THE CURRENT STATUS OF THE CERULEAN WARBLER ON ITS WINTER RANGE

Maria Isabel Moreno¹, Paul Salaman², and David Pashley²
¹Fundación ProAves Colombia (www.proaves.org)
²American Bird Conservancy (www.abcbirds.org)
August 2006

CONTENTS

INTRODUCTION ................................................................................................................................. 2
METHODS....................................................................................................................................... 2
DISTRIBUTION AND ECOLOGY ON THE WINTERING RANGE .................................................... 2
  Summary ..................................................................................................................................... 2
  Winter Range and Habitat Requirements ................................................................................... 3
  Social Behavior .......................................................................................................................... 3
  Non-breeding Season Distribution Models ................................................................................ 3
  Changes in Distribution .............................................................................................................. 4
PRESENT AND POTENTIAL WINTER HABITAT LOSS ............................................................... 4
  Forest Loss ............................................................................................................................... 4
  Conservation .............................................................................................................................. 5
CONCLUSIONS ............................................................................................................................. 6
ACKNOWLEDGMENTS .................................................................................................................. 6
REFERENCES .............................................................................................................................. 7
BIBLIOGRAPHY ........................................................................................................................... 8
FIGURES ....................................................................................................................................... 9
TABLES ....................................................................................................................................... 15
APPENDICES ............................................................................................................................. 17
CONTACTS ..................................................................................................................................... 21
INTRODUCTION

Fundación ProAves and American Bird Conservancy (ABC) assisted the U.S Fish and Wildlife Service with an assessment of the current status of the Cerulean Warbler and its associated habitats in its wintering range. Project objectives included compilation of all available relevant information from South America and establishment of a database with all sources of information and contacts.

Major results include:
- A summary of all biological information available for the species,
- A detailed, though preliminary, description of potential wintering range across the Andes,
- An assessment of preferred habitat in the wintering range, and
- An assessment of landscape changes in the Andes that may affect the species.

METHODS

Available relevant literature in Spanish on Cerulean Warbler and its habitat was compiled and translated into English. Biologists from countries where the species has been recorded in South America (Colombia, Venezuela, Peru, and Bolivia) were asked to contribute additional written information and government documents. The contacts included representatives from governmental agencies and non-governmental organizations. Information gleaned in this manner was recorded in a database.

Working with the Cerulean Warbler Technical Group, Fundación ProAves and ABC compiled all historical and recent data on Cerulean Warbler in Latin America for the analysis presented in this document.

DISTRIBUTION AND ECOLOGY ON THE WINTERING RANGE

Summary

The Cerulean Warbler (Dendroica cerulea) is one of the most threatened (Vulnerable by IUCN 2006) Nearctic migrant passerines that winters in South America.

The Cerulean Warbler has been considered to range at low densities across large areas of the Northern Andes. However, our data analysis, predicted range modeling, and target follow-up research has revealed that the species is actually quite selective in its ecological preferences. It appears to prefer specific climatic conditions, such as cooler lower subtropical clines with moderate rainfall levels. These conditions are highly correlated with coffee production areas of the Northern Andes, particularly the intermontane valleys of central Colombia, source of more than 50% of all non-breeding records.

For over a century, these intermontane valleys in Colombia have been intensively farmed. Little or no intact native forest remains, and what does remain is unprotected. Traditionally, the dominant agriculture in this region has been Arabica coffee grown as an understory crop under agro-forestry systems using a diversity of canopy tree species to create shade conditions. These shade coffee conditions have suited wintering Cerulean Warblers. Unfortunately, however, shade coffee agro-forestry practices currently are being rapidly converted to higher-yielding sun-coffee varieties following a market collapse in retail prices and national policy aimed at maximizing production. While no comprehensive figures exist on shade to sun conversion rates, one key Cerulean Warbler stronghold has lost over 80% of its shade canopy cover. It is our conclusion that the lack of native forest in valleys preferred by Cerulean Warblers and the rapid pace of changing agricultural practices place the species at increasing risk on its wintering grounds in the northern Andes.
Winter Range and Habitat Requirements

