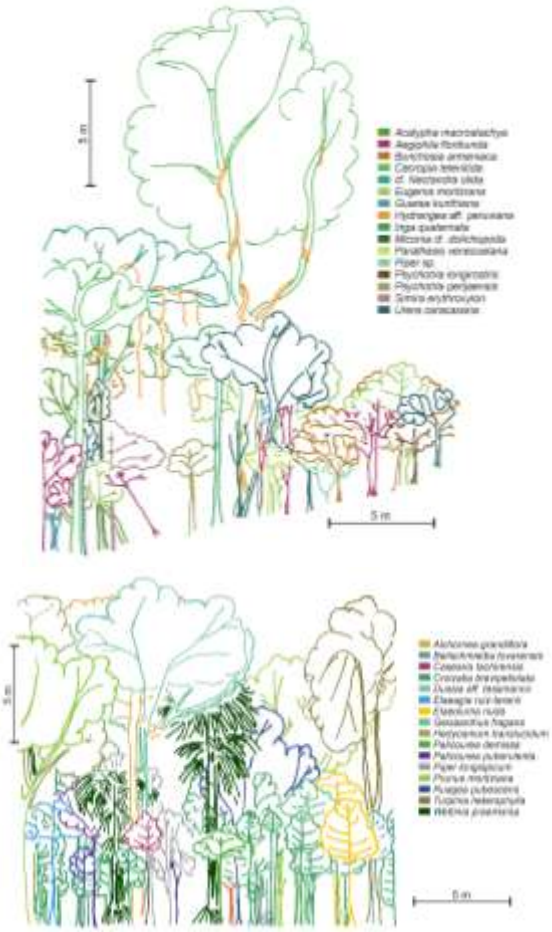


Figure 2. Physiognomy and structure of Venezuelan Sub-Andean forest. Note the stratum complexity of the forest (Cuello 1999).

6.1.2.2 Sub-Andean Forest

At the lower elevational limit, the canopy height can reach 20 m for species such as *Cecropia telenitida* (Cecropiaceae), *Acalypha macrostachya* (Euphorbiaceae), and *Toxicodendron striatum* (Anacardiaceae). From 1,900 to 2,350 m the canopy height can be from 12 to 15 m with emergent trees 20 m. or more. The canopy is not dominated by a few species; the diversity is higher at the upper limit of the Sub-Andean forest, where species such as *Pouteria baehniana* (Sapotaceae), *Prunus moritziana* (Rosaceae*), Merinan macrophylla, Ruagea pubescens* (Meliaceae*), Alchornea grandiflora, Tetrochidium rubrivenium, Hyeronima olbonga, Hyeronima moritziana,* and *Sapium stylare* (Euphorbiaceae) occur, among others. In the middle strata, the abundance of the palm *Wettinia praemorsa* (Arecaceae) is high, and the species may form very dense colonies at elevations from 1,900 to 2,000 m (Cuello 1999, Hernández Camacho and Gómez Mejía 1996; Figure 2).

6.2. Cerulean Warbler Habitat Selection

A Cerulean Warbler database of records from 1800 until the present currently consists of 758 records. Of these, 57% are from Colombia, 21% from Venezuela, 13% from Ecuador, and 9% from Peru (Figure 3B). Some differences occur in the elevational limits of forest between countries, and also between mountain systems within each country. It is necessary to look closer at recent Cerulean Warbler records with elevation data (*n*=226; Figure 3A) to determine the forest types in which the species likely occurs.

6.2.1 Venezuela

In Venezuela there are seven different mountain systems, heterogeneous in size, geology, and origin. The position with regard to the direction of prevailing winds and the distance from the sea influence the conditions that prevail in each mountain range, resulting in a great variety of ecosystems. Because of this ecological complexity, it is difficult to have a single criterion to understand the Venezuelan mountain ecosystems (Ataroff 2001). Among Cerulean Warbler historical records with adequate data, the species has been found most frequently in the Cordillera de la Costa (*n*=5) and in the Cordillera de Mérida (*n*=41). Of the 48 Cerulean Warbler records in Venezuela, 64% have been made in Sub-Andean Forest, 25% in Lowland Humid Forest, and 8% in Cloud Forest.

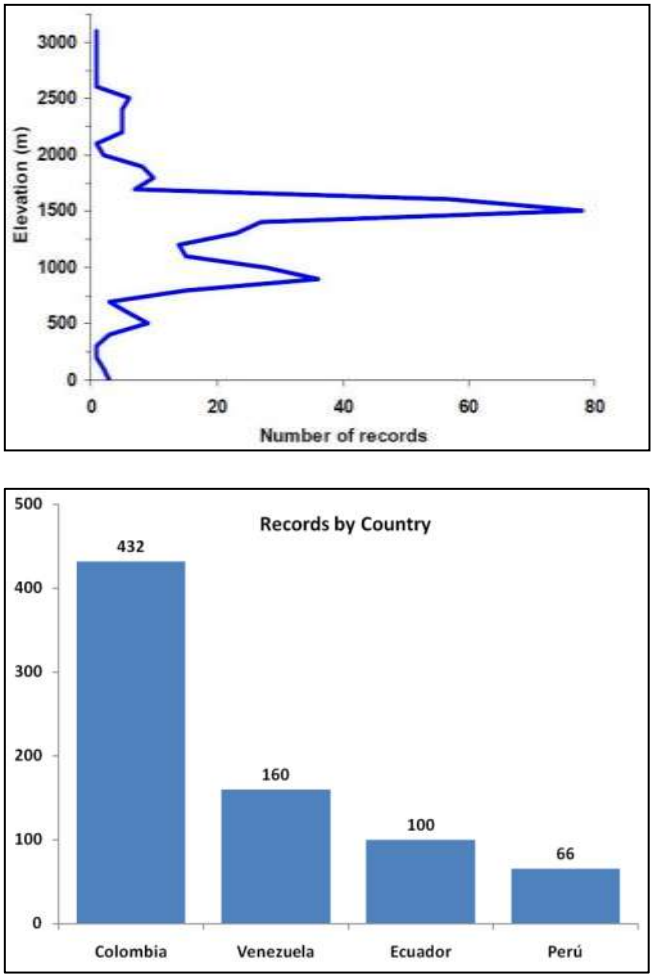


Figure 3. **A**. Elevational distribution of Cerulean Warbler records with known elevation. **B**. Total number of records (with and without elevational data) for each Andean country.

6.2.2 Colombia

Colombia seems to be the core nonbreeding region for the Cerulean Warbler (Fundación ProAves 2009), although perhaps more effort has been made to find the species in that country. The majority of Cerulean Warbler records (*n*=46) are from the western slope of the Eastern Andes. Of these, 91% are from Sub-Andean Forest, 1% are from Lowland Forest, and 8% from Cloud Forest. There are also records from the Central (*n*=36) and Western Andes (*n*=26).

6.2.3 Ecuador

Cerulean Warbler records from Ecuador are concentrated on the eastern slope of the Andes, between 850 and 2,000 m (*n*=38), versus the western slope of the Andes (*n*=6). This elevational range is occupied by two forest types, the lowland humid forest from 300 to 1,300 m (*n*=28, 64%), and Sub-Andean Forest from 1,300 to 2,000 m (*n*=16, 36%; Sarmiento 2001).

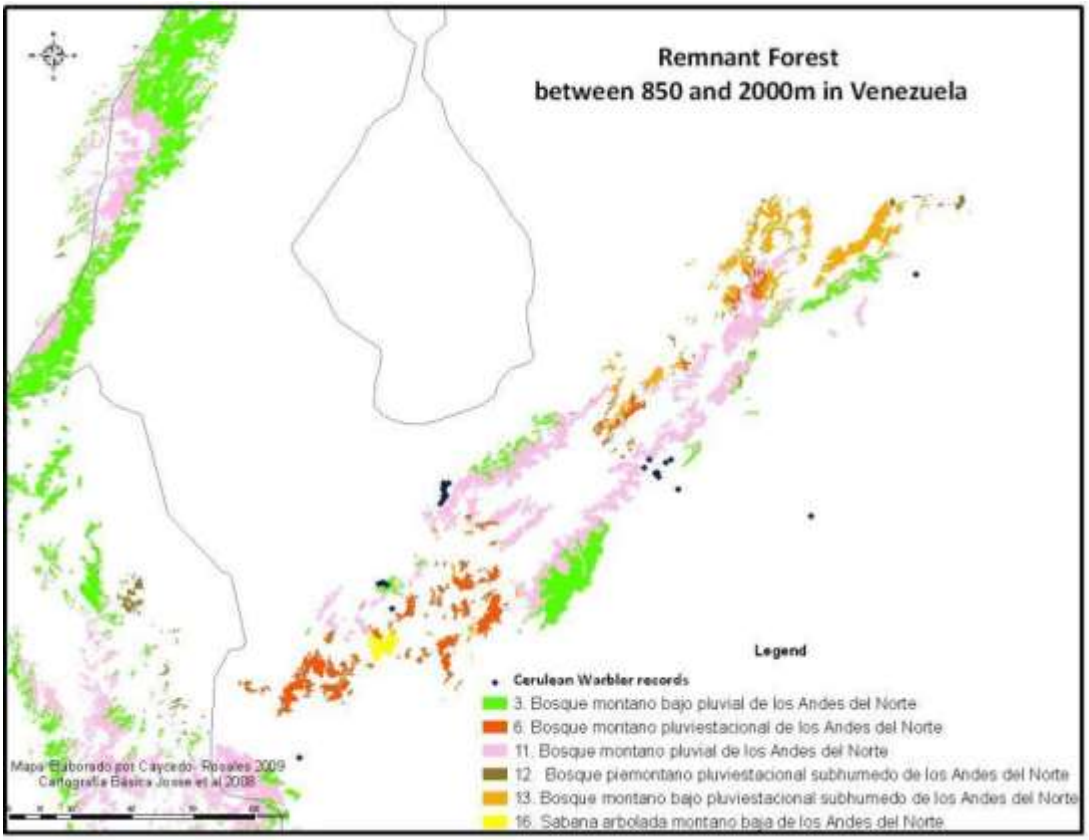
6.2.4 Peru

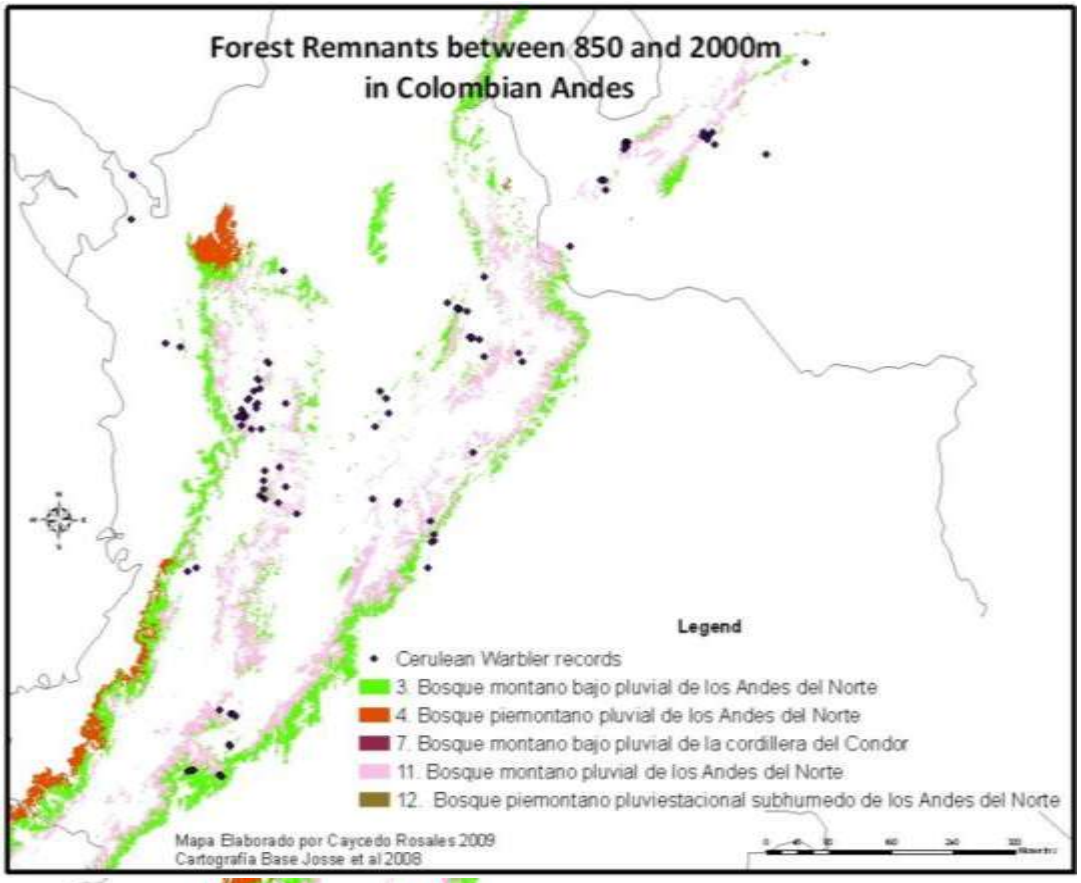
Cerulean Warbler records from Peru have come only from the eastern slope of the Andes, between 850 and 2,000 m. This elevational range is occupied by two forest types. The Lowland Montane Forest ranges from 300 to 1,300 m (*n*=15, 60%) and Sub-Andean Forest from 1,300 to 2,000 m (*n*=10, 40%; Young and León 2001).

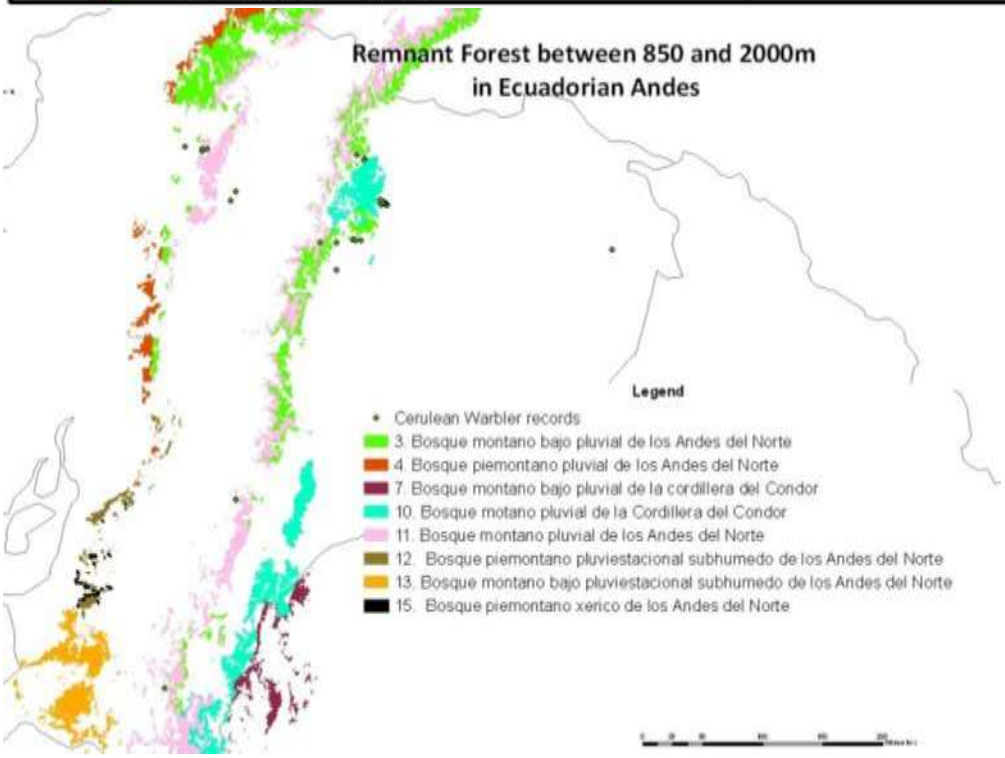
6.3. Cerulean Warbler Elevational Distribution

Cerulean Warblers have been observed from 20 m (record from the Phelps Collection in Venezuela) to 4,700 m in Parque Nacional Natural de los Nevados in Colombia. However, the great majority of the observations have been made between 850 and 2,000 m (Figure 3A).

As we have seen, this elevational range is represented by different types of mountain forest. The elevational limits of those forests change in different mountain ranges, and also latitudinally along the Andes.




Forest Remnants between 850 and 2000m
in Colombian Andes
Legend
Cerulean Warbler records
3. Bosque montano bajo pluvial de los Andes del Norte
4. Bosque piemontano pluvial de los Andes del Norte
7. Bosque montano bajo pluvial de la cordillera del Condor
11. Bosque montano pluvial de los Andes del Norte
12. Bosque piemontano pluviestacional subhumedo de los Andes del Norte
Mapa Elaborado por Caycedo Rosales 2009
Cartografía Base Josse et al 2008


Remnant Forest between 850 and 2000m
in Ecuadorian Andes
Legend
Cerulean Warbler records
3. Bosque montano bajo pluvial de los Andes del Norte
4. Bosque piemontano pluvial de los Andes del Norte
7. Bosque montano bajo pluvial de la cordillera del Condor
10. Bosque motano pluvial de la Cordillera del Condor
11. Bosque montano pluvial de los Andes del Norte
12. Bosque piemontano pluviestacional subhumedo de los Andes del Norte
13. Bosque montano bajo pluviestacional subhumedo de los Andes del Norte
15. Bosque piemontano xerico de los Andes del Norte

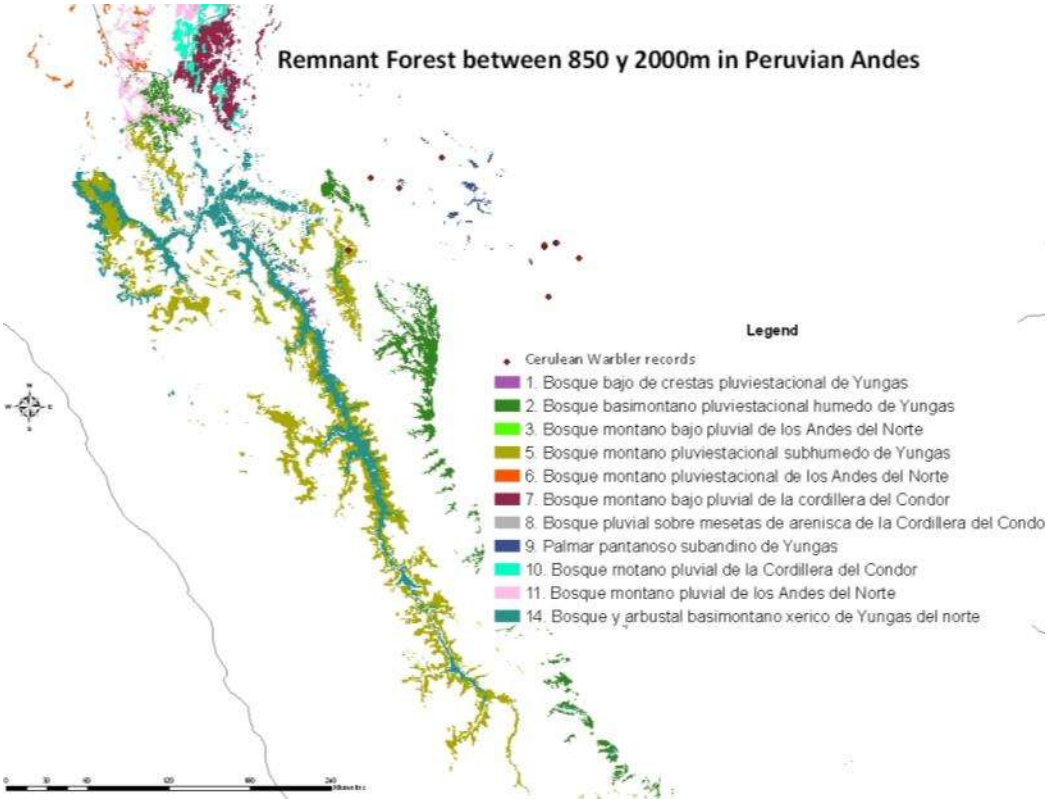


Figure 4. Northern Andes remnant natural forest types between 850 and 2,000 m. Maps are based on Josse *et al*. (2008), selecting forests in the 850 to 2,000 m elevational range, where most Cerulean Warblers have been observed.