Throughout its entire range in South America, Cerulean Warbler is an uncommon winter resident (October-February) of northern Andean forests. This habitat consists of tall forest canopy and forest borders, particularly in broadleaf evergreen forests and in shade coffee plantations in the lower subtropics and premontane forest of the Andes from Colombia to Peru, possibly to Bolivia, and, at least hypothetically (based on a single record), in the tepui region of Venezuela. The species typically occurs at elevations from 500-1500 m, reaching higher in the northern portion of the range than in the south (Hilty and Brown 1986, Robbins et. al 1992, Jones et. al 1992, Hamel 2000).

Cerulean Warbler is a canopy and subcanopy dweller with insectivorous feeding habits and behavior (Colorado et. al 2006). The species uses primary forests as well as mature shade coffee and other agroforestry crops like cacao and cardamom, especially in areas where the remnant forest is scarce or absent in its restricted elevation range (Colorado & Cuadros 2004, Hamel & Jones 2005, Moreno et. al 2006). Intensive surveys have shown that the species is not equally distributed across its potential range (Moreno et. al 2006). The probability of detecting a larger number of individuals is correlated with the amount of available habitat and its quality (type, structure, and area) within specific conditions of elevation, temperature (19-23 ºC), and precipitation (Moreno et. al 2006). In its preferred habitat, it is possible to find Cerulean Warbler with reasonable regularity (Moreno et. al 2006). In dense forest habitat the birds may be overlooked because they are mostly silent and it is more difficult to observe them here than in a shaded plantation. In a few core areas the Cerulean Warbler showed intra- and inter-seasonal site fidelity to a particular wintering location (Colorado & Cuadros 2004, Moreno et. al 2006).

Social Behavior

Cerulean Warbler is usually a member of mixed species flocks, although it is not restricted to this behavior. It exhibits few interactions with other flock members (Colorado et. al 2006). Some ecological studies suggest that it is more sedentary and solitary during the rainy season (October – November) when there is a greater abundance of food available and more mobile and gregarious later (January – March) when available food resources diminish and the birds have to move and join flocks to increase foraging success (Ramoni-Perazzi 2005).

Non-breeding Season Distribution Models

Grupo Cerúleo members of the Cerulean Warbler Technical Group (including ProAves and ABC) have studied Cerulean Warbler winter distribution and habitat records since 2003. The winter range of Cerulean Warbler includes the Northern Andes in Colombia, Venezuela, Ecuador, and northern Peru. There are also a few records from southern Peru and northernmost Bolivia. The species occurs primarily at middle elevations on humid forested slopes of the Andes (Figure 1), with 79.4% of 220 records between 800 and 1600 meters (median 1,350 m). The species is absent from the wettest and driest slopes (e.g., Chocó and Tumbesian). This elevation range is highly correlated with the principal areas of coffee production.

We used Cerulean Warbler records from October to February and MAXENT 2.2 (Phillips et al. 2006) to develop a climatic model of the potential non-breeding distribution of the species. Data layers with a resolution of 1 km² came from the Grupo Cerúleo CERW Latin America Database. We created 10 bioclimatic layers of temperature and precipitation (WorldClim—http://www.worldclim.org) for the winter period and combined these with a discrete vegetation cover layer (GlobalVegetationMonitoringUnit—http://www-gvm.jrc.it/glc2000/) for the model. The program was set to use the automatic features option and default regularization values (Phillips et al. 2006). We call the resulting modeled potential distribution of Cerulean Warbler the “original” distribution. We then clipped the original non-breeding distribution with a vegetation layer of current forest within
the study area to create a model of “current” distribution. Model performance was evaluated using receiver operating characteristic (AUC) curves (Fielding & Bell 1997).