6.4. Cerulean Warbler Distribution by Habitat Types

Across the Northern Andes occurs a great diversity of Sub-Andean and Cloud Forest communities between 850 and 2,000 m, each with different plant associations (Cleef pers. comm.); these associations are determined by variables such as slope, aspect, soil, humidity, and temperature.

Josse *et al*. (2008) evaluated the similarities in species composition, structure of the forest, location, land cover, spatial scale and pattern, similar ecological systems, and adjacent ecological systems, to characterize the forest types in the Northern Andes. They reported 82 natural systems, 39 of which are Mountain Forest (Upper and Lower; NatureServe 2009). With this information georeferenced they developed a cover map of the Northern Andes. In this map, the transformed areas have not been distinguished, but it is important to notice the natural areas remaining, where Cerulean Warblers may occur (Figure 4). However, the species has been recorded in just two of these natural forest types: (3) Bosque Montano Bajo Pluviestacional and (11) Bosque Montano Pluvial de los Andes del Norte.

6.5 Cerulean Warbler Nonbreeding Grounds Distribution Models

Effective conservation plans require accurate estimates of the species' spatial distribution. In order to make an approximation of the Cerulean Warbler distributional range, several different mathematical algorithms have been used. All the models used to predict the potential Cerulean Warbler distribution have used bioclimatic data (www.worldclim.com) with a spatial resolution of 1 km^2. Because of the Andes' topography, a pixel resolution of 1 km^2 is averaging a very wide range of environmental conditions. In the future it will be important to include higher resolution layers of bioclimatic and other variables, as well as some features not related with geographic range size but to ecological niche breadth including observations about competitive interactions between Blackburnian Warbler (*D. fusca*) and Cerulean Warbler.

6.5.1 Previous Distribution Models

6.5.1.1 Distribution Models by ProAves

In 2006, Fundación ProAves developed a distribution model for Colombia (Figure 5), using 358 records (literature review *n*=7, Project BioMap museum specimens *n*=36, Monitoring and Migratory Bird Conservation Program *n*=150, banded *n*=19, direct observations *n*=146). This method consisted of the projection of 19 bioclimatic variables, two topographic variables (WorldClim www.worldclim.org), a vegetation coverage map (Global Vegetation Monitoring Unit www.evaluation.com), and the 358 records of Cerulean Warbler in Colombia. MAXENT 3.3 (Phillips *et al*. 2006) was used to model the distribution map. The ProAves model was a simplification of the work of Barker *et al.* (2006), which dealt with the entire Northern Andes.

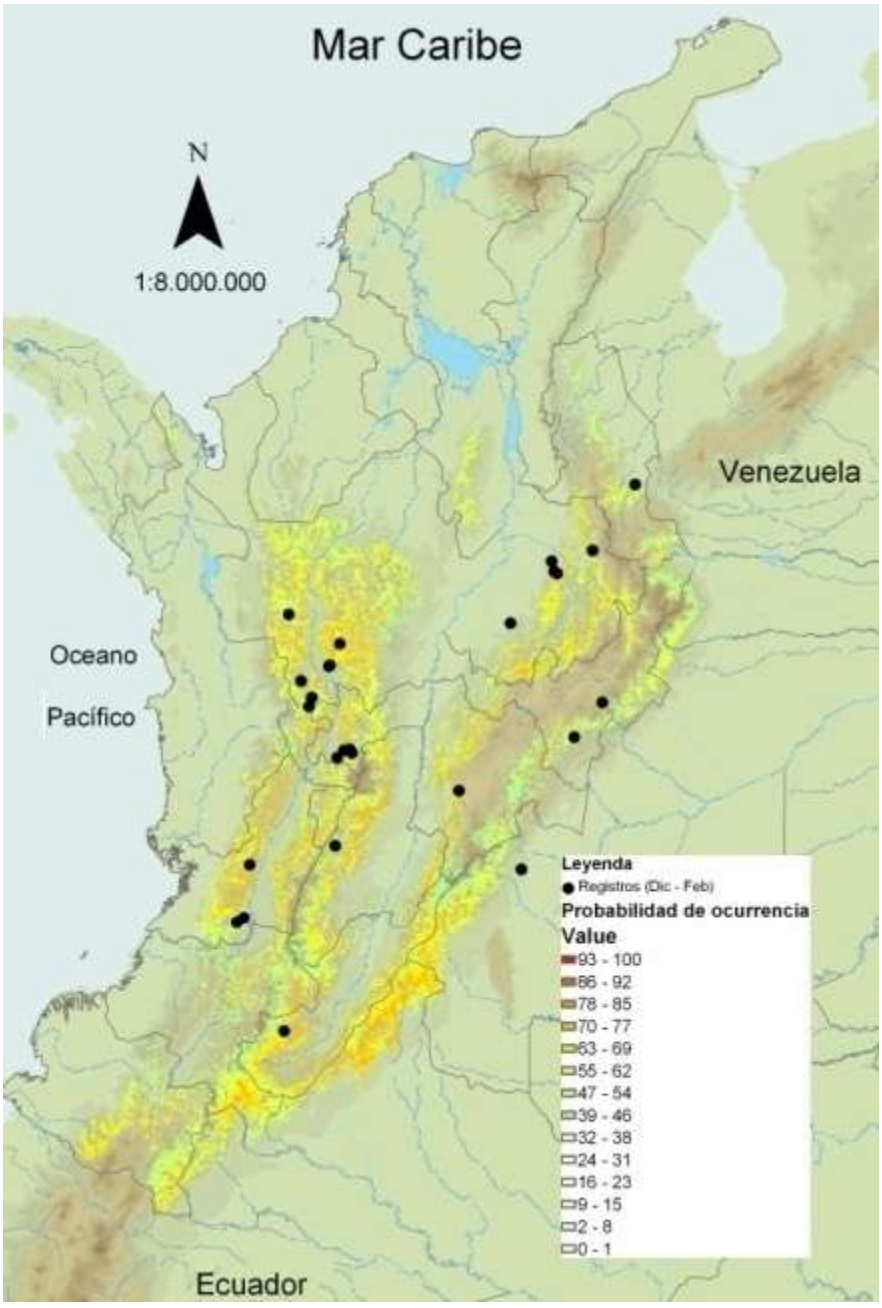


Figure 5. Modeled distributional range of Cerulean Warbler in Colombia using MAXENT 3.3 selecting a threshold of the 10th percentile. The black dots correspond to confirmed locations of Cerulean Warbler for the months of December through February (to exclude passage birds that distort the models; Fundación ProAves 2009).

This model was created in order to guide field explorations and to test its predictions. The analysis of the model reveals a strong negative correlation

between precipitation and the presence of the species. According to this model, the species prefers environments with moderate to low precipitation (but not dry forest or deserts) and a temperature between 19 and 23°C.

Based on the modeling, localities that could be important for Cerulean Warbler are the Serranías de los Yariguíes and the San Gil and Charalá regions of Santander. Sampling also was done in the Central Andes (Campamento, Angostura, and Amalfi in Antioquia Department), but no Cerulean Warblers were found there despite the presence of large areas of seemingly suitable habitat. This may be explained because the average annual rainfall in the area is very high, more than 3,000 mm, which could act as a constraining factor (Colorado and Cuadros 2006).

6.5.1.2 Distribution Models by El Grupo Cerúleo

El Grupo Cerúleo developed spatial hypotheses of the species' occurrence in South America (Barker *et al.* 2006). They summarized physical, climatic, and recent land-cover data for the northern Andes using ArcGIS. They developed five hypothetical distributions based on Mahalanobis D, GARP, Biomapper, MAXENT, and Domain. They used a cluster analysis to select seven environmental variables from a set of 23 variables. Seven variables were then selected for analysis. Next, the models were tested to determine which one gave the best approximation of the distribution of Cerulean Warbler. The AUC (area under the curve) was uniformly above 0.8, suggesting that all the models were better than random to account for variation in the data. The results of the different models were combined, allowing the design of a rigorous strategy to validate the map and thus to identify sites for protection of the species in South America (Figure 6). Field surveys are underway (Colorado *et al.* 2008) to identify which models were most successful at predicting the actual occurrence of the species.

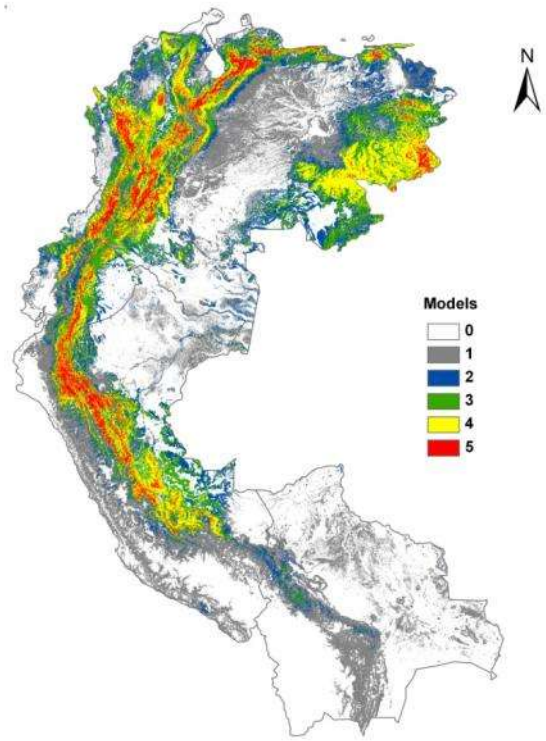
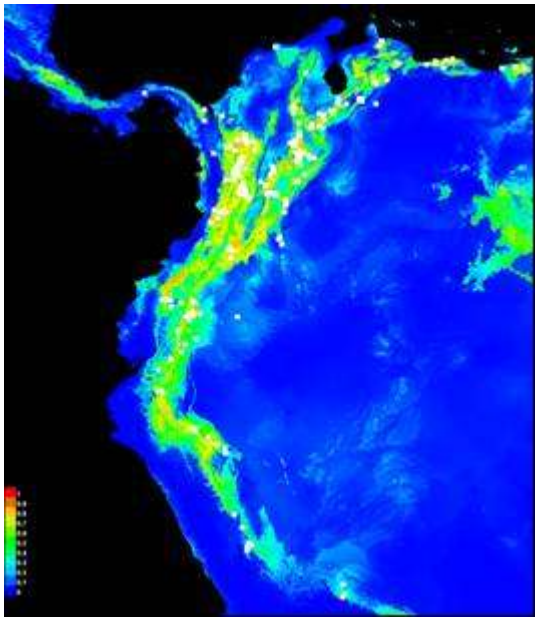


Figure 6. Combined map of binary results of different potential distribution models. Areas in white were predicted by none of the models, gray by one model, blue by two models, green by three models, yellow by four models, and those in red by all five models (Barker *et al.* 2006).

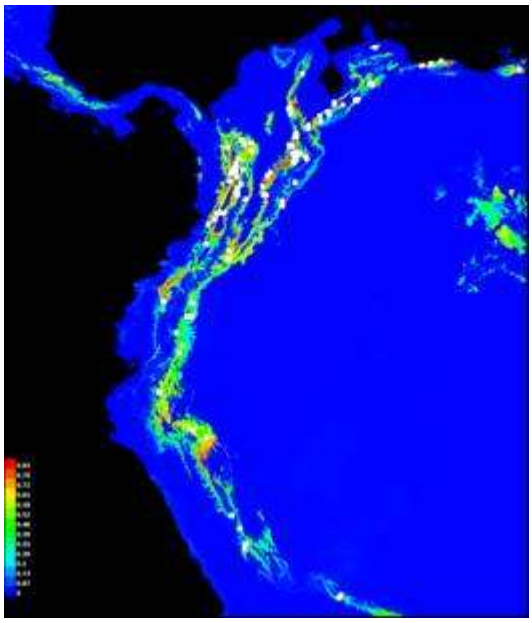
6.5.2 Updated Cerulean Warbler Nonbreeding Range Distribution Model

ProAves updated the potential distribution model for Cerulean Warbler and combined it with a map of natural forest remnants of the Northern Andes (Josse *et al.* 2008). First, the coordinates of the Cerulean Warbler observation records were checked for accuracy, and then the records were filtered by elevation and date to include the nonbreeding period in South America (from October to February). We used MAXENT 3.3 (Phillips *et al*. 2006) to develop a potential distribution model based on these restricted features (Figure 7). Using this potential distribution model, fieldwork was conducted in Venezuela, Colombia, Ecuador and Peru in February – March 2008 to look for Cerulean Warblers in previously unvisited places where the model predicted a high probability of presence. The fieldwork, coordinated by Fundación ProAves and

American Bird Conservancy, was carried out by institutions from the countries of the Cerulean Warbler nonbreeding range; in Venezuela by ANDIGENA Foundation (Mérida Cordillera), in Ecuador by Fundación Jocotoco (Pichincha Province, west side of Volcán Sumaco, Tena Zone), in Colombia by Fundación ProAves (Santander, Cauca and Huila Departments) and in Peru by Fundación ECOAN (Moyobamba Region).



A.



B.

Figure 7. MAXENT model for Cerulean Warbler with filtered data. **A.** Nonbreeding Records (*n*=574); data from 1885 to 2007; months from Oct-Feb; elevation range between 0 to 4,700 m. **B.** Nonbreeding Records PLUS Preferred Elevation (*n*=533); data from 1885 to 2007; months from Oct-Feb; elevation range between 850 to 2,000 m.

In two of the seven sites sampled, no Cerulean Warblers were observed (in Venezuela and in Cauca, Colombia). In Santander and Huila, Colombia, 33 individuals were observed: 14 males and 19 females (19 adults, 14 immatures); all the sample sites were coffee / rural landscapes. In Ecuador, 47 individuals were observed in Pichincha Province: 25 males and 22 females (17 adults, 1 immature, 29 unknown). The study area in Ecuador was mainly native forest matrix with pasture lands. In Peru, where fieldwork was done mainly in coffee / rural landscapes, 23 individuals were observed: 13 males and 10 females (9 adults, 2 immatures, 12 unknown).

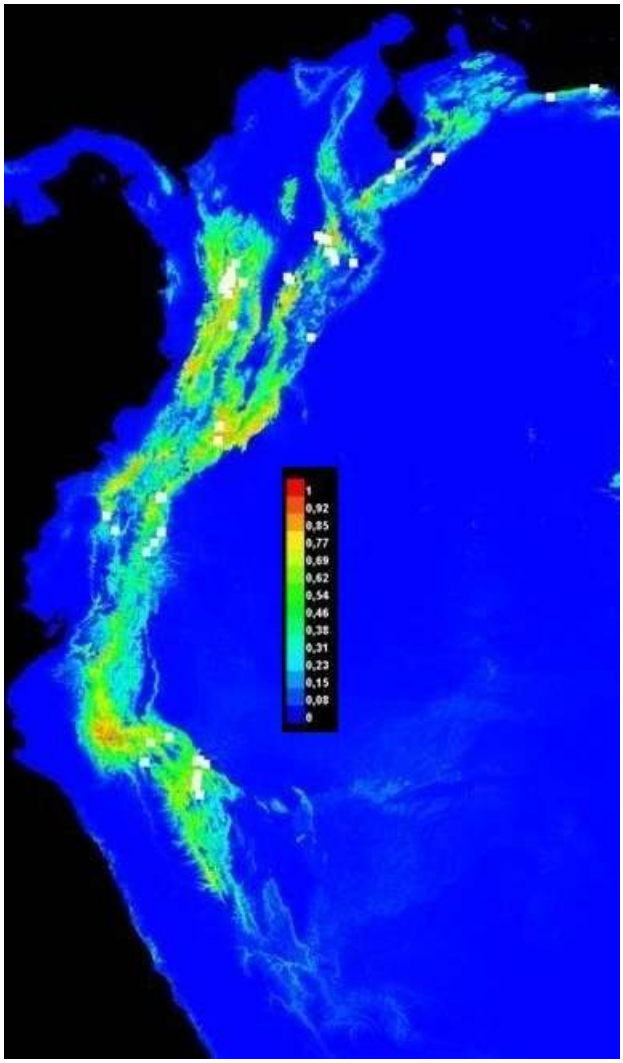


Figure 8. Update of Cerulean Warbler Potential Distribution Model, based on observations from 2008.

The model was run again using the new records from 2008 (*n*=182) with 19 bioclimatic variables, and two physical properties of the mountains: aspect and slope (Figure 8). The AUC was 0.5; an acceptable initial fit to the data. A jackknife test of variable importance shows that the variable with highest gain when used in isolation is the mean temperature of the warmer months. Slope appears to be the variable that contains the most unique information, as its omission from the model decreases the gain more than the omission of any other single variable.

We filtered the MAXENT model by the warmer colors that show areas with greater likelihood (10 percentile training presence = 0.419) and combined this map with the natural forest remnants map (following Josse *et al*. 2008; as seen in Figure 4), to identify the amount and location of natural forest remnants in the Northern Andes where the Cerulean Warbler might possibly be found (Figure 9). This final map could be used as a base for the selection of pilot areas for conservation efforts. Testing the new model in the field, in order to examine its predictive power, will provide a better understanding of the habitat requirements of this species.

In each country there are important regions or "hotspots" for the conservation of Cerulean Warbler (Figure 9).

6.5.2.1 Venezuela

The area of greatest potential for Cerulean Warblers in Venezuela is in the shade-grown coffee landscapes of northeastern Trujillo and Lara States, as well as those of north Barinas and southeastern Portuguesa States.

6.5.2.2 Colombia

The model predicts potential habitat in the western slope of the Western Andes; however, following Fundación ProAves (2009), the Cerulean Warbler prefers dry forest more than the very humid forest that is found in the Chocó region. In Serranía de San Lucas Bolivar (Nariño Department), the model predicts potential habitat for Cerulean Warbler. No documented observations exist for this mountain system as it is completely unexplored for birds during the nonbreeding period. In addition, the eastern slope of the Eastern Andes (Caquetá and Putumayo Departments) has been poorly explored by ornithologists.

The inter-Andean Valleys in Santander, Antioquia, Huila, and Tolima departments show potential habitat for Cerulean Warbler. The Serranía de los Yariguíes in Santander Department has the highest number of Cerulean Warblers reported. Some recent explorations show that the species is not abundant in Cauca (Barrera 2008), but in Huila, where a shade-grown coffee matrix mixed with remnant forest fragments exists, Barrera (2008) reports high numbers of the species.

The western slope of the Eastern Andes as well as the southern region of the eastern slope of the Central Andes seem to be very important regions for the species (Figure 9). It is necessary to continue exploring these zones to delineate where the species actually occurs.

6.5.2.3 Ecuador

Even though the model indicated a high probability of the presence of Cerulean Warbler in the western slope of the Ecuadorian Andes, some authors (Jahn and Mena Valenzuela 2006, Juiña 2008a) found that continuous Chocó forest is only of minor importance as nonbreeding habitat. Perhaps this is because of the high annual precipitation (3,000-4,000 mm) and high average temperatures (20-24 C) in this zone, and also because this is a highly wet forest life zone.