Winter sites at which Cerulean Warblers have been recorded most frequently were characterized by warm temperatures (winter mean temperature), low seasonality, and intermediate mean diurnal and annual temperature ranges (Figure 2) and precipitation at the lower end of the precipitation range (Figure 3) with intermediate seasonality. Broadly, these variables coincide with conditions that the species finds in its breeding range. With a high AUC value (0.970±0.010), the model was a successful predictor of the presence and absence of Ceruleans (Figure 4). The most important predictors for its winter distribution were the minimum temperature of the coldest month and seasonal precipitation.

The climatic model for Cerulean Warbler winter distribution predicted presence of the species across the northern Andes. However, it also predicted occurrence in areas outside its known winter range, including an area from southern Mexico to northern Panama, the tepuis of Venezuela, and the Caribbean from eastern Cuba, Jamaica, Haiti and Dominican Republic throughout the Lesser Antilles. These out-of-range predictions comprise commission errors (over-prediction). For our subsequent analyses, we restricted the area of study to the countries of the Northern Andes ecoregion.

**Changes in Distribution**

Comparison of the “original” (potential range inferred from climatic variables of record locations) and “current” (portion of the original range on which appropriate vegetation still occurs) model distributions suggests a loss of nearly 60% of suitable Cerulean Warbler habitat in the Northern Andes (Table 1, Figure 5). GIS analysis comparing the “original” and “current” coverages revealed an increase in fragmentation across the species range: number of patches more than doubled (increased by 117%), total edge increased by 29%, and edge density more than tripled (increased by 229%) while mean patch size decreased by 81.5% (Table 1). Eighty-five percent of the species’ modeled current distribution occurs in the remaining dense evergreen and closed-canopy evergreen tropical forests (Table 2).

We feel that the modeled distribution is actually far too general, however, and fails to take into account Cerulean Warbler’s specific ecological preferences. Source data may also have included sporadic, occasional, and passage records rather than only records from core wintering locations. Those of us with extensive experience with Cerulean Warbler in the field believe that it is more likely that less than 10% of its original intact natural forest and coffee agro-forestry habitats remain and that these remaining areas are being rapidly lost to habitat conversion. In addition, there are currently no state protected areas in the core of the wintering range of the species.

**PRESENT AND POTENTIAL WINTER HABITAT LOSS**

**Forest Loss**

The original vegetation cover in the Northern Andes has been drastically transformed. Documentation of landscape transformation varies among countries, but there is general agreement on the causes behind the transformation, including colonization/human settlement, infrastructure and development projects, mine and/or petroleum exploitation, and wood cutting for fuel. There are few figures that accurately reflect annual Andean deforestation rates,, in part because existing analyses have been performed at different levels of detail and under different vegetation classification systems and therefore are not comparable. The most reliable estimates come from Venezuela, Ecuador, and Colombia and range from 200 to 600 thousand hectares per year in recent time periods. In general, reforestation does not keep pace with deforestation.
Fires are the most important natural cause of transformation. Lack of appropriate management plans, inability to influence management on non-public land, and lack of capacity to control the boundaries of protected areas have resulted in unsustainable use of natural resources (FAO.2006, FAO & INRENA 2005, FAO & IDEAM 2005, Rodríguez 2005, Rodríguez et al 2004, IDEAM 2001, FAO 1999).

In the Colombian Andes, only 9.6% of the 2,763,523 ha of original forest within the 1500–2000 m elevation range remains (Rodriguez et al. 2004). Approximately 870,000 hectares between 800–2000 m on the three Andean cordilleras are currently devoted to coffee production on coffee farms averaging 2 ha in size. The valley of the Cauca River between the Central and Western cordilleras is Colombia’s main coffee region. In 2000, only 26% of this entire coffee region comprised natural ecosystems, and much of that natural area was forest above 2,000 m in elevation. Traditional agriculture in the Colombian Andes has transformed mountain ecosystems into rural landscapes. In most of this area, elements of agricultural landscapes are the only alternative for biodiversity conservation, as there are very few fragments of natural ecosystems remaining (Armenteras et al. 2005).

In the inter-Andean region of Ecuador, only 7% of original forest cover (805,000 ha) survived in 1999. The forest cover in the Sierra region of Peru has been reduced by 32% in the last 20 years (FAO & INRENA 2005). In Venezuela, a great percentage of remnant forests are restricted to regions with pronounced slopes since these slopes were a physical obstacle to transformation. Otherwise, flat and moderately sloped areas were all transformed. This pattern results in a drastic decrease in habitat heterogeneity that is evident throughout the Andean system (Rodríguez 2005).

Conservation

Very little of the original forest preferred by Cerulean Warbler survives intact, and many current records occur within agro-forestry systems (human-altered landscapes) that are rapidly undergoing conversion to more intense non-canopy production unsuitable for the species. Since the species’ preferred wintering areas traditionally have been the most sought-after agricultural farmland areas of the Andes (coffee production, livestock, etc), those areas are almost entirely unprotected by state or regional reserves.

The growing level of awareness and worldwide interest in generating forest protection mechanisms is encouraging. However, current land protection is largely restricted to areas of low commercial value and wilderness areas. The particular requirements of the Cerulean Warbler suggest alternative approaches: (1) encouraging small private protected areas where natural habitat remains, and (2) sustaining traditional shade-dominated agro-forestry systems.

The modeled distribution of the Cerulean Warbler suggests that as much as 15% of its potential range falls within protected areas (Appendix 1), most of which are in Colombia and Venezuela (Figure 1). However, surveys and records do not indicate occurrence of the species within those areas (despite the fact that surveys are usually biased toward protected areas). Hence the suggestion that 15% of Cerulean habitat is under state protection is misleading. In addition, we have no evidence that there is anything resembling a population stronghold within any existing state protected area.

The species is predicted to occur in 47 Important Bird Area (IBA) and 6 Alliance for Zero Extinction (AZE, www.zeroextinction.org) sites, although many of those sites remain unprotected or inadequately protected (Appendix 2).

A partial version of the “Forest Law for Natural and Protected Areas” is being applied in Ecuador. This law still contains various weaknesses in need of improvement (Zúñiga 1999). In Venezuela, wood extraction is controlled by the government and requires a special permit on both private and public land. Wood extraction from natural reserves is based on management plans that are given to managers through long-term agreements (Ministerio del Ambiente y de los Recursos Naturales...
Renovables 1999). In Colombia, various plans, programs, and laws address protection of forest resources, ranging from the “National Plan for Forest Development,” the “Management Plans for Protected Areas,” the “Watershed Recovery,” and a “Green Plan” for restoration and establishment of forests.

Achievement of sustainable development remains one of the greatest challenges in tropical countries. Recent increases in conservation activities in South America suggest that new generations of conservationists are maturing with sustainability in mind. The extent of protected areas in South America has increased (FAO 2006). Initiatives such as those of Fundación ProAves Colombia in establishing the first protected area for a neotropical migrant in Latin America—the Cerulean Warbler Natural Bird Reserve—need to be expanded and replicated in other countries. There is a close relationship between wintering migrants like Cerulean Warbler and a large portion of the endangered resident biodiversity. Likewise, there should be continued support and promotion of agro-forestry initiatives (such as supporting consumption of “bird friendly” shaded coffee) that benefit preservation of migrant and resident species.

CONCLUSIONS

- We believe that the Cerulean Warbler is a non-breeding habitat specialist in South America. Rather than being evenly distributed throughout its range, its presence is influenced by a specific configuration of elevation, rainfall, temperature, and habitat type. The species prefers sites with low rainfall levels (but not dry or deciduous forest) located in sheltered humid intermontane valleys within the Andes between elevations of 800 to 1,600 m.

- Winter residency sites of Cerulean Warbler with cool climate, moderate rainfall, and rich subtropical soils are highly correlated with areas of coffee production. The species prefers primary forest and mature shade coffee plantations, especially those with Guamo trees (*Inga* spp.) or native tree canopy that are similar in structure to primary forest. Such coffee production areas are facing severe threats of conversion from shade to sun coffee or banana shade coffee plantations.