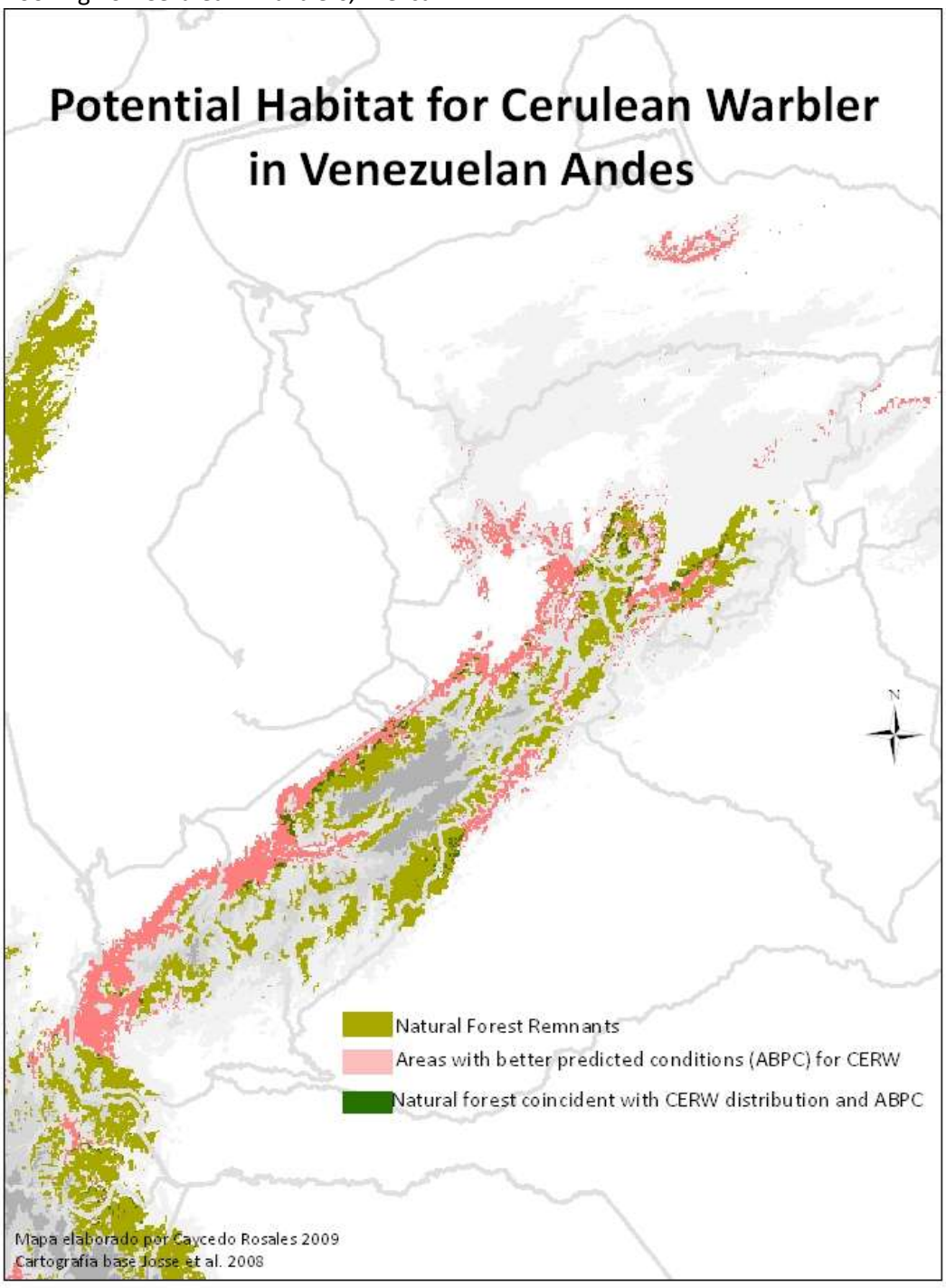
The southeastern slope has some reports of Cerulean Warbler in Zamora Chinchipe Province, between 900 and 1,400 m (Andrade *et al.* 2006), but it seems that a larger number of individuals winters in the northeastern Andean slope of Tena Province (Juiña 2008a). These areas are dominated by pasture, but some important forest fragments still remain, often in stream forests (Juiña 2008a), and also some protected areas (for example, compare Figure 17).

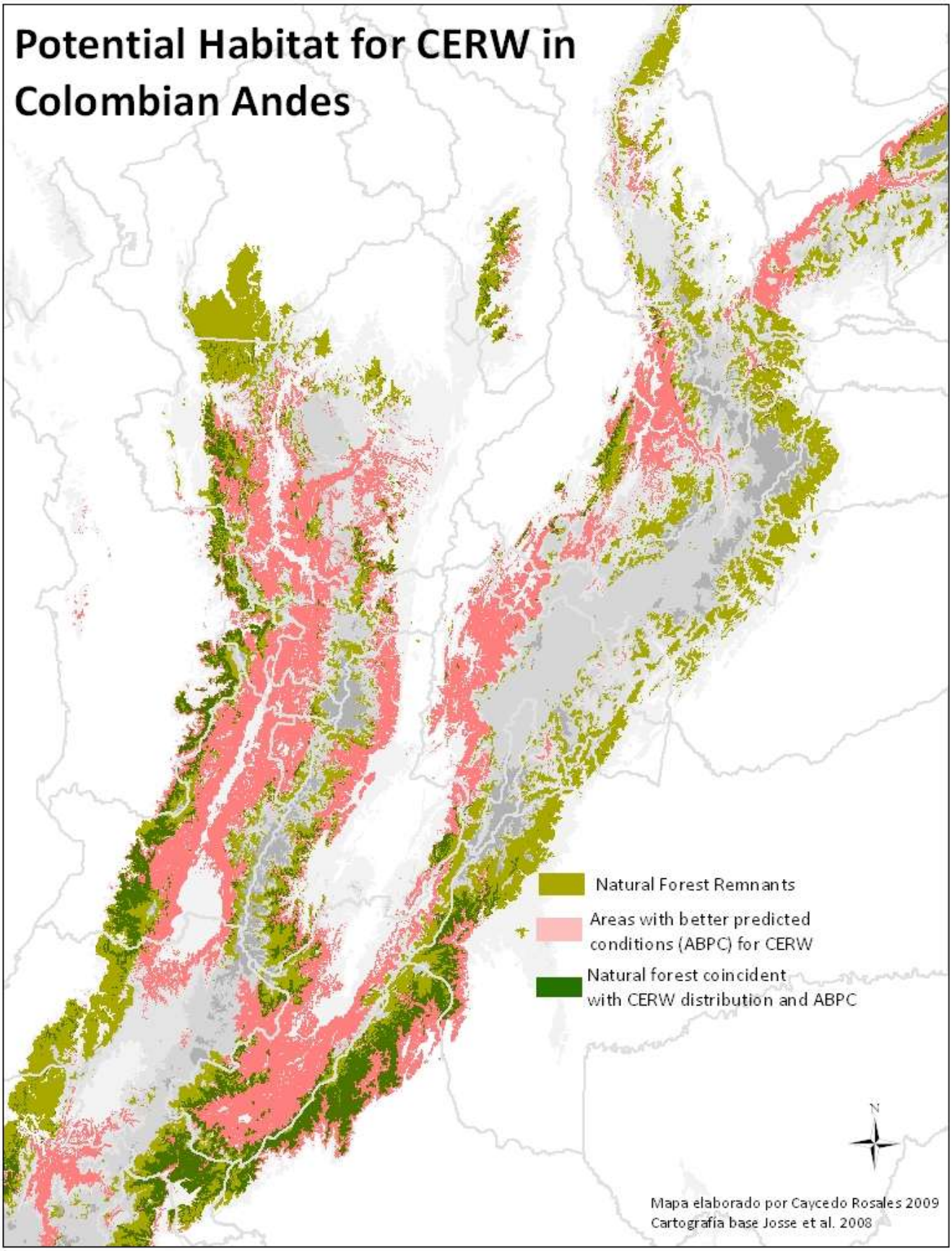
6.5.2.4 Peru

Figure 9 shows that the northeastern Andes have potential habitat for Cerulean Warbler; however, the species has not been reported in the Andean zone of Cajamarca and Amazonas departments in spite of intensive sampling (José Altamirano, pers. comm.).

The species has been reported in Lamas, Moyobamba and Rioja provinces in the Department of San Martin in the eastern Andes. There, Altamirano observed 13 males and 10 females in the canopy and subcanopy of shade-grown coffee plantations of this coffee region.

We need more information to enhance the predictability of the MAXENT model. However, as a next step in looking for Cerulean Warblers, we can use the areas where natural forest coincides with predicted or observed Cerulean Warbler presence (Figure 9) to guide future field explorations. Maps of other mountain systems besides the Northern Andes, such as the Cordillera de la Costa, the Guianas, Sierra Nevada de Santa Marta, and Serranía de la Macarena, will be useful to carry out the same exercise, and determine the importance of those mountain systems for Cerulean Warbler.




Potential Habitat for CERW in Colombian Andes
Natural Forest Remnants
Areas with better predicted conditions (ABPC) for CERW
Natural forest coincident with CERW distribution and ABPC
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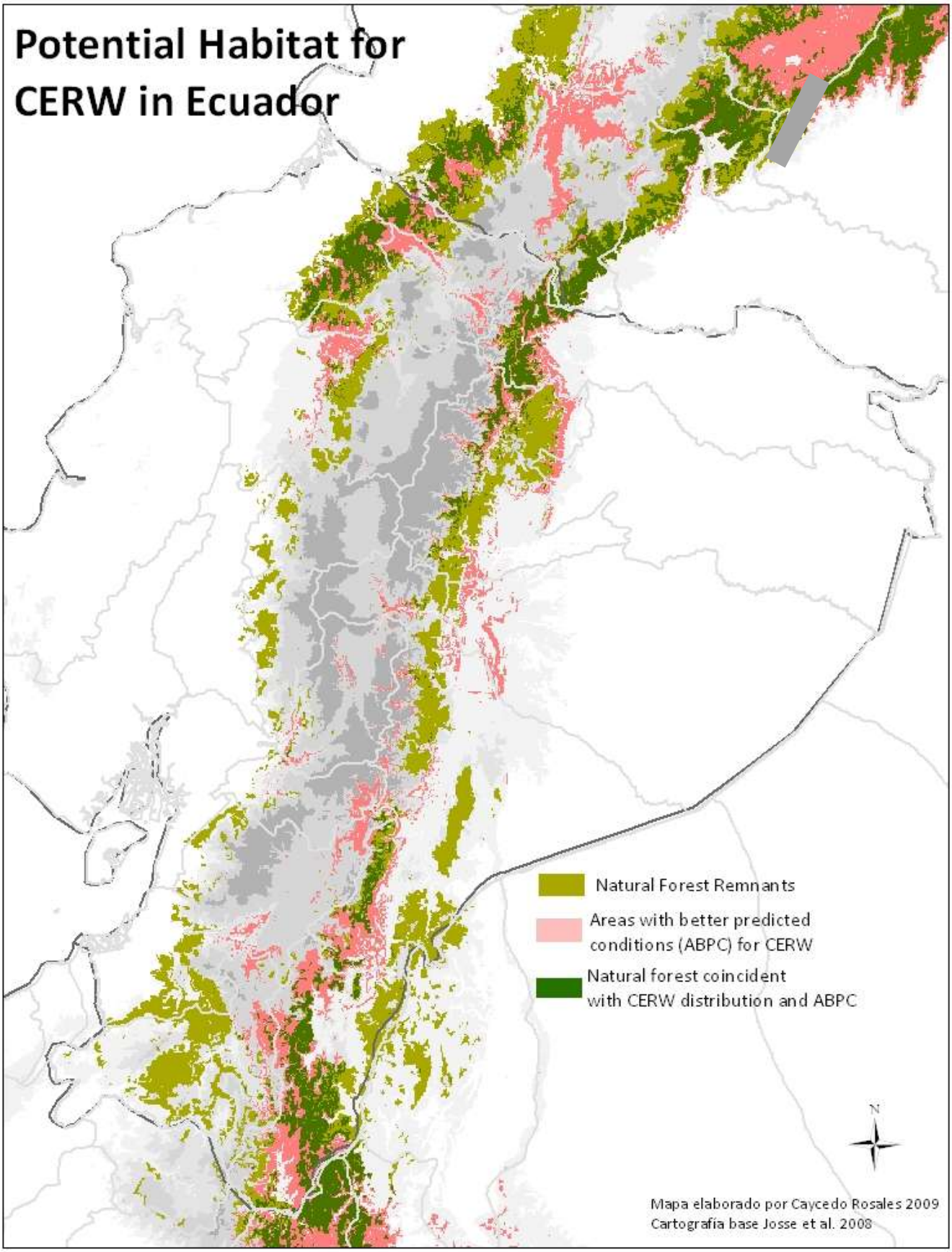
Mapa elaborado por Caycedo Rosales 2009
Cartografía base Josse et al. 2008


Potential Habitat for CERW in Ecuador
Natural Forest Remnants
Areas with better predicted conditions (ABPC) for CERW
Natural forest coincident with CERW distribution and ABPC
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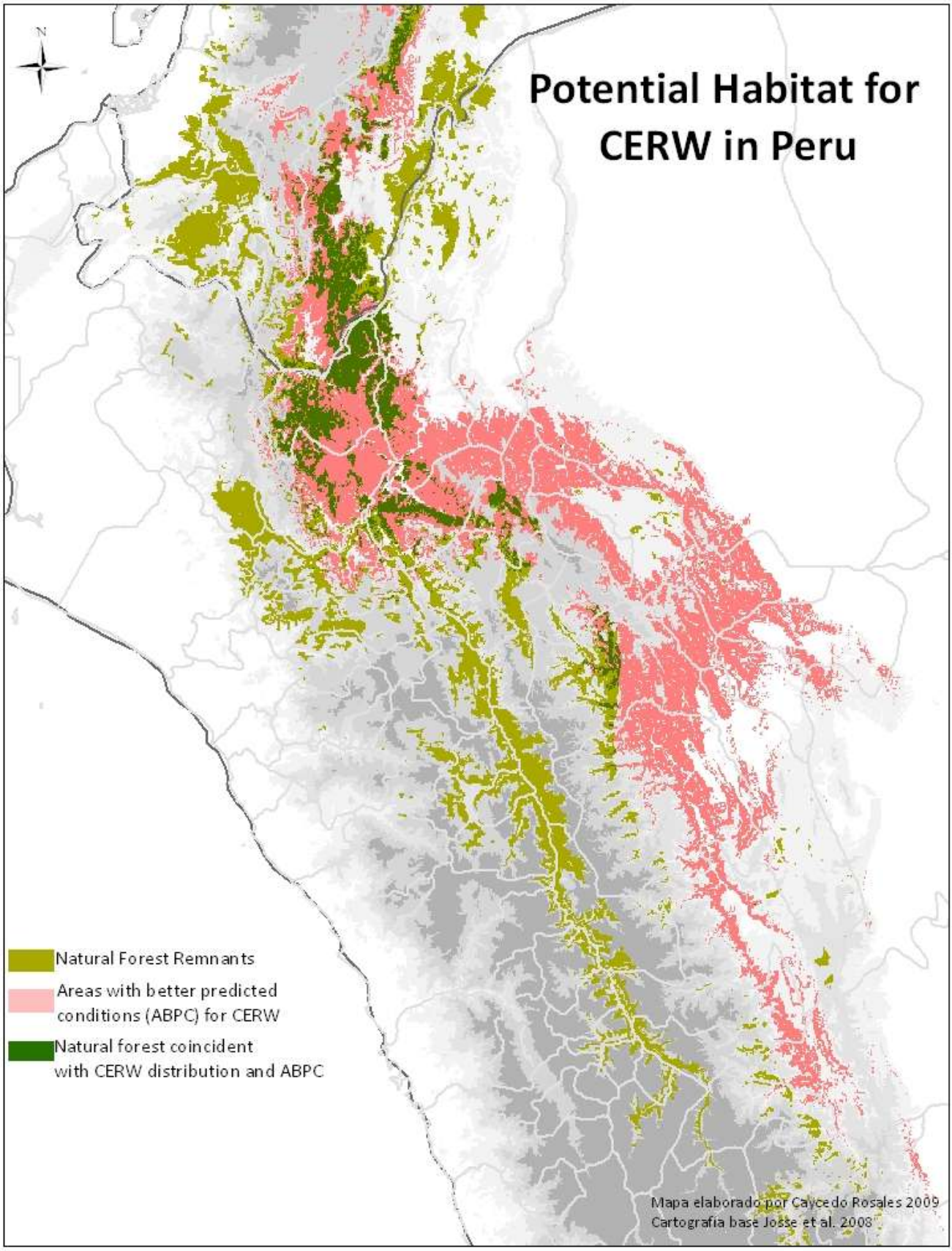

Figure 9. Potential Natural Forest Remnants for Cerulean Warbler in Venezuela, Colombia, Ecuador and Peru.

7. NONBREEDING ECOLOGY OF THE CERULEAN WARBLER

7.1. Foraging and Diet

The Cerulean Warbler is a highly insectivorous species (Jones *et al.* 2000). In Colombia, it was in constant motion flying between trees and rarely stopping while foraging, although occasionally pausing to look about for food or clean its bill against the twig it was perched on. When obtaining food, Cerulean Warblers attack using both near-perch (non-aerial) and aerial maneuvers (Calderon 2006).

In shaded plantations, the species was observed mainly on trees such as guamo (*Inga* spp.), pisquín (*Albizia carbonaria*), and nogal cafetero (*Cordia alliodora*). The guamo is an important resource for the Cerulean Warbler, not only in plantation monoculture but also in natural forest. In secondary forest, the species has been seen feeding on insects on lianas and vines, as well as on trees such as chiminango (*Pithecelobium dulce*) and native guamos (Colorado *et al.* 2006). Guevara (2008) observed foraging on tree species like *Cordia alliodora* (Boraginaceae), *Ochroma pyramidale* (Bombacaceae), *Beilschmedia pendula* (Lauraceae), *Miconia sp*., *Tibouchina sp.* (Melastomataceae), and *Vismia baccifera* (Melastomataceae), all within second growth forest.

Calderon (2006) studied foraging behavior and techniques in Colombia, and found it constantly in motion, scanning the back of *Cordia* and *Inga* leaves, and occasionally twisting *Cordia* leaves. Among the non-aerial foraging movements, the warbler used those restricted to the outside of the substratum. "Lunge" was the most frequent foraging behavior and the four types of hanging maneuvers were also very common. "Glean" was performed in 8.0% of all observations. Among aerial feeding behaviors, Cerulean Warblers used wing- and leg-powered ones. Almost half of all observations were "leap" (leg-powered) and among the wing-powered ones, "flush-pursue" was equally common, far more than "flutter-chase." He also found the Cerulean Warbler foraging at an average height of 7.81 m above the ground at an average speed of 1.42 m/min.

Calderon (2006) made two observations of adult male Cerulean Warblers taking green larvae, presumably Lepidoptera, from *Inga* leaves. The food-handling technique "snap" was used to catch these larvae. In all his remaining observations small insects apparently were taken.

7.2. Habitat Use

The Cerulean Warbler has been recorded in primary and secondary forests, in shade crops (mainly coffee, cacao, and in lower proportion cardamom), and in some cattle landscapes with scattered trees or in borders between forest fragments and pastures (Jones *et al.* 2000, Hamel 2000b, Calderon 2006, Fundación ProAves 2009, Bakermans *et al.* 2009). Studies on the nonbreeding grounds have found that its abundance is higher in shade plantations than in natural forest (Fundación ProAves 2009). In spite of the greater number of records in different shade plantations compared with forest, it is not possible to affirm that the species prefers this kind of habitat, rather than natural forest (Fundación ProAves 2009). The difficulty of observing this species in the forest is high. Even among a group of ten professional ornithologists, just one of them could see a Cerulean Warbler in the forest canopy; on the contrary, all of them saw it easily in shade plantations and borders (Paul Salaman pers. com.), mainly because the forest has higher canopy diversity and height, more vegetative strata, closed canopy, and fog (see Figure 2).

Some authors suggest that habitat quality can be better assessed by comparing parameters other than abundance among habitat types, such as sex and age ratios, body condition, return rates, within-winter and annual survivorship, and migration delay to breeding grounds (Johnson *et al*. 2006, Komar 2006, Bakermans *et al*. 2009).