- The little suitable natural habitat that survives in the Andes is fragmented, unprotected, and at risk of deforestation. Based on our modeling analysis and the opinions of some biologists familiar with the species in the field in the northern Andes, only 40% to perhaps less than 10% of the original forest cover remains in areas preferred by Ceruleans. Conservation actions in its core wintering areas are fundamental for the survival of the species.

- Initiatives such as establishment of protected area for this Neotropical migrant in Latin America must be extended and replicated in Andean countries. There is a close relationship between wintering Nearctic-Neotropical migrants and a large portion of endangered resident biodiversity.

- Support and promotion of agro-forestry initiatives (such as marketing and consumption of “bird friendly” shade coffee) will benefit preservation of both migrant and resident species.

ACKNOWLEDGMENTS

We thank the U.S Fish and Wildlife Service for support for this project. The Neotropical Migratory Bird Conservation Act – USFWS and Fondo para la Accion Ambiental y la Niñez helped to fund the Colombian Neotropical Migratory Bird Program. The National Fish and Wildlife Foundation and The Nature Conservancy, helped support the efforts of Grupo Cerúleo. Special recognition goes to Paul Hamel (USDA Forest Service), Jorge Velasquez, and the Graham Lab for assisting in the
development of the distribution maps and models for the species and to Camila Gómez for her help with translations and review.

REFERENCES


**BIBLIOGRAPHY**


**- Venezuela -**


30. Proyecto GAIA- Caso Venezuela. Centro de Simulación y Modelos de la Universidad de


**- Colombia -**


48. - Ecuador -


FIGURES

Figura 1. Elevation of non-breeding range records of Cerulean Warbler ........................................ 10
Figura 2. Temperature profiles of Cerulean Warbler winter habitat................................................. 11
Figura 3. Precipitation profiles of Cerulean Warbler winter habitat................................................. 12
Figura 4. Predicted Cerulean Warbler occurrence in northern South America ................................ 13
Figura 5. “Original” and “current” modeled distribution of Cerulean Warbler ................................. 14
Figura 6. Male and female Cerulean Warblers in Colombia .......................................................... 14
Figura 1. Elevation of non-breeding range records of Cerulean Warbler.
Figura 2. Temperature profiles of Cerulean Warbler winter habitat (° C x 10).
Figura 3. Precipitation profiles of Cerulean Warbler winter habitat.
Figura 4. Predicted Cerulean Warbler occurrence in northern South America.
Figura 5. “Original” (left) and “current” (right) distribution of Cerulean Warbler modeled from climatic variables at locations of known records of the species using MAXENT 2.2 (Phillips et al. 2006). Contour line represents 1000 m elevation.

Figura 6. Male (left —Jardin, Antioquia) and female (right —San Vicente de Chucuri, Santander) Cerulean Warblers in Colombia.
TABLES

Tabla 1. Landscape analysis of modeled distributions of Cerulean Warbler. .................................. 15
Tabla 2. Vegetation cover types across Cerulean Warbler “current” distribution ......................... 16

Tabla 1. Landscape analysis of “original” and “current” modeled distributions of Cerulean Warbler.