In Venezuela, Bakermans *et al.* (2009) studied Cerulean Warblers in shade-grown coffee plantations (38-63% canopy cover) and primary forest (58-88%), and did not find any habitat segregation by sex in the two habitats. However, in shade-grown coffee plantations a greater proportion of females were captured because females forage significantly lower than males, making them easier to catch in mist nets. This suggests some level of segregation at least at the

microhabitat level. Their findings on body condition, survival, and return rates of Cerulean Warblers in shade-grown coffee plantations are presented in Section 7.4.

In the Eastern Andes of Colombia, Cerulean Warblers were observed in shade plantations of cardamom and coffee and in small to medium native forest fragments, at an elevation of 1,500 m. In plantations, the birds used only the canopy/shading trees, like guamos and carboneros (*Albizia*), when foraging for insects. In the same region, a few Cerulean Warblers were observed foraging in a small monoculture of nogales with no bushy understory, and a few times they used scattered trees in cattle pastures (always carboneros) outside the plantations. Additional plant species used by Cerulean Warblers were melastomes (Melastomataceae), mangos (*Mangifera indica*) and a species of Urticaceae (cf. *Boehmeria*; Calderon 2006).

7.3. Population Density

Just one published demographic study of this species in the nonbreeding range exists (Bakermans *et al.* 2009). This study was conducted in Venezuela on the western slope of the Mérida Mountains in La Azulita. Over two years, 20 line transects were surveyed in shade-coffee plantations and primary forest sites to estimate Cerulean Warbler densities in each habitat type (10 routes in each habitat type, each visited seven times per year for two years, for a total of 280 surveys). Using passive mist netting in both shade-grown coffee plantations and forest sites they banded 29 Cerulean Warblers from 2005 to 2007. In addition, habitat characteristics were measured in 0.04-ha circular plots located along each line transect (*n*=20).

The densities of all migratory warblers were 3-14% higher in shade-grown coffee plantations than primary forest sites, even after accounting for differences in detectability (Figure 10).

The relationship between density in shade-grown coffee plantations and forest is supported in studies from Colombia by Gabriel Colorado (pers. com.), the birds being more dense in shade-grown coffee plantations (Figure 11).

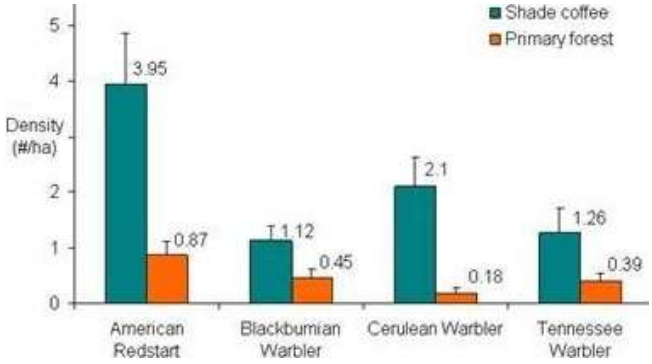

Figure 10. Migrant density in shade-grown coffee plantations and natural forest in Venezuela. Based on 10 transects per habitat surveyed seven times per year for two years for 280 visits; analyzed with DISTANCE (Bakermans *et al.* 2008).

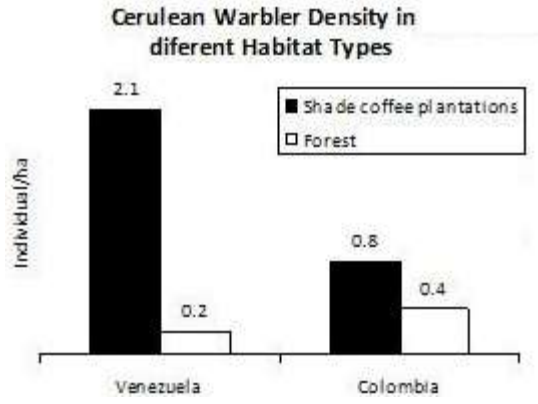

Figure 11. Cerulean Warbler densities in different habitat types (Colorado unpublished data).

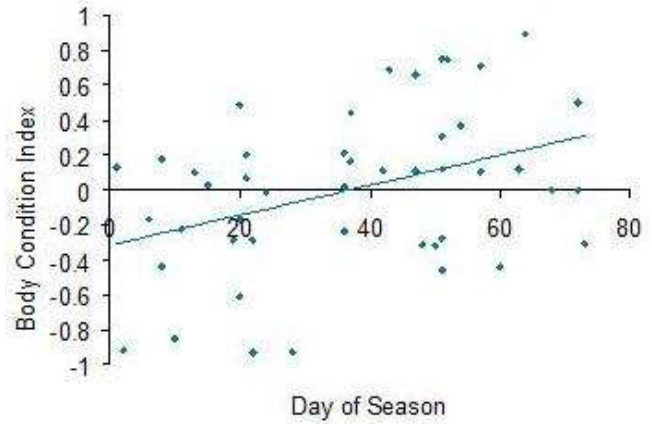

Figure 12. Cerulean Warbler body condition in shade-grown coffee plantations in the Mérida Mountains, Venezuela. Birds falling below the horizontal zero line are below average in condition, while birds above the zero line are above average (Bakermans *et al.* 2008).

7.4. Body Condition and Annual Survivorship Estimates

Bakermans *et al.* (2009) investigated if body condition changed over the course of the season. In coffee plantations, the body condition of Cerulean Warblers increased with day of the season ($F_{1,44} = 7.82$, $P = 0.008$; Figure 12); data from birds using forest habitats were not analyzed because of the low number of captures. They accounted for body frame (structural) size by first performing a principal components analysis (PCA) on morphometric variables (wing chord and tarsus length). Body size was regressed against mass and the residuals were used as a condition index. The extent to which the actual value deviated from expected mass given a specific body size indicated whether the bird was in good (residual above the regression line) or poor (i.e., residual below) body condition (Bakermans *et al.* 2008; Figure 12).

Bakermans *et al.* (2009) reported that 25 of 29 color-banded Cerulean Warblers were re-sighted within the season after the initial banding event, and more than 50% were regularly re-sighted within each season. Using Program MARK, apparent monthly survivorship for Cerulean Warblers was estimated as 0.97 ±0.02. There were no differences in monthly survival based on sex or age. In the small sample of birds returning in subsequent years, age, but not sex, influenced the likelihood that individual birds returned in the next year, as 89% of adults returned compared to 46% of immature birds (Bakermans *et al.* 2009). This may be attributable to differential dispersal and survival among juveniles compared with adults. They estimated annual survival rates, and found that adults had higher survival rates (0.73) than juveniles (0.45) and mortality was greater for juveniles during migratory periods (Figure 13).

7.5. Vocal Behavior

Like other migratory birds, Cerulean Warblers occasionally sing on the nonbreeding grounds, but are much more frequently heard calling with "chip" notes. With knowledge of the call, the Cerulean Warbler can be distinguished from other migrant birds. Playback methodology sometimes is effective in locating Cerulean Warblers during spring migration (Melinda Welton, pers. com.). This technique consists of broadcasting Cerulean Warbler songs when a bird or flock is seen or during a point count to lure them in for closer observation.

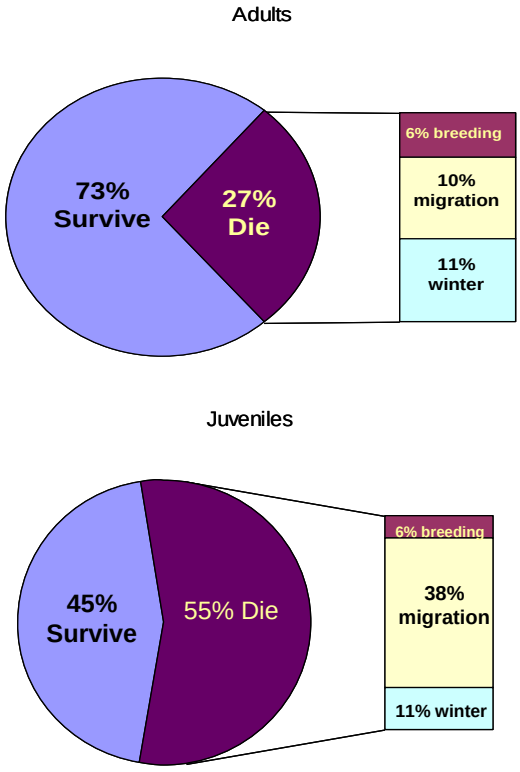

Figure 13. Adult and juvenile survival rates in the entire annual cycle (Bakermans *et al.* 2008).

7.6. Social Behavior

Although Cerulean Warbler can be seen solitary or in pairs, it is known to occur in mixed-species flocks during migration and on the nonbreeding grounds (Robbins *et al.* 1992, Parker 1994, Jones *et al*. 2000, Hamel 2000b); more than 90% of observed Cerulean Warblers were associated with mixed-species flocks of canopy-dwelling birds (Jones *et al*. 2000, Hamel 2000b). Winter habitat thus consists not only of geographical, elevational, and vegetational structure components, but may include specific avifaunal components as well (Hamel 2000b).

Jones *et al*. (2000) reported that, on average, two individual Cerulean Warblers (range one to four) were detected in each flock in Venezuela, usually one male and one female in an average flock territory size of 2.5 ± 0.2 ha. In Peru never more than two individuals were present in mixed-species flocks (Robbins *et al.* 1992). It appears that, once on the nonbreeding grounds, Ceruleans adopt a sociality

similar to that of the resident species that exist in mixed-flocks, that is, a single male and single female per flock (Jones *et al.* 2000).

Recent studies on the nonbreeding grounds have found some new aspects about Cerulean Warbler flocking behavior. Bakermans *et al.* (2009) found that 86% of the flocks observed in Venezuela contained Cerulean Warblers, and they were present in 82% of flocks observed in Colombia (Colorado unpublished data). Some flocks contained large numbers of Ceruleans with up to 9 individuals in Venezuela and up to 8 in Colombia. Mixed species flocks contain a wide variety of migrant and resident birds and may move large distances (Bakermans *et al.* 2008).

7.6.1. Interspecific Behavior

Reports of interspecific interactions between Cerulean Warblers and other flock members are variable. Colorado (2006) reported only two occasions where Cerulean Warblers interacted with other species, once with a Chestnut-sided Warbler *(D. pensylvanica)* and once with a Golden-faced Tyrannulet (*Zimmerius chrysops*). In the first case, the Chestnut-sided attacked the Cerulean Warbler while foraging. The level of the attack was significant enough to cause the Cerulean to move to another branch. After this, the Cerulean seemed to continue foraging without any problem. He also reports an antagonistic behavior between a Cerulean Warbler and a resident species, White-winged Becard (*Pachyramphus polychopterus*). Parra (2008) reported frequent interactions between Cerulean Warbler and Blackburnian Warbler.

Competitive interactions between Cerulean Warbler and other species could explain different patterns of habitat use at the landscape level. For example, Blackburnian Warblers were the most common species in mixed-species flocks in forest habitat, while Cerulean Warblers were most common in coffee plantations (Bakermans *et al.* 2009).

8. MIGRATION STOPOVER AREAS

While migration may be the most difficult portion of the annual cycle to study, it is likely the source of the largest annual mortality (Sillett and Holmes 2002). The Cerulean Warbler has one of the longest migrations of any warbler or passerine of similar size, traveling approximately 4,000 km (2,500 miles) between the breeding grounds in eastern North America and the wintering grounds in northern South America (Hamel 2000b). Unlike most migratory birds, however, remarkably few specimens or published observations exist for this species during spring and fall migration with the exception of those compiled by Ted Parker in the spring of 1992 in Belize (Parker 1994).

8.1 Spring Migration

Based on his numerous observations in the Maya Mountains of Belize, Parker proposed that during the first two weeks of April the entire population of Cerulean Warblers stops over in the Caribbean-facing mountains of northern Central America. In Parker (1994), this proposed stopover region extends from eastern Mexico, through southern Belize, across Guatemala, to northern Honduras and possibly northwestern Nicaragua. If true, this hypothesis suggests that significant habitat degradation in a geographically small area could imperil the species.

In 2004, Welton *et al.* (2008a, b) initiated a multiyear project to assess the status of the Cerulean Warbler in northern Central America during spring migration. The first year of the study confirmed that Cerulean Warblers continued to use the area of the Columbia River Forest in Belize where Parker made his initial observations. In 2005–2007, other areas in Central America were surveyed. From four to six teams of Honduran, Guatemalan, Mexican, and foreign biologists conducted line transect surveys from March 25 to April 22 in primary forest, secondary forest, and rustic shade-grown coffee plantations in Honduras, Guatemala, and Chiapas, Mexico. In 2008 and 2009 additional surveys were conducted in Nicaragua. The 2005 and 2006 survey locations were selected based on historic Cerulean Warbler records or sites that generally conformed to Parker's criteria of lower montane forests of Caribbean-facing

mountains. The 2007 through 2009 survey locations were primarily in areas predicted as potential stopover locations by a Cerulean Warbler stopover habitat model (Beachy *et al.* 2008).

Over 130 Cerulean Warblers were observed during 183 surveys. All were found in mixed-species foraging flocks with from one to five individuals per flock, and males outnumbered females three to one. Preliminary results indicated that the distribution of Cerulean Warblers in northern Central America during spring migration generally conforms to Parker's hypothesis (Welton *et al.* 2008a, b). However, the encounter frequency of Cerulean Warblers varied greatly among locations (Figure 14), with the highest frequencies occurring in southern Mexico and central Guatemala, and lower frequencies in eastern Honduras.

8.2 Stopover Habitat Model

In order to get a better understanding of Cerulean Warbler distribution during spring migration, a predictive habitat model was developed using the 94 Cerulean Warbler locations recorded during the first three years of the migration project (Beachy *et al*. 2008, Welton *et al*. 2008a, b). The first iteration of a potential stopover habitat map generated by the model is shown in Figure 15.

Validated using data gathered during the 2007 spring migration season, the model showed 95.8% of the transects where Cerulean Warblers were located were correctly classified as potential stopover habitat. The proportion of correctly predicted absences could not be calculated. Therefore, the model appeared to effectively predict the presence of Cerulean Warblers in the region studied and may, with refinement, become a useful tool to identify potential stopover sites in Central America.

8.3 Fall Migration

Data from Costa Rica suggests that the majority of Cerulean Warblers that migrate through this country do so during a short window of time from late-August to mid-September, along the Caribbean foothills (Carman and Vargas unpublished data). The number of individuals seen in one day varied from one to 14. Most individuals encountered were in mature primary forest or in young secondary forest adjacent to primary forest. Only a very small percentage of sightings of this species were in agricultural or urban areas containing tall trees. Cerulean Warblers were mostly found in mixed species flocks; times when they were found alone were generally before 0630 and after 1600, when mixed species flocks were not active. Dietary observations during fall migration included larvae, small orthopterans, arachnids, and, on several occasions, the small fruits of a *Miconia* (Melastomataceae). One of the study sites in Costa Rica, on the northeast slopes of Volcan Turrialba, is likely to be a very important stopover site for Cerulean Warblers during fall migration.

Figure 14. Encounter frequency for Cerulean Warblers (birds observed per hour of survey) in Belize, Guatemala, Honduras, and Mexico 2004–2007 (Welton *et al.* 2008a, b).

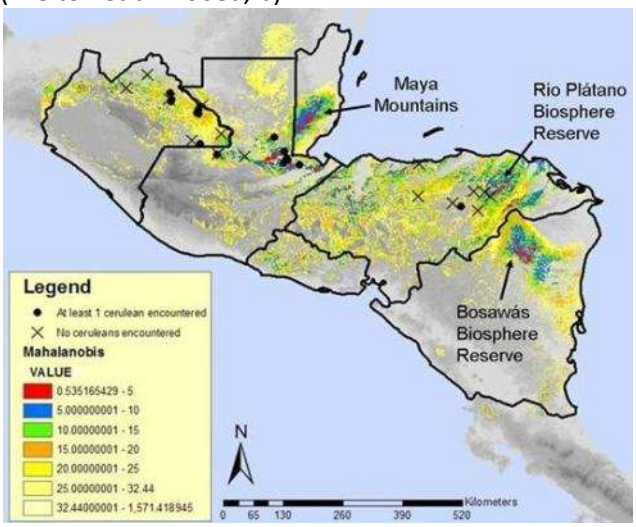

Figure 15. Output of D^2 model depicting potential suitable habitat for the Cerulean Warbler in Central America. Lower values indicate higher probability of encountering a Cerulean Warbler. The dots and X's represent presences and absences, respectively, collected in April 2007 (Beachy *et al.* 2008).

9. THREATS TO THE CERULEAN WARBLER

Neotropical migrants are often sensitive to anthropogenic impacts and represent one of the most challenging groups for which effective conservation strategies can be developed, because of their wide geographic ranges. The ecological and conservational contexts that face the Cerulean Warbler illustrate both the complexity and the urgency for Neotropical migratory bird conservation. Cerulean Warblers generally spend three months in breeding areas, two months or less migrating, and seven months or more in the nonbreeding grounds (Hamel 2000b). With the majority of the annual cycle being spent in the nonbreeding range, it is important to understand historical changes in land use and cover in the Northern Andes and the pressures driving these changes. In this chapter we will see how Cerulean Warbler nonbreeding survival may have been affected by historical landscape transformation, and consider in detail the agro-forestry systems that the Cerulean Warbler uses in the nonbreeding range. Finally we review the diversity of tools available to us for enhancing both ecological and social aspects of management practices such that they are favorable to nonbreeding Cerulean Warblers.

9.1 Summary of Limiting Factors and Threats

The factors limiting Cerulean Warblers are poorly understood (Bakermans *et al.* 2008, Hamel 2000a, Latta and Baltz 1997, Rappole and McDonald 1998). However, with new information on their geographic distribution and preferred habitats together with an evaluation of the threats facing those key areas and habitats, we can indicate the major threats facing the Cerulean Warbler on its core nonbreeding range. The principal threats are:

1) **Loss and fragmentation of Sub-Andean forests across the Northern Andes**: The major driver of the population decline is considered to be habitat loss together with a significant lack of protected habitat within the elevational range of the Cerulean Warbler. The *Colombian National Conservation Plan for Migratory Birds* estimated that only 16% of the potential (modeled) range of the Cerulean Warbler in Colombia is protected (Fundación ProAves 2009). The loss of habitat has been primarily due to agricultural production, notably coffee, as well as conversion of forests to pasturelands for cattle grazing.

2) **Loss and fragmentation of shade-grown coffee landscape**: The Cerulean Warbler uses shade-grown coffee plantation landscapes with high broken canopy perhaps because of the lack of suitable natural forest. However, shade-grown coffee is rapidly being replaced by sun-coffee varieties and remaining shade-grown coffee plantations are more patchily distributed, reducing potential habitat.

9.2 Loss and Degradation of Nonbreeding Habitat

South America is losing its forest at a high rate. The annual net rate of forest loss between 2000 and 2005 was 0.50% and was higher than that of the nineties (0.44%; Global Forest Resources Assessment 2005). The leading cause of deforestation was the conversion of forested areas to agriculture.

Despite an increase in forests designated for conservation over the past 15 years (average 2% increase per year between 2000 to 2005 in Colombia), the vast majority are lowland forests outside of the core nonbreeding range of Cerulean Warblers. More alarming still is the almost complete inability of national governments to enforce the protection of key Andean National Parks and other state, provincial, or local protected areas. So while additional protected areas are vital, it is critical that what little resources are available for protection are efficiently used for protection.

Several countries in the region are considered global leaders in innovative approaches to forest management, such as payments for environmental services (Food and Agriculture Organization of the United Nations 2007). However, these approaches

are rarely applied in the largely degraded and fragmented forest habitats of the Northern Andes.

Of greatest concern is that the areas where Cerulean Warblers winter (mainly between 800-2,000 m in the Andes) are prime locations for agriculture, with high human population densities (compared with the rest of South America). With the exception of Venezuela, the human population has historically settled in the Northern Andean mountain forest, and, since the early 1970s, the changes in economic and political tendencies have dramatically altered the forested landscape in order to make way for technological agronomy (Etter *et al.* 2008, Guhl 2004), part of a global movement to "modernize" agriculture (Guhl 2008).