<table>
<thead>
<tr>
<th>Landscape Metric</th>
<th>Units</th>
<th>Original</th>
<th>Current</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape Area</td>
<td>Sq. km</td>
<td>608932.777</td>
<td>244627.204</td>
<td>-59.827</td>
</tr>
<tr>
<td>Number of patches</td>
<td></td>
<td>4263.000</td>
<td>9262.000</td>
<td>117.265</td>
</tr>
<tr>
<td>Mean patch size</td>
<td>Sq. km</td>
<td>142.841</td>
<td>26.412</td>
<td>-81.510</td>
</tr>
<tr>
<td>Patch size coefficient of variance</td>
<td></td>
<td>5078.192</td>
<td>1788.142</td>
<td>-64.788</td>
</tr>
<tr>
<td>Patch size standard deviation</td>
<td>Sq. km</td>
<td>7253.759</td>
<td>472.283</td>
<td>-93.489</td>
</tr>
<tr>
<td>Total edge</td>
<td>km</td>
<td>210853.076</td>
<td>272187.239</td>
<td>29.089</td>
</tr>
<tr>
<td>Edge density</td>
<td>km/sq.</td>
<td>0.346</td>
<td>1.113</td>
<td>221.331</td>
</tr>
<tr>
<td>Mean patch edge</td>
<td>km/patch</td>
<td>49.461</td>
<td>29.388</td>
<td>-40.585</td>
</tr>
<tr>
<td>Mean shape index</td>
<td></td>
<td>0.262</td>
<td>0.347</td>
<td>32.076</td>
</tr>
<tr>
<td>Area weighted mean shape index</td>
<td></td>
<td>35.492</td>
<td>14.200</td>
<td>-59.992</td>
</tr>
<tr>
<td>Mean patch fractal dimension</td>
<td></td>
<td>0.102</td>
<td>0.102</td>
<td>0.035</td>
</tr>
<tr>
<td>Average weighted mean patch fractal dimension</td>
<td></td>
<td>5.540</td>
<td>2.110</td>
<td>-61.917</td>
</tr>
</tbody>
</table>
Tabla 2. Vegetation cover types across Cerulean Warbler “current” distribution.

<table>
<thead>
<tr>
<th>Forest type</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montane forests &gt;1000m - dense evergreen</td>
<td>129.105</td>
</tr>
<tr>
<td>Montane forests 500-1000 - dense evergreen</td>
<td>52.846</td>
</tr>
<tr>
<td>Closed evergreen tropical forest</td>
<td>24.577</td>
</tr>
<tr>
<td>Montane forests &gt;1000m - open evergreen</td>
<td>15.452</td>
</tr>
<tr>
<td>Montane forests &gt;1000m - closed deciduous</td>
<td>6.999</td>
</tr>
<tr>
<td>Montane forests &gt;1000m - closed semi-deciduous</td>
<td>6.213</td>
</tr>
<tr>
<td>Montane forests 500-1000 - open evergreen</td>
<td>5.914</td>
</tr>
<tr>
<td>Montane forests 500-1000m - closed deciduous</td>
<td>3.772</td>
</tr>
<tr>
<td>Montane forests 500-1000m - open semi-deciduous</td>
<td>3.201</td>
</tr>
<tr>
<td>Open semi deciduous forest</td>
<td>2.511</td>
</tr>
<tr>
<td>Montane forests &gt;1000m - open semi-deciduous</td>
<td>1.887</td>
</tr>
<tr>
<td>Open evergreen tropical forest</td>
<td>1.706</td>
</tr>
<tr>
<td>Montane forests &gt;1000m flooded forest</td>
<td>1.187</td>
</tr>
<tr>
<td>Montane forests 500-1000m - flooded forest</td>
<td>910</td>
</tr>
<tr>
<td>Closed deciduous forest</td>
<td>708</td>
</tr>
<tr>
<td>Fresh water flooded forests</td>
<td>529</td>
</tr>
<tr>
<td>Montane forests 500-1000m - closed semi-deciduous</td>
<td>528</td>
</tr>
<tr>
<td>Montane forests &gt;1000m flooded forest</td>
<td>306</td>
</tr>
<tr>
<td>Closed semi deciduous forest</td>
<td>163</td>
</tr>
<tr>
<td>Permanent swamp forests</td>
<td>141</td>
</tr>
<tr>
<td>Montane forests 500-1000m - flooded forest</td>
<td>83</td>
</tr>
<tr>
<td>Montane forests 500-1000m - transition forest</td>
<td>12</td>
</tr>
<tr>
<td>Montane forests &gt;1000m flooded forest</td>
<td>12</td>
</tr>
<tr>
<td>Bamboo dominated forest</td>
<td>2</td>
</tr>
<tr>
<td>Montane forests &gt;1000m - bamboo dominated</td>
<td>2</td>
</tr>
<tr>
<td>Montane forests &gt;1000m - transition forest</td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDICES

Appendix 1. Protected areas with predicted presence of the Cerulean Warbler.