The original land cover of the sub-Andean dry forests in the Colombian Eastern Andes has been almost totally replaced by semi-natural habitats (Etter *et al.* 2008). Primary forests at these elevations are being cleared for the production of coffee, cacao, and pasture to graze livestock, among other reasons (Robbins *et al.* 1992). Transformed ecosystems covered 51% of the Eastern Andes in Colombia at the beginning of the 21st century; the other 49% corresponded to natural ecosystems such as páramos and Andean and Sub-Andean forests (Armenteras *et al.* 2003). An estimated 64% of the natural forest habitat for nonbreeding Cerulean Warblers might already have been lost (Fundación ProAves 2009).

Such loss not only directly limits habitat availability but it also has an impact at the landscape level by degrading the quality of surrounding habitats. In addition to the loss of primary forest, secondary forest habitats, such as those provided by shade-grown coffee or other shade-grown agricultural products, are also being lost to other land uses that do not require shade (Rice 1996; Guhl 2004, 2008). As in other neotropical migratory birds, the reduction in suitable habitat likely results in reduced over-winter survival rates and/or reduced overall body condition in Cerulean Warblers. Reduced body condition may not only affect over-winter survival but could also carry over to impact survival rates during spring migration, as well as to potentially lower the reproductive output on the breeding grounds (Marra *et al*. 1998, Marra and Holmes 2001).

Loss of spring migratory stopover habitat is also a threat to this species. Just as nonbreeding ground habitat is under pressure from human development, so is stopover habitat. Because the spring stopover takes place in a narrow arc of Central America, Cerulean Warblers may be particularly vulnerable to habitat loss in this region. In addition, substantial loss of suitable stopover habitat for many Neotropical migrants has occurred (Barrow *et al*. 2005). Natural habitats along the barrier islands and coastline of the Gulf of Mexico are critical for exhausted birds that have made the long migratory flight across the Gulf. The lack of suitable habitat along the U.S. Gulf coast and pressures on stopover habitat in Central America constitute specific threats to Cerulean Warblers that can result in decreased survival (USFWS 2007).

9.2.1 Non-habitat Related Threats

Several potential threats from non-habitat factors exist for Cerulean Warblers, although none have been studied sufficiently to quantify the degree of threat they might pose. These threats include: increased frequency of catastrophic weather events (particularly hurricanes during the fall migratory period), other potential effects from climate change such as shifts in location of suitable forest types and the timing of emergence of insects in the spring, risks from collisions with towers (including off-shore oil platforms, wind turbines, communications towers, etc.), mercury contamination, acid deposition, and the effects of diseases (e.g., West Nile virus, avian influenza; USFWS 2007).

9.3 Loss of Shade-grown Coffee Landscape

Traditional shade-grown coffee plantations are the agro-forestry system preferred by Cerulean Warblers in Colombia, Venezuela, and Peru. For this reason it is useful that we understand the historic, agronomic, social, and economic aspects of these plantations.

9.3.1 Coffee Production Systems

Coffee is cultivated in a variety of ways, which can be divided into five main coffee growing systems that differ structurally and in vegetation complexity. These systems form a gradient from sunny fields to modified forests (Rice 1996, Rice and Greenberg 2000, Guhl 2008). The ecological benefits of shade

trees are relevant as one step along the gradient from non-shade to forest shade.

a) Rustic: Understory plants are replaced with coffee plants and all canopy species are left to provide shade. This coffee system is characterized by a high associated biodiversity. The density of coffee plants is low (< 2,000 coffee plants/ha).
b) Traditional Polyculture: Coffee is cultivated under the original canopy but other plants like fruit trees or timber species are also planted. This system has high structural and vegetation complexity.
c) Commercial Polyculture: Original canopy species are replaced with shade tree species appropriate for the cultivation of coffee. This system is less diverse than either Rustic or Traditional Polyculture systems.

The three systems described above are known as traditional systems and contain a gradient of shade tree diversity and a complex structure. The following two systems are modern systems that are characterized by lower structural complexity of the shade canopy and lower associated biodiversity.

d) Specialized Shade: Coffee is planted under the shade of one tree species, frequently of the Leguminosae.
e) Unshaded Monoculture: Coffee is planted in direct sun and greater amounts of chemical fertilizers and pesticides are applied than typically occurs in other cultivation systems.

In traditional systems, the density of coffee plants is low (< 2,500 plants/ha), traditional varieties are used, the crop does not need high agricultural inputs, and the life cycle of the crop is longer (> 10 years). The canopy trees benefit the systems by regulating temperature and humidity, minimizing soil erosion, recycling soil nutrients, and regulating the availability of water, among others. This kind of system not only benefits the agro-forestry system but also provides important environmental services like carbon sequestration and storage, the production of clean air and water, increased connectivity at the landscape level and a refuge for a high level of native biodiversity (Somarriba *et al.* 2004; Rice and Greenberg 2000; Rice 1996, 1999; Perfecto *et al.* 1996; Guhl 2004, 2008). These systems also require few inputs such as fertilizers or pesticides and therefore provide a safer working environment in a social context (Guhl 2008).

With coffee as the understory shrub, the mixed shade canopy of fruit trees, banana plants, and towering hardwood species forms a forest-like agroecosystem. This structure results in a fairly stable production system, providing protection from soil erosion, favorable local temperature and humidity regimes, constant replenishment of the soil organic matter via leaf litter production, and home to an array of beneficial insects that can act to control potential economic pests without the use of toxic chemicals. Traditional coffee, in fact, has been cited as the region's most environmentally benign and ecologically stable agroecosystem (Rice 1996).

The traditional system or shade-grown coffee is becoming a new alternative for coffee growers in order to increase profits and at the same time contribute to biodiversity conservation (Rappole *et al.* 2003). In recent years the flowering of organic production markets has made small farms with traditional systems more profitable (Guhl 2008), alongside other products that are produced within these systems. Indeed, several "non-coffee" products are harvested on a continual basis from traditional coffee systems. This diversification helps shield small producers from risks arising from the vagaries of nature, international market fluctuations, or societal structures. For many coffee producers in Central America, the mixed nature of shade cover traditionally maintained in coffee plantations provides insurance against uncertainty, maximizes the use of limited land holdings, and has become an effective survival strategy. The coffee harvest provides income each year, the absolute amount of which depends upon yields and international prices (Rice 1996).

The specialty coffee markets, including environmentally friendly coffees, are the ones that have seen the greatest increase in demand at the global level (Guhl 2008, Moguel and Toledo 1999). Nevertheless, there are disadvantages to traditional forms of production, like lower productivity. Also natural habitat destruction is part of traditional systems, with the removal of the understory biota. In

commercial polycultures, for example, the original canopy trees are removed and replaced with other species of shade trees. If demand in the specialty coffee market continues to grow, remaining forest fragments may be converted to this agroecosystem which in any case is a substitute for the native forest (Rappole *et al.* 2003, Komar 2006, Guhl 2008).

Modern systems are characterized by a reduction or elimination of shade trees (sun coffee). The coffee plants are planted at higher densities (10,000 plants/ha), making the systems more productive per hectare. The variety (caturra) used in the modern system is smaller in size, and the plantation requires greater amounts of agricultural supplies (insecticides, pesticides, fertilizers) and has a shorter lifecycle duration (< 7 years; Moguel and Toledo 1999, Rice and Greenberg 2000, Rice 1999, Rice 1996, Perfecto *et al*. 1996, Guhl 2008). Sun coffee is not modern; it was used in other historical periods, and currently in Brazil the majority of coffee plantations are of sun coffee. In Venezuela in the 19th century sun coffee was also the main method of coffee production. The production pattern in Venezuela was characterized by replacement of Andean forest by sun coffee and once the soil was exhausted coffee growers moved to another site. At the end of the 19th century those coffee plantations were less important when Venezuela became a major petroleum producer. In Colombia some of the oldest coffee plantations are also of sun coffee in Cauca and Santander departments. What characterizes the modernization of the productive system is the use of agrochemicals, less diversity of coffee plants, and greater coffee plant densities (Palacios 1980, Guhl 2008). This kind of production system increases soil erosion and without agricultural additives, productivity is lower than in traditional systems. This dependence on agricultural supplies, which requires capital to buy, favors medium and large-scale plantations/farms (Guhl 2008).

9.3.2 Coffee Production History

Early in the 20th century, coffee production was concentrated in Latin America with Brazil and Colombia being the most important world producers. Coffee production systems were characterized by diverse shade and biological richness dominating the landscape. Even after World War II (1945) and into the last quarter of 20th century, coffee landscapes in most countries of the region were blanketed with a variety of shade trees (Rice 2003). The coffee landscape changed at the end of 20th century (1970-2000) following agricultural modernization (Guhl 2004, Bergquist 1999).

In Colombia, nearly 67% of the 3.1 million hectares of coffee have been affected by intensification (Guhl 2004), while in Peru the greater part of the coffee systems remain under shade (Rice and Greenberg 2000). Coffee production since 1950 has become similar to an industrial process. In the 1950s, the coffee growers were resistant to this change, because there was a coffee boom after the end of World War II. Some coffee growers began to remove tree cover and introduce agrochemicals in 1950. The collapse of the coffee economy in the 1970s accelerated this trend. The appearance of a fungus named *La Roya*, which prospers in the higher humidity environment of shade-grown coffee farms, provided added stimulus for coffee crop modernization changing from shade to sun coffee systems in Central America, the Caribbean and Colombia (Rice 2003, Guhl 2004). In Colombia, the area of coffee grown under shade has markedly decreased from 1970 (~100% shade-grown coffee) until 2000 (>30% shade-grown coffee; Guhl 2004, Guhl 2008) and continues to decrease.

9.3.2.1 International Coffee Market

The coffee market is unpredictable and volatile (Palacios 1980, Guhl 2008). It depends on environmental variables such as above-average rainfall and frost in Brazil, among others. Historically there have been some attempts to stabilize the fluctuations in prices for the coffee growers. An agreement was signed in 2007 by 77 countries, both producers and consumers, to strengthen the International Coffee Organization's role as a forum for intergovernmental consultations, facilitate international trade through increased transparency and access to relevant information, and promote a sustainable coffee economy for the benefit of all stakeholders, particularly small-scale farmers.

In spite of the inequality in prices for coffee producers, coffee remains one of the most profitable products for exportation in developing countries. One initiative to address this imbalance is through certification schemes that benefit producers (from a higher price and better quality of life for the coffee

workers) and promote biodiversity (Guhl 2008, LGT 2003).

9.3.3 Environmental Certification Systems

Certification processes are promoted by institutions and nongovernmental organizations (NGOs) that work in an ecological context. Their function is to open opportunities in the global market in order to promote environmentally friendly products. Consumers are taught to recognize the value of good environmental practices for themselves and the planet. Under this context the promotion of the green market has a chance.

Coffee certification programs may offer one way to protect biodiversity and maintain farmer livelihoods. Established coffee certification programs fall into three distinct, but not mutually exclusive, categories: organic, fair trade, and shade. Criteria and cost for each category differ (Philpott *et al.* 2007). However, it is clear that coffee itself is not factor most affecting Cerulean Warbler conservation (it does not feed within the coffee bushes themselves) nor is the species affected directly by Fair Trade programs (which promote improved social conditions for humans), but the bird benefits from certification programs that strongly promote the density and diversity of canopy shade. In fact, studies of the certified farms that promote shade-grown coffee in Colombia have reported increased use by Cerulean Warblers (Barrera 2008).

Shade-grown coffee is certified under two main programs: Smithsonian Bird-Friendly and Rainforest Alliance Certified, each based on research findings that structurally complex and diverse shade canopies protect biodiversity. Smithsonian Bird-Friendly charges a per-year certification fee and farms must also be organic. Rainforest Alliance charges a per-hectare fee plus travel and per-diem expenses for inspectors but tries to minimize costs to coffee farmers by employing local certification agencies (Philpott *et al.* 2007).

Shade is not the only element involved in certification of farms in the Rainforest Alliance Certification Standards (Sustainable Agriculture Network 2009). The standard for sustainable agriculture includes the following:

> "2.1 *Critical Criterion*. All existing natural ecosystems, both aquatic and terrestrial, must be identified, protected and restored through a conservation program. The program must include the restoration of natural ecosystems or the reforestation of areas within the farm that are unsuitable for agriculture.
>
> 2.2 Critical Criterion. The farm must maintain the integrity of aquatic or terrestrial ecosystems inside and outside of the farm, and must not permit their destruction or alteration as a result of management or production activities on the farm."

Together, these criteria protect those natural habitats remaining on the farm itself, which often harbor species of significant conservation importance.

In some localities in Colombia, and perhaps in other coffee growing countries of the Americas as well, climatic conditions preclude absolute adherence to specific criteria defining the amount of shade in terms of tree densities or percent cover of shade in the coffee stand itself, because of edaphic or climatic factors particular to the local coffee growing region (Farfan and Jaramillo 2009). Recognizing this reality, criterion 2.8 which deals with the standard for Forest cover within the coffee plot is no longer a critical criterion for certification of the entire farm or watershed. The criterion follows:

> "2.8 Farms with agroforestry crops located in areas where the original natural vegetative cover is forest must establish and maintain a permanent agroforestry system distributed homogenously throughout the plantations. The agroforestry system's structure must meet the following requirements:
>
> a. The tree community on the cultivated land consists of minimum 12 native species per hectare on average.
> b. The tree canopy comprises at least two strata or stories.
> c. The overall canopy density on the cultivated land is at least 40%.
>
> Farms in areas where the original natural vegetation is not forest – such as grasslands,

savannas, scrublands or shrublands - must dedicate at least 30% of the farm area for conservation or recovery of the area's typical ecosystems. These farms must implement a plan to establish or recover natural vegetation within ten years."

Application of the revised criterion in the context of the standards of the Sustainable Agriculture Network (2009) provides a mechanism for delivery of the education in biodiversity conservation that the certification is designed to promote. In the end, it is perhaps the producer educated in conservation practices who will provide the most habitats for birds such as the Cerulean Warbler on their lands.

9.3.1.3 Cerulean Warbler Conservation Coffee

The Andean Coffee Growers Cooperative COOPERAN works in the Department of Antioquia in the Colombian Western Andes. This is one of the most important cooperatives in the country with 5,000 associated farmers and occupies third place in national coffee sales. In conjunction with Fundación ProAves a special brand, "Cerulean Warbler Conservation Coffee" (Figure 16), was created. Both institutions signed an agreement in order to promote and commercialize shade-grown coffee where ProAves confirmed that the shade-grown coffee plantations supported nonbreeding Cerulean Warblers. The principal objective is to promote habitat conservation for the Cerulean Warbler; however, the coffee is not Rainforest Alliance nor Smithsonian Bird-Friendly certified.

Figure 16. Cerulean Warbler Conservation Coffee. For more information visit www.proaves.org

10. SOCIAL AND POLITICAL CONSERVATION FRAMEWORK

This section discusses the social and political framework within which the Cerulean Warbler Conservation Plan will be implemented within South America.

10.1 Regional Environmental Policies

Following the Earth Summit held in Rio de Janeiro (June 1992) and during the XI Andean Presidential Council held in Cartagena, Colombia (May 1999), the Andean Community of Nations (CAN) agreed to design a community strategy regarding sustainable development. This led to the creation of the Andean Committee of Environmental Authorities (CAAAM) and the development of the Guidelines for Environmental Management and Sustainable Development in the Andean Community (High Level Meeting of National Authorities on Environmental Issues in the Andean Community, Quito, Ecuador, July 2001).

The Regional Biodiversity Strategy for the Countries of the Andean Tropics, adopted in 2002, is a specific action derived from those guidelines. It is one of the first efforts of the North Andean subregion to develop an integrated platform for community action. It is also one of the first strategies of a community nature adopted on this topic by a group of countries that are signatories to the Convention on Biological Diversity, and is a specific contribution to meeting the goals of the Convention. At the same time, it is a valuable instrument for enhancing the Andean peoples' own perception of the importance of their rich natural heritage. It is also a tool of great significance for constructing new kinds of relationships among countries, regions, and continents (CAN 2002, 2008a).

The Johannesburg Summit (September 2002) was held for the purpose of revitalizing global agreements on sustainable development made ten years before at the Rio Summit and to strengthen international actions to eliminate poverty. In response, the CAAAM

drafted the "Andean plan for follow-up on the Johannesburg World Summit 2003-2005" (June 2003) and afterwards designed the Andean Environmental Agenda 2006-2010 (Andean Council of Environment and Sustainable Development Ministries, Paracas, Peru, April 2005), in which the Regional Biodiversity Strategy for the Tropical Andean Countries is framed. It contains both short- and medium-term subregional actions that add value to national efforts and help strengthen the capacities of the Member Countries with regard to environmental and sustainable development issues. Its aim is to guide the actions of both the Council of Ministers of the Environment and Sustainable Development and the CAAAM and, thereby, to facilitate the work of the CAN Member Countries on that subject (CAN 2007; 2008a).

Two countries in the nonbreeding range of the Cerulean Warbler, Ecuador and Peru, are parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS). CMS parties strive towards strictly protecting migratory species, conserving or restoring the places where they live, mitigating obstacles to migration, and controlling other factors that might endanger them. Besides establishing obligations for each party joining the Convention, CMS promotes concerted action among the Range States of many of these species. However, the Cerulean Warbler is not yet included in the list of migratory threatened species (CMS 2008).

10.1.1 Regional Biodiversity Strategy for Andean Countries

The vision of the Strategy is that "*by the year 2010, integrated biodiversity management based on the principles of equity, interculturality and sustainability, becomes a strategic factor and a competitive advantage in the development of the Andean Community*, under the Principle of Regional Integration: *The Regional Biodiversity Strategy addresses matters of regional concern only. The achievement of a synergy effect should be a primary consideration in any action planned within its framework."* (CAN 2007).

Three interdependent strategic guidelines were defined for action to be taken: conservation; knowledge; and sustainable use of biological diversity and equitable sharing of its benefits. The conservation work carried out so far within the Andean subregion has focused on the protection of representative samples of such biodiversity as exists within the individual countries. In order to make such conservation initiatives effective, to consolidate protected areas and to use biodiversity sustainably, it is now necessary for biodiversity to acquire meaning, to become a value to the society concerned. The lack of knowledge of Andean biodiversity is possibly one of the principal causes of the destruction of ecosystems and therefore, of biological diversity in Andean countries. To be effective, knowledge must be shared by all sectors of society and most importantly it must be used as a tool to promote development and contribute to the welfare of the population.

10.1.2 Andean Environmental Agenda 2006-2010

The Andean Environmental Agenda 2006-2010 is a guiding document framed in a long-term vision, which proposes, at the same time, concrete, agreed-upon, short and medium-term actions. Subregional actions are established in order to add value to national efforts and build capacity of the member countries on environmental and sustainable development matters.

The Agenda is organized around two types of issues:

- Three thematic or major issues – Biodiversity, Climatic Change and Water Resources – that have been dealt with since the approval of the Andean Plan for Follow-up on the Johannesburg World Summit 2003-2005.
- Three cross-cutting issues – Capacity Building for Trade, Environment and Sustainable Development; Environmental Education; and Sustainable Production and Consumption.

The actions are to promote the participation of the different sectors interested in each area of the agenda, including representatives of government as well as civil society.

The CAAAM and the Andean Committee on Genetic Resources, together with the General Secretariat of the Andean Community's (SGCAN) Environment and Sustainable Development Program, shall coordinate and carry out the actions indicated on the agenda

with the technical and financial support of the strategic allies and groups of experts on climate change, water, biotrade, genetic resources, traditional knowledge, trade, and environment, etc.
In the context of the Cerulean Warbler Conservation Plan, the most relevant thematic issue is Biodiversity. The Agenda considers the following objectives for the Biodiversity action plan:

- To implement and disseminate the Regional Biodiversity Strategy (RBS) so that it constitutes the subregional platform for channeling the efforts and financing related to conservation and sustainable use of biological diversity in the Andean Community
- To agree on common positions in international forums for negotiating biodiversity issues
- To coordinate national actions aimed at knowledge, conservation and sustainable use of biodiversity in compliance with the RBS.

10.2 National Protected Areas Systems

In article 8 (*In situ* conservation) of the Convention on Biological Diversity, the signing countries committed to establish and manage a system of protected areas in their territory (UN 1993). There are strategic plans for the national protected areas systems in each of the four countries in the nonbreeding range of the Cerulean Warbler.

Venezuela is among the countries with the most land area subject to a protection regime and management, and has a wide range of natural protected areas organized in the national system of Areas Under Special Administration Regime (ABRAEs), which include the Protected Natural Areas (ANAPROs). These areas were defined in the Conceptual Framework of the Plan of the National System of Protected Natural Areas (SINANPE); however, they still lack a legal framework that supports them (ECOSIG 2008). The System comprises 174 ANAPROs that cover almost 31.6 million ha (nearly 34.5% of the total land area), including 43 National Parks, 36 Natural Monuments, seven Wildlife Shelters, two Biosphere Reserves and 79 Recreational Parks (ANAPRO 2007).

Colombia: The National System of Protected Areas of Colombia (SINAP) was designed to include public, private and community areas, organized with several protection levels at different scales:

National Protected Areas of the Natural National Parks System of Colombia (SPNN), which includes 41 Natural National Parks, nine Flora and Fauna Sanctuaries, two Natural National Reserves, one Road Park and one National Unique Area, covering 11.6 million ha or 10% of the land area (PNN 2008), although this area is primarily in the lowland Amazon. The public entity that administers and manages the National Protected Areas is the Special Administrative Unit of the Natural National Parks System of the Ministry of Environment. The Unit is also in charge of coordinating the SINAP (PNN 2008).

Regional Protected Areas of the Regional Systems of Protected Areas (SIRAPs) are SINAP subsystems of protected areas of regional interest. Generally, these are under the coordination of one or more Regional Autonomous Corporations (CARs; SINAP 2008; PNN 2008).

Departmental Protected Areas of the Departmental Systems of Protected Areas (SIDAPs) are coordinated by the departmental governments. At least ten of the 32 departments have already created their SIDAPs and many others are in process. SIRAPs generally include one or more SIDAPs (SINAP 2008; PNN 2008).

Local Protected Areas of the SILAPs (Local Systems of Protected Areas) are protected areas of local interest that are generally included in the SIDAPs and are the smallest subdivision of the SINAP. These are generally under local public responsibility, such as the municipality (SINAP 2008; PNN 2008).

Within the private, public communitarian and private communitarian sectors, two additional types of protected areas are proposed at the local or regional level (SINAP 2008):

Communitarian Managed Natural Resources Reserves represent 46 to 62% of the natural forests (between 25 and 28 million ha) that are collective property of indigenous and Afro-Colombian communities (Fundación Gaia Amazonas 2005) and are a recognition of their autonomy to manage their natural resources.

Private Natural Reserves of Civil Society include private properties that have been registered as protected areas, presently totaling more than

49,000 ha, and organized under the Network of Private Natural Reserves of Civil Society (RESNATUR 2008).

Ecuador: At present, the National System of Protected Areas of Ecuador (SNAP) comprises 40 protected areas: nine National Parks, ten Ecological Reserves, two Biological Reserves, four Fauna Reserves, nine Wildlife Shelters, one Geobotanical Reserve, two National Areas of Recreation, one Binational Park, and two Marine Reserves, and covers more than 4.8 million ha (19% of continental and insular area, although mostly marine and/or in the Amazon region; ECOLAP & MAE 2007).

The Ministry of the Environment, through the National Directorate of Biodiversity and Protected Areas, is the governmental authority that is responsible for the SNAP. The structure is decentralized in ten Regional Districts, and each area has its own field administration. In five cases, the administration of protected areas has been delegated to different authorities: the municipality (Cajas National Park), indigenous organizations (Cofan Bermejo Ecological Reserve), Army (Arenillas Ecological Reserve), and NGOs (Pasochoa and Muisne Wildlife Shelters). There is also a shared park with Peru: El Condor Bi-national Park (Boyla and Estrada 2005). Natural protected areas of private, community, municipal and provincial character will be incorporated as subsystems in SNAP through incentives for indigenous, Afro-Ecuadorians, sectional governments, local communities and private owners, according to the Strategic Plan 2007-2016 (Ministerio del Ambiente del Ecuador 2006; SNAP 2008).

Peru: The natural protected areas of Peru are organized in the National System of Natural Areas Protected by the State (SINANPE). The network comprises 60 protected areas with a total area of more than 19 million ha covering nearly 14.8% of the country. It is organized into ten protection types: 11 National Parks, seven National Sanctuaries, four Historical Sanctuaries, 11 National Reserves, two Wildlife Shelters, two Landscape Reserves, six Community Reserves, six Protection Forests, two Hunting Enclosed Lands, and nine Reserved Zones (SINANPE 2008).

The National Institute of Natural Resources (IRENA) is a public decentralized entity of the Ministry of Agriculture that is in charge of the formulation, implementation, follow-up and evaluation of the Director Plan of the SINANPE. The Director Plan is the highest level planning document for management of each natural protected area and each area must have its own management plan, which must be revised and updated every five years (Boyla and Estrada 2005). The Plan proposes an arrangement of the natural protected areas in three levels of the public sector (national, regional, and local) and Protected Natural Areas of the private sector (Ministerio de Agricultura del Perú 1995), as follows:

1. National protected areas are the core of SINANPE. They include National Parks, National Sanctuaries, Wildlife Shelters and Natural National Reserves, among the most relevant.
2. Regional or departmental protected areas are under management and administration of regional and local governments. They include Regional Parks/Sanctuaries, Regional Natural Reserves, Community Reserves, Forests and other regional protection zones.
3. Municipal Protected Natural Areas comprise a single type, Municipal Conservation Areas, with flexible criteria to respond to local needs for protection or regulation of natural resources.
4. Natural Protected Areas of the Private Sector are private lands that can be recognized by the national authority of the SINANPE and included in the System.

10.3 Participants in Cerulean Warbler Conservation Implementation

10.3.1 Coordination at Regional Level

At a regional level, the highest environmental authority of the CAN is the Andean Community's Council of Environmental and Sustainable Development Ministers that coordinates and sets the guidelines for the CAAAM, composed of national authorities from each Member Country responsible for the environment. CAAAM is in charge of promoting and coordinating different regional activities, such as the formulation of the RBS, and propitiating the compliance of the assumed commitments in international environmental forums by the Member Countries (CAN 2008b). There is a growing interest of Member Countries towards

institutional development, formulation of legal frameworks, and growing participation of international forums in their environmental management agendas. However, this has not been reflected in an effective commitment to achieve consistent results in sustainable resource use and environmental conservation at a regional level (PNUMA 2003).

10.3.2 National Environmental Institutions

Venezuela: The national environmental authority of Venezuela is the Ministry of Popular Power for the Environment. It is the governing organ, responsible for formulating, planning, directing, executing, coordinating, and evaluating policies, programs, projects and strategic activities for the environmental management. The Environmental Organic Law, which recently came into effect, states that "the Environmental National Authority will promote de-concentration and decentralization processes regarding the environment towards the states, municipalities and districts, under the principles of integrity, territoriality, cooperation, solidarity, concurrence and co-responsibility, in function of regional and local needs and aptitudes…" and "in order to contribute to management of the environment, regional, state and local instances that allow coordination and inter institutional and citizen participation can be established" (Environmental Organic Law 2007). However, these instances are not yet determined by the law. Presently there are 24 State Environmental state offices under the governance of the Ministry. The administration of Natural Protected Areas is coordinated by the National Institute of Parks and its regional direction and coordination units by the National Office of Biological Diversity and by the General Direction of Environmental Planning and Organization.

Colombia: There are four environmental authorities. The governing body of the environmental and natural resources management is the Ministry of the Environment, Housing, and Territorial Development (MAVDT). At the regional level, the 33 CARs are decentralized corporate public entities with administrative and financial autonomy, self-sufficiency, and legal identity. Their legal responsibility is to administrate the environment and the renewal of natural resources and to promote sustainable development in its jurisdiction area, according to the legal dispositions and policies of the MAVDT. The autonomous character of the CARs provides them high influence in economic and regional development decisions. At a local level there are two kinds of public environmental authorities: those of the Large Urban Centers and those of the Special Districts. The environmental authority in charge of the National Protected Areas is the Special Administrative Unit of the Natural National Parks System of the MAVDT. The Environmental National System (SINA) is formed by a group of institutions and its purpose is to assure intersectorial coordination in environmental and natural resources policies, programs and plans at the public level. The institutions that integrate them include the MAVDT, the CARs, the National Parks Unit, territorial entities and Research Institutes that are attached to the Ministry, such as Alexander von Humboldt Institute, INVEMAR (Instituto de Investigaciones Marinas), IDEAM and SINCHI (IDEAM 2008).

Ecuador: The Environmental Management Law establishes that the national environmental authority is the Ministry of the Environment, as the governing, coordinating and regulating body of the Decentralized National System of Environmental Management. The latter constitutes the mechanism of transectorial coordination, integration and cooperation between the different levels of environmental and natural resources management. It is directed by the National Commission of Coordination, integrated by the Minister of the Environment, the highest authority of the Technical Secretary of Planning of the Presidency, representatives of different local councils, the president of the Ecuadorian Committee for Protection of Nature and Defense of the Environment (CEDENMA) and representatives of Afro-Ecuadorians, the Armed Forces, and the National Council of Higher Education (Law 37 / 1999). The National Direction of Biodiversity and Protected Areas of the Ministry of the Environment is the governmental authority responsible for the National Protected Areas.

Peru: The national environmental authority of Peru is the Environmental National Council (CONAM), which is in charge of planning, promoting, coordinating, controlling, and watching over the environment and the natural heritage of the nation. It is a decentralized public organization attached to the

Presidency of the Council of Ministers, and is composed of representatives of the National, Regional and Local Governments, of secondary and tertiary economic sectors, environmental NGOs, and educational institutions. There are also Sectorial Authorities and Environmental Commissions at a Regional, Municipal and Local levels (Law 28245 / 2004). The environmental authority in charge of the SINANPE is IRENA, attached to the Ministry of Agriculture.

10.3.3 Environmental Control Agencies

Venezuela: The Environmental Organic Law of 2007 states that besides the Environmental National Authority (currently the Ministry of Popular Power for the Environment), other institutions intervene in the defense of a healthy, safe, and ecologically balanced environment: the Inspector General's Office, the Public Ministry, the Ombudsman Office, the National Armed Forces, as well as the other national, state, and municipal entities that have competence in the subject, according to the norms that dictate their functions and to the established dispositions of the Environmental Organic Law.

Colombia: Law 99 / 1993, in which the basis for the Colombian environmental policy is described, designs a special body of the National Police, the Environmental and Natural Resources Police, in charge of giving support to environmental authorities, territorial entities and communities for the defense and protection of the environment and renewable resources and in the functions and actions of control and surveillance contemplated in the law. Other public entities have environmental control functions in different territorial levels: MAVDT, as the main controlling authority at a national level; the CARs at a regional level, excluding the authorities given to the Ministry; the Departmental Governments at a Department and intermunicipal level, in coordination with the Environmental National System (SINA) and the CARs, supported by the public force and subject to the legal distribution of competences; the Municipal Governments and the districts with special constitutional regimes, at a local level, in coordination with the other entities of the SINA and subject to the legal distribution of competences. The Armed Forces will also watch for the protection and defense of the environment and renewable natural resources in the national territory.

Ecuador: Law 37/1999 of Environmental Management designates the Ministry of the Environment as the national environmental authority, and the competent entities as controlling and enforcing organisms. However, these are not detailed in the law.

Peru: Law 28245 / 2004, Framework for the National System of Environmental Management, specifies that environmental authorities such as CONAM, the national environmental authority, sectorial authorities, and regional, municipal, and local governments watch over the compliance and application of the current legal framework, apply sanctions for infringements and incentives. The State authorities shall inform CONAM of any damage or infraction to the environmental legislation during the fulfillment of their duties.

11. CONSERVATION UNDERWAY FOR THE CERULEAN WARBLER

11.1 Governmental Protected Areas for the Cerulean Warbler

The majority of Cerulean Warbler records occur on private lands across the Andes, which is of great concern as the vast majority are unprotected and at risk. There are some confirmed records from state protected areas, and Cerulean Warblers are likely to occur at other national parks as shown in Figure 17. All confirmed or possibly occurring records in state and private protected areas are listed in Table 1.

11.2 NGO Conservation Actions for the Cerulean Warbler

Some private protected areas held by NGOs have important populations of Cerulean Warblers and are worth highlighting as examples of targeted protected areas for the Cerulean Warbler.

11.2.1 Cerulean Warbler Bird Reserve, Colombia

In Colombia, the "Cerulean Warbler Bird Reserve" is the first protected area created in South America to conserve a migrant species. It was created in July, 2005, with the financial support of American Bird Conservancy, Robert Giles, and the Howard County Bird Club (Maryland, USA). This reserve protects 200 hectares of Andean Forest in the Eastern Andes (1,345–2,000 m) in San Vicente de Chucurí, Santander. The reserve is surrounded by shade-grown coffee and pasturelands for cattle. This is one of the last areas of well-conserved oak forests of the region, and shelters a significant population of Cerulean Warblers in the nonbreeding period (several individuals can be seen in a day). The reserve also protects seven resident threatened birds, such as Gorgeted Wood-Quail (*Odontophorus strophium*), Black Inca (*Coeligena prunellei*), Chestnut-bellied Hummingbird (*Amazilia castaneiventris*), White-mantled Barbet (*Capito hypoleucus*), Parker's Antbird (*Cercomacra parkeri*), Upper Magdalena Tapaculo (*Scytalopus rodriguezi*), and Mountain Grackle (*Macroagelaius subalaris),* and numerous other endemic species.

11.2.2 Cerulean Warbler Reserve – Narupa, Ecuador

In April 2006, Fundación Jocotoco inaugurated its eighth nature reserve, called the Cerulean Warbler Reserve – Narupa (Sornoza 2008). This reserve protects 200 ha of Andean forest at 1,100 m elevation on the east slope of the Andes, near Narupa in Napo Province. This is another endemic-rich zone, where there are many sightings of the Cerulean Warbler as well as several globally threatened bird species, such as Military Macaw (*Ara militaris*), Coppery-chested Jacamar (*Galbula pastazae*), and Orange-breasted Falcon (*Falco deiroleucus*). There is a plan to expand the reserve further and provide visitor facilities in the future (www.fjocotoco.org). Other protected areas in the range of the Cerulean Warbler include Sumaco Wildlife Sanctuary, not far from Narupa, the Río Bigal Reserve, and some small community reserves in the area.

11.2.3 Community Outreach

Acquisition of protected areas is an excellent tool for conservation, but it must be done in conjunction with environmental outreach and education with the local community for lasting conservation impact. One such activity has been the annual Migratory Bird Festival conducted each October since 2006 across Colombia and since 2007 in Peru and Ecuador with ECOAN and Fundación Jocotoco. The theme of these annual events is often the Cerulean Warbler. This outreach also draws attention of coffee farmers to the importance of maintaining shade-grown coffee plantations.

This festival, and activities of other institutions, demonstrates the opportunities available for outreach to local communities to inform the public about conservation of migratory and resident birds. These activities include, among others, Censos Participativos de Aves en las Zonas Cafeteras Colombianas conducted by the Biodiversity Program of CENICAFE (López 2008), Community outreach in Nicaragua of Alianza para las Areas Silvestres (Chavarría Duriaux 2008), the festival of migratory birds of ECOAN in Peru (Palomino 2008), and in Ecuador, the community outreach activities of Fundación Jocotoco (Juiña 2008b) and the

development of local conservation groups by Aves&Conservación (Loor Vela 2008).

11.2.4 Cerulean Warbler Habitat Restoration

Fundación ProAves is working with the community of San Vicente de Chucurí to implement a silvipasture project with the aim of connecting the Cerulean Warbler Bird Reserve with the Pauxi pauxi Bird Reserve by planting and designing a Conservation Corridor, 10 km long and 7,000 ha in size (Valle 2008a). The Cerulean Warbler occurs in both reserves (Luna 2008) and the valley between them is considered one of the most important nonbreeding areas in the Andes. Two tree nurseries, with 29 native species and production of 35,000 tree seedlings/year, have been established in both reserves (Valle 2008b).

11.2.5 Ecological Easements

Similar to ecological easement laws elsewhere, private land owners in Colombia can voluntarily designate part or all of their land permanently for conservation through a formal contract between two or more parties. The additional party ensures the permanent sustainable management of the easement by the owner (Valle 2008b). The agreement protects natural habitat and prohibits cutting of trees. Ecological easements have been successfully implemented by ProAves with over a dozen landowners in key Cerulean Warbler areas, especially with shade-grown coffee plantation owners that pledge not to clear the canopy trees.

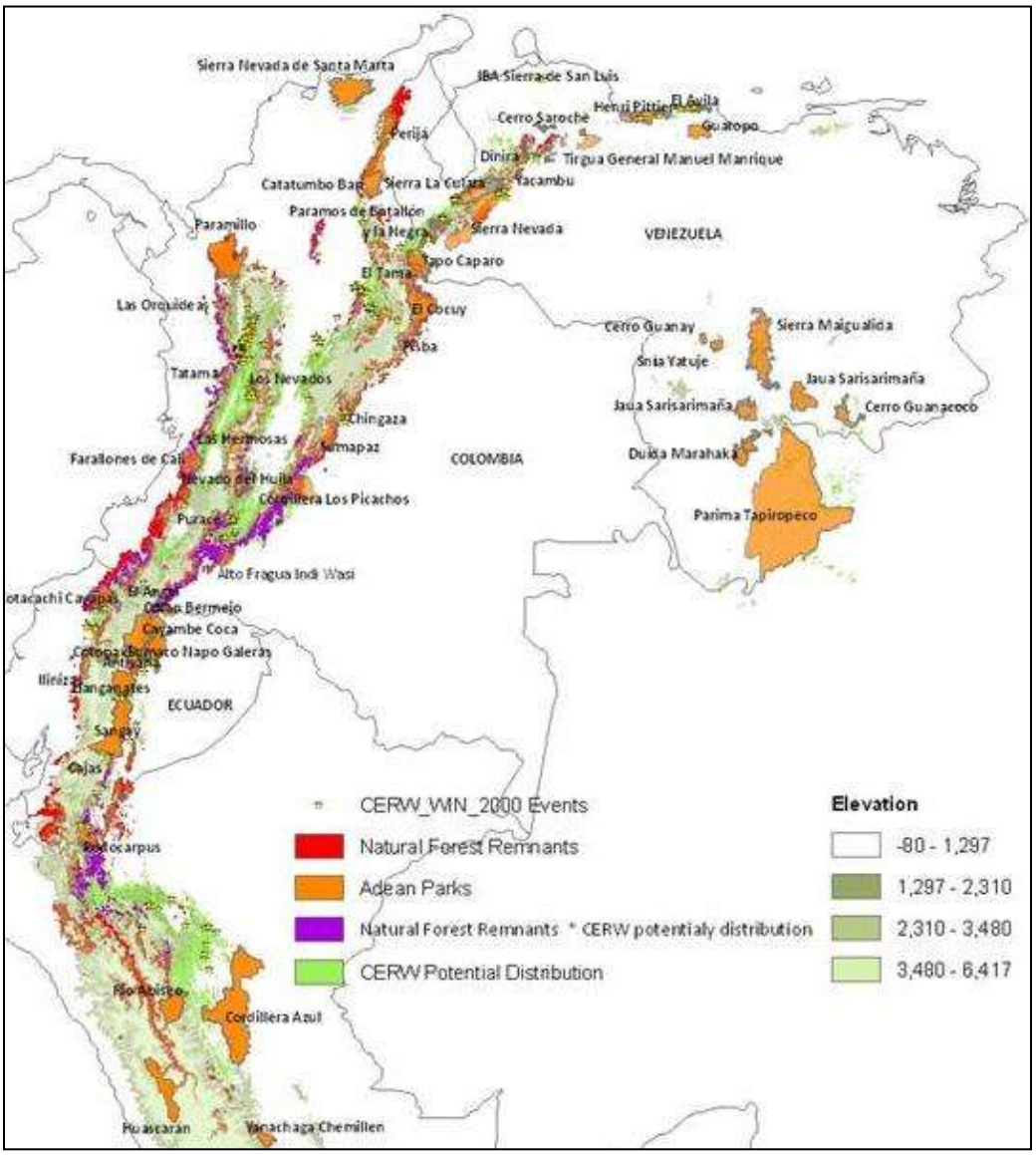

Figure 17. National Parks, protected areas, and forest remnants of the Northern Andes where Cerulean Warblers have been reported or may occur.