<table>
<thead>
<tr>
<th>Area type</th>
<th>Country</th>
<th>Name</th>
<th>Area protected (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>Ecuador</td>
<td>Sangay National Park</td>
<td>1759</td>
</tr>
<tr>
<td>International</td>
<td>Peru</td>
<td>Manu National Park</td>
<td>1492</td>
</tr>
<tr>
<td>International</td>
<td>Peru</td>
<td>Rio Abiseo National Park</td>
<td>618</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Alto Fragua - Indi Wasi</td>
<td>130</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Catatumbo-Barí</td>
<td>879</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Cordillera de los Picachos</td>
<td>1613</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Cueva de los Guácharos</td>
<td>43</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>De Iguáque</td>
<td>34</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Guanenta Alto Río Fonce</td>
<td>86</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Paramillo</td>
<td>3104</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Sierra Nevada de Santa Marta</td>
<td>1598</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Colombia</td>
<td>Sumapaz</td>
<td>793</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Cayambe-Coca</td>
<td>1669</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Cotacahi-Cayapas</td>
<td>717</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Llanganates</td>
<td>1111</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Los Illinizas</td>
<td>485</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Podocarpus</td>
<td>1097</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Sangay</td>
<td>1687</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Ecuador</td>
<td>Sumaco Napo Galeras</td>
<td>1411</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Peru</td>
<td>Alto Mayo</td>
<td>1235</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Peru</td>
<td>Bahuaja-Sonene</td>
<td>4287</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Peru</td>
<td>Manu</td>
<td>1415</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Peru</td>
<td>Río Abiseo</td>
<td>580</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Peru</td>
<td>San Matías San Carlos</td>
<td>300</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Peru</td>
<td>Tabaconas Namballe</td>
<td>194</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Area Metropolitana de Caracas</td>
<td>500</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Cerro Saroche</td>
<td>302</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Cuenca Alta de los Ríos Maticora</td>
<td></td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>y Cucuiza</td>
<td>540</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Cuenca Alta del Río Cojedes</td>
<td>743</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Cuenca Alta del Río Tocuyo</td>
<td>331</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Dinira</td>
<td>240</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>El Avila</td>
<td>642</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>El Guácharo</td>
<td>390</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>El Tamá</td>
<td>1205</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Guatopo</td>
<td>810</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Henri Pittier</td>
<td>737</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Litoral Central</td>
<td>149</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Macarao</td>
<td>163</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Macizo Montañoso del Turimiquire</td>
<td>2752</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Médanos de Coro</td>
<td>101</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Perijá</td>
<td>1363</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Piedemonte Norte de la</td>
<td></td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Cordillera Andina</td>
<td>1387</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Páramos del Batallón y La Negra</td>
<td>204</td>
</tr>
<tr>
<td>Area type</td>
<td>Country</td>
<td>Name</td>
<td>Area protected (km²)</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>--------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Río Capaz</td>
<td>249</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Río Chuspita</td>
<td>83</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Río Tocuyo</td>
<td>74</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Río Torbes y sus Alrededores</td>
<td>56</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Ríos Guanare, Boconó, Río Chuspita</td>
<td>1269</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Río Tocuyo</td>
<td>982</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Serranía de San Luis</td>
<td>308</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Sierra Nevada</td>
<td>489</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Sto. Domingo-Motatán</td>
<td>4048</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Terepaima</td>
<td>149</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Turuépano</td>
<td>151</td>
</tr>
<tr>
<td>National IUCN</td>
<td>Venezuela</td>
<td>Yacambú</td>
<td>192</td>
</tr>
<tr>
<td>National other</td>
<td>Bolivia</td>
<td>Madidi</td>
<td>6309</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Alto Río Bojaya</td>
<td>434</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Alto Río Buey</td>
<td>94</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Alto Río Cuta</td>
<td>161</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Alto Río Tagachi</td>
<td>95</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Arhuaco de la Sierra Nevada</td>
<td>641</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Bete, Auro Bete y Auro del Buey</td>
<td>59</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Puerto Alegre y la Divisa</td>
<td>197</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Ríos Jurubida, Chori y Alto</td>
<td>762</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Ríos Uva y Pogue</td>
<td>416</td>
</tr>
<tr>
<td>National other</td>
<td>Colombia</td>
<td>Ríos Valle y Boroboro</td>
<td>204</td>
</tr>
<tr>
<td>National other</td>
<td>Peru</td>
<td>Amarakaeri</td>
<td>2055</td>
</tr>
<tr>
<td>National other</td>
<td>Peru</td>
<td>Apolobamba</td>
<td>1126</td>
</tr>
</tbody>
</table>
Appendix 2. Conservation priority sites with predicted presence of the Cerulean Warbler.