Table 1. Protected Areas where Cerulean Warbler has been reported or are potentially present. "IBA" indicates Important Bird Area, as defined by BirdLife International and local country representatives.

Country	Protected Area	Site Name	Cordillera	Confirmed (R)
Venezuela	Governmental	Juan Pablo Peñaloza	Mérida	**R**
Venezuela	Governmental	Tama	Mérida	
Venezuela	Governmental	Teta de Niquitao – Guirigay	Mérida	**R**
Venezuela	Governmental	Sierra la Culata	Mérida	**R**
Venezuela	Governmental	Gral. Cruz Carrillo en Guaramacal	Mérida	
Venezuela	Governmental	Dinira	Mérida	
Venezuela	Governmental	Perijá	Perijá	**R**
Venezuela	Governmental	Henri Pittier	La Costa	**R**
Venezuela	Governmental	Pico Codazzi	La Costa	**R**
Venezuela	IBA	San Rafael de Gusare	Perijá	
Venezuela	IBA	Sierra de San Luis	Falcón	**R**
Venezuela	IBA	Laguna de Boca Caño	Eastern	**R**
Colombia	Governmental	Catatumbo Bari	Eastern	
Colombia	Governmental	Tama	Eastern	
Colombia	Governmental	SFF Otun Quimbaya	Central	**R**
Colombia	Governmental	Paramillo	Western	
Colombia	Private	Reserva Natural de las Aves Reinita Cielo Azul	Eastern	**R**
Colombia	Private	Reserva Natural de las Aves El Paujil	Eastern	**R**
Colombia	Private	Reserva Natural de las Aves Pauxi pauxi	Eastern	**R**
Colombia	Private	Reserva Natural de las Anfibios Ranita Dorada	Central	**R**
Colombia	Private	Reserva Natural de las Aves Arrierito Antioqueño	Central	**R**
Colombia	Private	Reserva Natural de las Aves Las Tangaras	Western	**R**
Colombia	Private	Reserva Natural de las Aves El Dorado	Costa	**R**
Colombia	Private-IBA	Reserva Río Blanco	Central	**R**
Colombia	Governmental	Cueva de los Guacharos National Park	Central	**R**
Colombia	Governmental	Cordillera de los Picachos National Park	Eastern	**R**
Colombia	Private	Serranía de las Minas	Central	**R**
Colombia	Private-IBA	Cañón del Río Barbas y Bremen	Central	**R**
Colombia	Governmental	Bosques del Oriente de Risaralda	Central	**R**
Colombia	Private	Reserva Forestal Yotoco	Western	**R**
Colombia	Private	Bosque de San Antonio/Km 18	Western	**R**
Ecuador	Governmental	Cayamabe Coca	Eastern	
Ecuador	Governmental	Sangay	Eastern	**R**
Ecuador	Governmental	Llanganates	Eastern	
Ecuador	Governmental	Cotacachi Cayapas	Western	**R**
Ecuador	Private	Reserva Reinita Cerúlea - Narupa	Eastern	**R**
Ecuador	Private	Wild Sumaco Wildlife Sanctuary	Eastern	
Ecuador	Private	Rio Bigal Reserve	Eastern	
Ecuador	IBA	Cordillera de Huacamayos--Sierra Azul	Eastern	
Ecuador	IBA	Reserva Ecológica Antisana	Eastern	
Ecuador	IBA	Reserva Ecológica Cayambé Coca	Eastern	
Ecuador	Governmental	Parque Nacional Sumaco-Napo Galeras	Eastern	
Peru	IBA	Moyobamba	Eastern	
Peru	IBA	Rio Mataro	Central	
Peru	IBA	Alto Mayo	Eastern	

12. CERULEAN WARBLER NONBREEDING CONSERVATION PLAN

12.1 Conservation Plan Outline

The summary of research data on the Cerulean Warbler on its nonbreeding range has been vital towards formulating the conservation plan. Particular attention has been paid to the specific habitat preferences and accordingly discontinuous nonbreeding range across the Northern Andes, resulting from the two principal threats that challenge the survival of the species during the nonbreeding period:

1. Loss and fragmentation of Sub-Andean forests,
2. Loss of shade-grown coffee landscape.

During the 3rd Cerulean Warbler Summit in Bogotá in October 2008, participants contributed to the identification of the most important objectives and activities for the Cerulean Warbler conservation plan. Furthermore, previous conservation efforts for the Cerulean Warbler in the wintering range, albeit small in scale, have provided useful experience and results.

Based on our current knowledge of the Cerulean Warbler's nonbreeding ecology, together with detailed assessments published for the entire Andean region (Boyla and Estrada 2005) and for Colombia (Fundación ProAves 2009), we identified the key "hotspots" of known and/or modeled areas for the Cerulean Warbler across its nonbreeding range. These include many Important Bird Areas (IBAs) in the following regions:

Venezuela: Sub-Andean forested slopes and valleys around the Mérida Cordillera, principally areas of coffee in the States of Táchira, Mérida, Barinas, Portuguesa, Trujillo, and Lara.

Colombia: Sub-Andean forests and shade-grown coffee landscapes on the slopes of the Cauca and Magdalena valleys, particularly the Cauca Valley in Antioquia Department, the eastern slope of the Central Andes (Caldas, Huila and Tolima Departments), Serranía de San Lucas (Bolivar Dept), Serranía de Yariguíes, (Santander Dept), and the western slope of the Eastern Andes (Santander, Boyacá and Cundinamarca departments).

Ecuador: Sub-Andean forests within sheltered valleys on the eastern slope of the Andes (Napo, Zamora Chinchipe, Loja, and Morona Santiago Provinces).

Peru: Sub-Andean forests and coffee landscapes on the eastern slope of the Andes in northern Peru, especially in Lamas, Moyobamba, and Rioja Provinces in San Martín Department, as well as the Departments of Amazonas, Cajamarca and Huánuco.

12.1.1 Implementation

Many stakeholders and actors will be necessary to implement this conservation plan, from regional, national, and local government institutions; international, national, and local NGOs; communities; research institutions; and citizens. Many of these are already part of El Grupo Cerúleo and if not, can coordinate with it through this plan and the Group's webpage (www.GrupoCeruleo.org). We invite other institutions, agencies, and individuals to become involved in carrying out this plan. We recommend that actions be coordinated with El Grupo Cerúleo, and wish to encourage any contribution to achieving these objectives. We hope the following plan helps guide you to do that!

12.2 General Objective

This plan is a complement to the breeding ground conservation plan (USFWS 2007); together they aim to mitigate threats to the survival of the Cerulean Warbler. The goal of this conservation plan is to address the various conservation needs of the Cerulean Warbler on its nonbreeding range through three main strategies:

1. Habitat Conservation and Management
2. Education, Communication, and Partnership
3. Research and Monitoring

12.3 Habitat Conservation and Management Strategy

12.3.1 Habitat Management

Objective: Improve the capacity of existing landscapes to provide habitat for Cerulean Warbler while maintaining their economic productivity.

Actions:

- Maintain the extent and improve the quality of shade-grown coffee habitats within core Cerulean Warbler population areas.
- Promote the importance of shade-grown coffee to producers, consumers, certifiers and coffee industry.
- Monitor changes in shade-grown coffee area across Venezuela, Colombia, Ecuador, and Peru.
- Identify and map farms certified by Rainforest Alliance, Smithsonian Bird Friendly® Coffee, and other recognized certifiers.
- Clarify the economic benefits of shade-grown coffee to coffee farmers, extensionists, and others, in collaboration with local and regional cooperatives, and national coffee organizations.
- Encourage inclusion of shade-grown coffee and other conservation practices among additional certification programs.
- Identify market brands and certification labels favorable to Cerulean Warbler and other migratory bird species, such as Smithsonian Bird Friendly® Coffee, Cerulean Warbler Conservation Coffee, and others.
- Develop a marketing strategy in North America for certification labels that benefit the Cerulean Warbler and increase biodiversity in coffee growing landscapes.
- Promote additional incentives to coffee farmers to maintain shade, such as carbon credits and pricing structures that provide premiums to specialty coffees and certified crops.
- Assist shade-grown coffee farmers to achieve the requirements for certification.
- Develop management practices in shade-grown coffee farms that are favorable to Cerulean Warbler and other migratory and resident bird species and compatible with economic productivity of coffee and other products.
- Evaluate the effect on Cerulean Warblers and on biodiversity of alternative arrangements of forest cover within agroforestry and shade-grown coffee landscapes.
- Develop and demonstrate silvipasture systems compatible with Cerulean Warbler habitat and populations.
- Explore opportunities to increase silvicultural productivity of the shade-grown coffee landscape using tree species compatible with coffee production, as well as firewood and timber production.

12.3.2 Habitat Restoration

Objective: Restore habitats for Cerulean Warblers and improve connectivity within and between landscapes harboring the birds.

Actions:

- Influence local, regional, and national institutions responsible for environmental services and with obligations to reforest areas, so as to target key areas with reforestation efforts using appropriate tree species.
- Work with coffee cooperatives and industry to mitigate reductions in shade-grown coffee area with forest restoration in the same landscapes.
- Enhance the availability of high quality, genetically appropriate, nursery stock of native species for use in restoration efforts.
- Increase the quantity and quality of canopy tree cover around core populations of Cerulean Warblers, particularly in the buffer zones of key protected areas, and in fragmented landscapes.
- Identify key areas where habitat restoration can extend buffer areas or connect habitats with corridors or living fences.
- Conduct forest restoration using native tree species (especially species favored by Cerulean Warbler) within corridors, protected areas, buffer zones, watersheds, etc.
- Promote carbon accreditation and sequestration schemes that would finance and promote silvipasture agroforestry by farmers with sun coffee, pasturelands, or areas otherwise degraded.
- Identify opportunities to restore tree species such as *Quercus humboldtii* and *Colombobalanus excelsa* as Cerulean Warbler habitat in appropriate landscapes.

12.3.3 Habitat Protection

Objective: Expand the network of Protected Areas within core population areas of the Cerulean Warbler.

Actions:

- Work with Municipalities, coffee corporations, and regional and provincial governments to

protect Sub-Andean watersheds that provide environmental services and habitat for Cerulean Warblers.

- Build the capacity of NGOs and authorities to manage protected areas effectively and efficiently.
- Establish economic incentives for habitat protection, such as land tax exemptions for easements.
- Increase the area of optimal habitat under permanent protection to meet critical habitat needs.
- Target known core nonbreeding areas and sites for permanent protection, using tools that:
  - Expand current National Parks and Nature Reserves through declarations, agreements or private land acquisitions.
  - Work with existing landowners to establish private reserves, ecological easements or other methods of establishing local or national protected areas.
  - Acquire and protect critical areas under private ownership and at imminent risk of destruction.
  - Identify opportunities to improve protection status of IBAs in which Cerulean Warbler has been reported.
  - Identify and protect important migratory stopover sites and habitats in Central America.
- Undertake surveys of potentially important (predicted) areas with intact habitat for Cerulean Warblers that could be protected (as indicated in **12.5.1**).

12.3.4 Promote Ecotourism and Agrotourism in Key Areas

Objective: Provide social and economic incentives to responsible landowners, coffee farmers, and cooperatives and assist the sustainability of protected areas that contribute to the conservation of Cerulean Warbler though promoting a regional certification program for ecotourism and agrotourism.

Actions:

- Identify potential partners and areas within each country for ecotourism and agrotourism which can serve as models for protecting the Cerulean Warbler and other resident and migratory birds by attracting visitation to protected areas and thereby providing additional sources of income to local landowners and farm families.
- Develop a marketing strategy focused on traditional coffee farming and birding tourism in order to promote areas to the ecotourism and agrotourism industry.
- Assist farmers and protected areas to provide visitor facilities, trails and promotional materials.

12.4 Education, Communication and Partnership Strategy

12.4.1 Connect to Communities through Environmental Events and Programs

Objective: Develop and implement an environmental educational program directed towards rural communities located in key Cerulean Warbler nonbreeding areas, focused on inspiring people of all ages to learn about and appreciate the Cerulean Warbler and other resident and migratory birds and take part in their conservation.

Actions:

- Conduct environmental educational programs directed towards rural communities that highlight and celebrate the Cerulean Warbler and other species, their migration and their use of the rural landscape.
- Promote International Migratory Bird Day across the nonbreeding range (including stopover areas) through the distribution of materials and a coordinated effort to raise awareness within rural communities and through the press in each region and nation (www.birdday.org).
- Link schoolchildren in the nonbreeding range to schoolchildren in the breeding range of Cerulean Warbler through letter-writing exchanges; e.g., children in coffee-producing communities in the Andes with children in coal-mining areas in the Appalachians.
- Coordinate with national and international partners to develop and implement education and outreach plans and materials that create a sustained impact for people of all ages.
- Develop and evaluate effectiveness of strategies for reaching target audiences, such as TV and radio, schools, regional authorities, etc.

- Share successful techniques of existing environmental education programs among different institutions involved in outreach to local communities.
- Build the capacity of environmental education staff and school teachers through training courses.
- Disseminate existing print, graphic, and poster materials on the Cerulean Warbler, endemic species, and common local birds to rural and urban communities, using materials such as the BioCartas of CENICAFE, and outreach materials of other partners.
- Develop an education handbook about the Cerulean Warbler and its conservation for different age groups.
- Generate strategic alliances with governmental entities, private enterprises, and educational institutions at all levels (schools, universities).

12.4.2 Involve Communities through Citizen Science

Objective: Involve local communities, protected area staff, and students in citizen-science projects on the Cerulean Warbler and other resident and migratory birds to promote awareness and advance knowledge.

Actions:

- Disseminate techniques such as the Censos Participativos de Aves en las Zonas Cafeteras Colombianas of CENICAFE to individuals and communities throughout the nonbreeding range of Cerulean Warbler to improve citizen understanding and participation in biodiversity conservation.
- Compile ideas from existing sources into a handbook for educators, extensionists, and researchers to use with local people to stimulate searches for the Cerulean Warbler.
- Offer training courses on bird identification and monitoring for local people, extensionists, and protected-area managers.
- Connect communities in nonbreeding range with communities in the breeding range through donations of binoculars.
- Promote citizen involvement in Cerulean Warbler conservation activities, perhaps by using a strategic idea such as "Each time you see a Cerulean Warbler, think of the people at the other end of its range to whom it links you."
- Connect people to Priority Migrant eBird (ebird.org/plone/primig/) to register sightings of Cerulean Warblers and other priority species: Golden-winged Warbler (*Vermivora chrysoptera*), Blue-winged Warbler (*V. pinus*), Canada Warbler (*Wilsonia canadensis*), and Olive-sided Flycatcher (*Contopus cooperi*).

12.4.3 Partnerships: Strengthen El Grupo Cerúleo

Objective: Facilitate and coordinate research, conservation, and education/outreach activities among all interested participants in the conservation of the Cerulean Warbler.

Actions:

- Maintain El Grupo Cerúleo's webpage with up-to-date information (www.GrupoCeruleo.org)
  - Develop an e-mail list of those interested in conservation or research on the Cerulean Warbler.
  - Establish links to directories of experts in restoration, communication, and community education who can assist conservationists and researchers to carry out this plan.
- Promote awareness of conservation planning and implementation efforts on behalf of the Cerulean Warbler among potential donors to raise funds to finance recommended actions.
- Facilitate the exchange of biological and other information within and beyond the Andean region at national and international meetings such as the Neotropical Ornithological Congress, Specialty Coffee Association of America, and others.
- Continue periodic Cerulean Warbler Summits to present and discuss results.
- Promote the importance of universities in North America to assist researchers in Latin America with studies and projects on the Cerulean Warbler.

12.5 Research and Monitoring Strategy

12.5.1 Advance Knowledge of the Cerulean Warbler on the Nonbreeding Grounds

Objective: Improve understanding of the abundance, distribution, demography, ecology, and habitat use of the Cerulean Warbler across the nonbreeding range, including migratory patterns and at migration stopover sites.

Actions:

- Increase exploration for sites with Cerulean Warbler (to support **12.3**), specifically:
  - **Venezuela**: explore Sub-Andean forests in Dinira, Yacambu, Sierra Nevada and Sierra La Culata National Parks and their buffer zones.
  - **Colombia**: explore Sub-Andean forests in Serranía de San Lucas, Serranía de Perijá, Catatumbo-Barí National Park and the eastern slope of the Eastern Andes (Meta to Putumayo departments).
  - **Ecuador**: explore Sub-Andean forests on the eastern slope of the Andes, including Llanganates and Sangay National Parks, Cordillera del Cóndor and Podocarpus National Park.
  - **Peru**: explore Sub-Andean forests and coffee landscapes on the eastern slope of the Andes in San Martín, Amazonas, Cajamarca and Huánuco Departments.
- Estimate amount of nonbreeding habitat required to support the target population established by Partners in Flight (Rich e*t al.* 2004).
  - Refine and continue application of existing habitat model to understand and predict distribution and guide protection efforts.
  - Determine relative contributions of different countries in the nonbreeding range to meet that estimate.
- Determine the spatial scale that is most appropriate for conservation planning.
- Identify options for increasing connectivity between forest fragments in core population areas.
- Assess the contribution of nonbreeding season events to the annual cycle of Cerulean Warbler.
  - Obtain minimum adult and immature survival estimates, site fidelity, habitat-specific differences in site fidelity and condition, behavior, and other necessary data on vital rates using appropriate technologies.
  - Undertake stable isotope sampling across the nonbreeding range (through collection of one or more feathers from birds captured in banding operations) to link nonbreeding areas with breeding areas.
  - Determine the effects of local management practices on warbler population dynamics.
  - Clarify migratory routes in fall and spring seasons, stopover patterns and locations, timing of age and sex classes in passage, survivorship of individuals during migratory period
  - Determine whether sex and/or age segregation exists between habitats, elevations, or portions of the range.

12.5.2 Establish Optimal Requirements for the Cerulean Warbler in Shade-grown coffee

Objective: Evaluate optimal habitat requirements for the Cerulean Warbler within shade-grown coffee to develop technical recommendations for coffee farmers, certifiers, and consumers.

Actions:

- Conduct controlled field studies and adaptive management experiments required to develop habitat management activities identified in section **12.3**, above.
- Compare demographic characteristics and survivorship between natural forest and shade-grown coffee.
- Determine microhabitat preferences in shade-grown coffee plantations for Cerulean Warbler, including comparing abundance with different percentages of shade trees and shade tree diversity.
- Establish guidelines for producers and conservation managers for key tree species and appropriate densities for productive use as shade for coffee and habitat for migratory and resident birds.

12.5.3 Establish a Region-wide Standardized Cerulean Warbler Monitoring Program.

Objective: Monitor Cerulean Warbler population changes across the nonbreeding range.

Actions:

- Develop a monitoring plan that combines surveys at known sites with Cerulean Warblers to more extensive surveys across larger landscapes.
- Establish and publish online standardized monitoring protocols across the nonbreeding grounds.
- Enhance data collection by using tools such as e-Bird and the Avian Knowledge Network to engage a wide range of observers in order to increase the number of records for distribution mapping and analyses.
- Provide field-training courses to train people in monitoring protocols across Latin American countries.

13. PLAN DE CONSERVACIÓN DE LA REINITA CERÚLEA EN LOS TERRITORIOS DE NO-REPRODUCCIÓN

13.1 Esquema del Plan de Conservación

Para la formulación de este plan de conservación ha sido vital la compilación de los datos obtenidos a partir de las investigaciones realizadas sobre la Reinita Cerúlea en las áreas no reproductivas. Se ha prestado especial atención a las preferencias específicas de hábitat de la especie y el rango no reproductivo en el norte de los andes, así como a las dos principales amenazas que ponen en peligro la supervivencia de la especie durante el período no reproductivo:

1. La pérdida y fragmentación de los bosques Sub andinos.
2. La pérdida del paisaje de café con sombrío.

Durante la tercera Cumbre de la Reinita Cerúlea en Bogotá, en octubre de 2008, los participantes contribuyeron a identificar los objetivos y actividades más importantes para el plan de conservación de la Reinita Cerúlea. Por otra parte, los esfuerzos previos para la conservación de la Reinita Cerúlea en Ecuador y Colombia, aunque de pequeña escala, fueron muy valiosos.

Basados en la información que existe acerca de la ecología de Reinita Cerúlea en las áreas no reproductivos junto con una evaluación detallada publicada para la región andina (Boyla y Estrada 2005) y para Colombia (Fundación ProAves 2009), se identificaron las principales áreas conocidas y/o potenciales para la Reinita Cerúlea en su rango de distribución durante la temporada no reproductiva. Esas incluyen varias áreas importantes:

Venezuela: laderas de Bosque Subandino y Valles de la Cordillera de Mérida, especialmente los paisajes de café en los estados de Táchira, Mérida, Barinas, Portuguesa, Trujillo y Lara.

Colombia: Bosques Subandinos y paisajes de café con sombrío en las laderas de los valles del Cauca y Magdalena, en particular las laderas del valle del Cauca en el Departamento de Antioquia, la vertiente oriental de la Cordillera Central (Departamentos de Caldas, Huila y Tolima), la Serranía de San Lucas (Departamento de Bolívar), la Serranía de los Yariguíes (Departamento de Santander), y la vertiente occidental de la Cordillera Oriental (Departamentos de Santander, Boyacá y Cundinamarca.

Ecuador: Bosques Subandinos dentro de los valles protegidos en la vertiente oriental de los Andes (Provincias de Napo, Zamora-Chinchipe, Loja, Morona-Santiago).

Perú: Bosques Subandinos y paisajes de café en la vertiente oriental de los Andes en el norte de Perú, especialmente en las provincias de Lamas, Moyobamba, Rioja y en el Departamento de San Martín, así como los Departamentos de Amazonas, Cajamarca y Huánuco.

13.1.1 Implementación

Hay varios tomadores de decisiones y actores interesados que podrían poner en práctica este plan de conservación. Desde las instituciones regionales, nacionales y locales, ONGs, institutos de investigación y los ciudadanos en general. Muchas de estas personas ya forman parte del Grupo Cerúleo y en caso de no hacer parte están invitados a vincularse y aprender más sobre él a través de la página web: www.GrupoCeruleo.org.

Para cada objetivo, se van a mencionar algunas instituciones (en orden alfabético) que ya han demostrado su liderazgo en el objetivo, pero esto de ninguna manera sugiere que los demás no deben involucrarse, asumir el liderazgo e impulsar acciones en diferentes temas a nivel local, regional y nacional. En general, se recomienda que las acciones se coordinen con el Grupo Cerúleo, pero esto no limitará o restringirá sus acciones de ninguna forma.

Finalmente, se anima a todos a colaborar de alguna manera en la conservación de la Reinita Cerúlea y se espera que el siguiente plan sea de ayuda para este fin.

13.2 Objetivo General

El objetivo de este plan consiste en complementar el plan de conservación para las áreas reproductivas, (USFWS 2007) el cual pretende ayudar a disminuir las amenazas que sitúan en peligro la supervivencia de la Reinita Cerúlea. Este plan de conservación abordará las diferentes necesidades de conservación de la Reinita Cerúlea a través de tres estrategias principales:

1. Estrategia de Manejo y Conservación del Hábitat.
2. Educación, Comunicación y Estrategia de conformación de alianzas.
3. Estrategia de Monitoreo e Investigación.

13.3 Estrategia de Manejo y Conservación del Hábitat

13.3.1 Manejo del Hábitat

Objetivo: Promover la restauración de hábitat y la conectividad del paisaje para la Reinita Cerúlea mientras se mantiene su productividad económica.

Acciones:

- Mantener la extensión y mejorar la calidad del café sombrío dentro de las áreas núcleo de las poblaciones de la reinita cerúlea.
- Promover la importancia del café sombrío a productores, consumidores, certificadores y la industria del café.
- Monitorear los cambios en la cobertura de café sombrío en Venezuela, Colombia, Ecuador y Perú.
- Identificar y realizar mapas de las fincas certificadas por RAINFOREST ALLIANCE, BIRD FRIENDLY COFFEE y otros reconocidos certificadores.
- Clarificar los beneficios económicos del café sombrío a agricultores de café, extensionistas y otros en colaboración con cooperativas locales y regionales, junto a organizaciones cafeteras.
- Promover la inclusión del café sombrío y otras prácticas de conservación junto con programas adicionales de certificación.
- Identificar marcas comerciales y certificadores que favorezcan la Reinita Cerúlea y otras aves migratorias, como el Smithsonian Bird Friendly Coffee, Cerulean Warbler Conservation Coffee, entre otros.
- Desarrollar una estrategia de mercadeo en Norteamérica para etiquetas de certificación que beneficien la reinita cerúlea e incremente la biodiversidad en paisajes con producción de café.
- Promover esquemas de acreditación de stocks de carbono entre los cultivadores de café a libre exposición, pastizales y otras áreas degradadas que puedan servir como fuentes de financiación para la promoción de sistemas silvipastoriles.
- Ayudar y asistir a agricultores de café para que logren cumplir los requerimientos para la certificación.
- Desarrollar prácticas de manejo en fincas que posean café sombrío que sean favorables para la reinita cerúlea, otras migratorias y aves residentes con el fin de que sean compatibles con la productividad económica y otros productos.
- Evaluar los efectos de los diferentes arreglos de la cobertura vegetal con procesos silviculturales y paisajes de café sombrío. sobre las poblaciones de reinita cerúlea y la biodiversidad.
- Desarrollar y demostrar que los sistemas silvipastoriles son compatibles con los hábitats de la reinita cerúlea y sus poblaciones.
- Explorar oportunidades para incrementar la productividad silvicultural de los paisajes de café sombrío usando especies de árboles compatibles con la producción de café así como también para leña.

13.3.2 Restauración del hábitat

Objetivo: restaurar hábitats para la reinita cerúlea y mejorar la conectividad dentro y entre los paisajes que acogen las aves.

Acciones:

- Influenciar instituciones locales, regionales y nacionales responsables por los servicios ambientales y con obligaciones de reforestar áreas para que sean áreas claves para implementar procesos de reforestación usando las especies de árboles apropiados.

- Trabajar con cooperativas cafeteras y la industria para mitigar la reducción de café sombrío con restauración de bosques en los mismos paisajes.
- Mejorar la disponibilidad de especies nativas de alta calidad, genéticamente apropiadas en los viveros para que puedan ser usadas en los procesos de restauración.
- Incrementar la cantidad y calidad de la cobertura de dosel en el núcleo de las poblaciones de la reinita cerúlea, particularmente en las zonas de amortiguación de las áreas protegidas y en paisajes fragmentados.
- Identificar áreas claves donde la restauración del hábitat puede extenderse a áreas de amortiguación y conectar hábitats con corredores y cercas vivas.
- Reforestar con especies de árboles nativas (especialmente aquellas especies que utiliza la Reinita Cerúlea) en los corredores, áreas protegidas, zonas de amortiguamiento, cuencas, etc.
- Promover esquemas de acreditación de stocks de carbono entre los cultivadores de café a libre exposición, pastizales y otras áreas degradadas que puedan servir como fuentes de financiación para la promoción de sistemas silvipastoriles.
- Identificar oportunidades de restaurar con especies arbóreas tales como *Quercus humboldtii* y *Colombobalanus excelsa*, para el hábitat de la reinita cerúlea y sus apropiados paisajes

13.3.3 Protección del hábitat

Objetivo: Ampliar la red de áreas protegidas dentro de las áreas núcleo de la población de la Reinita Cerúlea.

Acciones:

- Trabajar con las municipalidades, corporaciones cafeteras y gobiernos nacionales y regionales para proteger las cuencas hidrográficas que proveen servicios ambientales y hábitat para la reinita cerúlea.
- Aumentar la capacidad de las ONGs y autoridades gubernamentales para gestionar de manera eficaz y eficiente las áreas protegidas.
- Establecer incentivos económicos para la protección del hábitat, como exenciones de impuestos para las servidumbres ecológicas.
- Crear un área de hábitat de calidad protegida bajo el estatus de protección permanente para satisfacer las necesidades críticas de hábitat.
- Enfocarse en las áreas núcleo de su rango de distribución no reproductivo utilizando herramientas como:
- Ampliación de los Parques Nacionales y Reservas Naturales a través de sentencias, acuerdos o adquisiciones de tierras privadas.
- Trabajar con los propietarios actuales para la creación de reservas privadas, servidumbres ecológicas u otras figuras de protección local o nacional.
- Adquirir y proteger las áreas críticas que estén en riesgo inminente de destrucción por medio de la compra de tierras.
- Identificar oportunidades para mejorar la protección del estatus de las áreas protegidas en las cuales la reinita cerúlea ha sido reportada.
- Identificar y proteger importantes sitios de paradas de las aves migratorias y hábitats en Centroamérica.
- Realizar muestreos en áreas importantes (de acuerdo al modelo de distribución potencial) que presentan un hábitat óptimo para la población y que puedan ser protegidas (asi como se indica en la sección **13.5.1**).

13.3.4 Promover el ecoturismo y el agroturismo en áreas clave

Objetivo: Proporcionar incentivos sociales y económicos a los cultivadores y cooperativas de café así como ayudar a la sostenibilidad de las áreas protegidas que contribuyen a la conservación de la Reinita Cerúlea a través de la promoción de un programa de certificación regional para el ecoturismo y el agroturismo.

Acciones:

- Identificar posibles socios y áreas dentro de cada país que puedan ser de interés para desarrollar actividades de ecoturismo y

agroturismo que permitan obtener ingresos adicionales para ayudar a los agricultores y a las áreas protegidas y que a su vez sirvan como modelos para la protección de la Reinita Cerúlea y otras especies de aves residentes y migratorias.
- Desarrollar una estrategia de marketing con el fin de promover áreas de interés para la industria del ecoturismo y agroturismo, con un enfoque en la agricultura tradicional del café y el aviturismo.
- Ayudar a los agricultores y a las áreas protegidas a adecuar las instalaciones para los visitantes con senderos y material de promoción.

13.4 Educación, Comunicación y Estrategia de Alianzas

13.4.1 Conectar a las comunidades a través de eventos y programas medioambientales

Objetivo: Desarrollar e implementar un programa de educación ambiental dirigido a las comunidades rurales ubicadas en las zonas clave de las áreas no reproductivas, con el propósito de motivar a la gente de todas las edades a aprender más acerca de la Reinita Cerúlea y otras especies de aves residentes y migratorias y a participar activamente en su conservación.

Acciones:

Programas de educación ambiental dirigidos a las comunidades rurales que destaquen y celebren la migración de la Reinita Cerúlea y demás especies de aves migratorias:

- Promover el Día Internacional del Ave Migratoria (IMBD, por sus siglas en inglés) en todo su rango de distribución no reproductiva incluyendo los sitios de parada, a través de la entrega de materiales y de un esfuerzo coordinado para crear conciencia en las comunidades rurales por medio de los medios de comunicación de cada país. (www.birdday.org).
- Unir niños de colegio ubicados en el rango de no reproducción con niños de colegio que se encuentran en la zona de reproducción de la reinita cerúlea a través de intercambio de cartas escritas, por ejemplo, niños en comunidades productoras de café en los Andes con niños en áreas de minería en los Apalaches.
- Coordinar con los socios nacionales e internacionales el desarrollo e implementación de planes de educación, divulgación y elaboración de materiales que creen un impacto sostenido en personas de todas las edades.
- Desarrollar estrategias para llegar al público objetivo utilizando diferentes medios de comunicación como la televisión y la radio, así como por medio de las escuelas, autoridades regionales, etc.
- Compartir las técnicas exitosas de los programas de educación ambiental existentes entre las diferentes instituciones comprometidas en alcance de las comunidades locales.
- Capacitar el personal de educación ambiental y los profesores a través de cursos de formación.
- Entregar los materiales impresos gráficos y afiches ya existentes acerca de la reinita cerúlea, especies endémicas y aves locales a comunidades rurales y urbanas, usando materiales tales como “BioCartas de CENICAFE” y los materiales de alcance de otras organizaciones.
- Elaborar un manual de educación sobre la Reinita Cerúlea y su conservación para diferentes edades.
- Generar alianzas estratégicas con entidades gubernamentales, empresas privadas e instituciones educativas en todos los niveles (escuelas, universidades).

13.4.2 Participación de las comunidades a través de ciencia comunitaria

Objetivo: Involucrar a las comunidades locales, el personal de áreas protegidas y estudiantes en proyectos de ciencia comunitarios sobre la Reinita Cerúlea y demás especies de aves migratorias y residentes para crear conciencia y fomentar el conocimiento acerca de la especie.

Acciones:

- Socializar técnicas tales como Censos Participativos de Aves en las Zonas Cafeteras Colombianas de CENICAFE a individuos y

comunidades ubicadas en las zonas no reproductivas de las reinita cerúlea para mejorar el conocimiento ciudadano y la participación en la conservación de la biodiversidad.

- Establecer un manual para profesores e investigadores para ser utilizado con la población local con el fin de estimular la búsqueda de la Reinita Cerúlea.
- Realizar cursos de capacitación sobre monitoreo de aves migratorias para la población local y los administradores de áreas protegidas.
- Acercar a las comunidades y promover el interés sobre la especie por medio de las donaciones de binoculares y otros materiales.
- Promover el programa por medio de ideas estratégicas como "Cada vez que veas una Reinita Cerúlea, pide un deseo y ella lo llevará a alguien, en algún lugar del planeta."
- Promover uso de del Portal de Aves Migratorias Prioritarias e-Bird (ebird.org/plone/primig/) para registrar los avistamientos de especies de interés como: *Vermivora chrysoptera*, *Vermivora pinus*, *Wilsonia canadensis* y *Contopus cooperi*.

13.4.3 Alianzas: fortaleciendo El Grupo Cerúleo

Objetivo: Facilitar y coordinar la investigación, conservación y actividades de educación y divulgación entre todos los actores interesados en la conservación de la Reinita Cerúlea.

Acciones:

- Mantener la página web de Grupo Cerúleo actualizada (www.GrupoCeruleo.org)
- Elaborar una lista de correo para los interesados en realizar proyectos de conservación o investigación sobre la Reinita Cerúlea.
- Establecer un directorio de expertos que puedan asistir a los conservacionistas e investigadores.
- Desarrollar y facilitar reuniones nacionales e internacionales para el intercambio de información en la región Andina y con Norteamérica.
- Desarrollar eventos en asocio con otras reuniones para presentar y discutir los resultados.
- Promover la importancia de que las Universidades de Norteamérica asistan a los investigadores en Latinoamérica con los estudios y proyectos sobre la Reinita Cerúlea.
- Crear conciencia acerca de la situación y divulgar el presente Plan de Conservación entre los potenciales donantes de Norteamérica para ayudar a financiar las acciones recomendadas.

13.5 Investigación y estrategia de monitoreo

13.5.1 Avanzar en el conocimiento de la Reinita Cerúlea en las áreas no reproductivas.

Objetivo: Realizar estudios avanzados sobre abundancia, distribución y demografía de la Reinita Cerúlea en las áreas no reproductivas, incluyendo los sitios de parada durante la migración de primavera.

Acciones:

- Aumentar las exploraciones de la Reinita Cerúlea en diferentes sitos tales como:
  - **Venezuela**: explorar los bosques Subandinos en Dinira, Yacambú, en los Parques Nacionales de Sierra Nevada y Sierra La Culata así como en sus zonas de amortiguamiento.
  - **Colombia**: explorar los bosques Subandinos en la Serranía de San Lucas, la Serranía de Perijá de, el Parque Nacional Catatumbo-Barí, y la vertiente oriental de la Cordillera Oriental (Departamento de Meta al Putumayo).
  - **Ecuador:** explorar los bosques Subandinos de la vertiente oriental de los Andes, incluyendo los Parques Nacionales Llanganates y Sangay, la Cordillera de Cóndor y el Parque Nacional Podocarpus.
  - **Perú:** explorar los bosques Subandinos y paisajes de café en la vertiente oriental de los Andes en los Departamentos de San Martín, Amazonas, Cajamarca y Huánuco.
  - Estimar la cantidad de de hábitat de no reproducción requerido para mantener la población clave establecida por Compañeros en vuelo (Rich e*t al.* 2004).

- Refinar y continuar con la aplicación del modelo existente de hábitat para entender y predecir la distribución y guiar los esfuerzos de protección.
- Determinar las contribuciones de los diferentes países ubicados en el rango no reproductivo para saber el estimado.

- Determinar la escala espacial más apropiada para la planificación de la conservación.
- Identificar si es posible la conectividad entre fragmentos de bosque en las áreas núcleo de población.
  Evaluar la contribución de los eventos que se realizan en la temporada no reproductiva al ciclo anual de la reinita cerúlea.
- Hacer telemetría de los individuos para obtener estimaciones de supervivencia de adultos y juveniles, fidelidad de territorio, diferencias específicas de hábitat en estos territorios vs condición física del ave, estudios de comportamiento, entre otros.
- Llevar a cabo muestreos de isótopos estables en las áreas no reproductivas (a través de muestreos de una o más plumas de las aves capturadas en anillamiento) y relacionarlas con las áreas reproductivas.
- Determinar los efectos de los planes de manejo en la dinámica de la población. Determinar si hay segregación altitudinal o de hábitat o por sexo y/o edad.
- Clarificar las rutas migratorias en temporadas otoño y primavera, patrones de paradas y locaciones, sincronización de edad y clases de sexo y supervivencia de individuos durante el periodo migratorio.

13.5.2 Establecer las necesidades óptimas para Reinita Cerúlea en los cultivos de café de sombrío.

Objetivo: Evaluar las necesidades óptimas de hábitat para la Reinita Cerúlea en el café con sombrío con el fin de darles recomendaciones técnicas a cultivadores de café, certificadores y consumidores.

Acciones:

- Conducir estudios de campo controlado y experimentos de manejo adaptativo requeridos para desarrollar actividades de manejo de hábitat identificadas en la sección 13.3.
- Comparar las características demográficas y de supervivencia entre los bosques naturales y el café con sombrío.
- Determinar las preferencias de microhábitat de la Reinita Cerúlea en las plantaciones de café con sombrío, incluyendo comparaciones de abundancia de la especie vs. diferentes porcentajes de cobertura y diversidad.
- Establecer una guía de las especies de árboles clave y su densidad para ser utilizado como referencia entre los planificadores de la conservación.

13.5.3 Establecer un programa de monitoreo estandarizado en las áreas no reproductivas.

Objetivo: Monitorear los cambios en la población Reinita Cerúlea en las áreas no reproductivas.

Acciones:

- Desarrollar un plan de monitoreo que combine muestras de sitios conocidos donde se encuentre la reinita cerúlea a muestras más extensivas a lo largo de paisajes más amplios.
- Mejorar las colecciones de datos usando herramientas ales como e-birds and la red de conocimiento aviar para compromete u amplio rango de observadores con el fin de incrementar el número de archivos de distribución, mapas y análisis.
- Establecer y publicar en línea los protocolos de monitoreo estandarizados para las áreas no reproductivas.
- Ofrecer cursos de formación en campo para entrenar a las personas en los protocolos de monitoreo en los países latinoamericanos.

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