<table>
<thead>
<tr>
<th>Area type</th>
<th>Country</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZE</td>
<td>Colombia</td>
<td>Bosques_montanos_del_sur_de_Antioquia</td>
</tr>
<tr>
<td>AZE</td>
<td>Colombia</td>
<td>Cuchillo_de_San_Lorenzo</td>
</tr>
<tr>
<td>AZE</td>
<td>Colombia</td>
<td>Reserva_Biológica_Cachalí</td>
</tr>
<tr>
<td>AZE</td>
<td>Ecuador</td>
<td>Reserva_Tapichalaca</td>
</tr>
<tr>
<td>AZE</td>
<td>Peru</td>
<td>Alto_Mayo</td>
</tr>
<tr>
<td>AZE</td>
<td>Venezuela</td>
<td>Parque_Nacional_El_Tamá</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Bosques_montanos_del_sur_de_Antioquia</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Cañón del Río Combeima</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Cuchillo de San Lorenzo</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Cuenca de Río Toche</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Cuenca del Río San Miguel</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Reserva Biológica Cachalí</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Reserva Hidrográfica, Forestal y Parque Ecológico de Río Blanco</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Serranía de los Churumbelos</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Serranía de Perija</td>
</tr>
<tr>
<td>IBAS</td>
<td>Colombia</td>
<td>Valle de San Salvador</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Angashcola</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Arajuno-Alto Napo</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Corredor Ecológico Llanganates-Sangay</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>El_Cerro Golondrinas</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>La Bonita-Santa Bárbara</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Reserva Ecológica Antisana</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Reserva Ecológica Cayambe-Coca</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Reserva Tapichalaca</td>
</tr>
<tr>
<td>IBAS</td>
<td>Ecuador</td>
<td>Río Toachi-Chiriboga</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Alto Mayo</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Bosque de Cuyas</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Huamba</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Mina Inca</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Norte de Cordillera de Colan</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>San Jose de Lourdes</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Sandia</td>
</tr>
<tr>
<td>IBAS</td>
<td>Peru</td>
<td>Sur de Cordillera de Colan</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>El_Avila National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>El_Tamá National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Henri_Pittier National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Macarao National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Macizo_Montañoso del Turimiquire_Protective_Zone</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Palmichal</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Páramos Batallón y La Negra National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Pico_Codazzi_Natural_Monument</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>San_Esteban National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Terepaima National Park</td>
</tr>
<tr>
<td>IBAS</td>
<td>Venezuela</td>
<td>Yurubí National Park</td>
</tr>
</tbody>
</table>

AZE = Alliance for Zero Extinction (www.zeroextinction.org)
IBA = Important Bird Area
Appendix 3. Fundación ProAves de Colombia.

Fundación ProAves Colombia has partnered with ABC (www.proaves.org) to protect birds of conservation concern and their habitats across Colombia using the full range of conservation tools available. Founded in 1998, ProAves currently has 50 full-time professional staff (all Colombian; 24 conservationist, 15 field researchers, 5 environmental education officers, 6 administrative staff), and 21 conservation programs in progress which have resulted in the creation of the largest private reserve system to protect endangered species in the country (8,767 acres owned by the foundation in 8 reserves); significant reforestation efforts (more than 120,000 trees planted); the successful development and management of a national bird banding and monitoring program (230,000 records, 70,000 birds banded); management of three community properties that adjoin reserves through municipality agreements; establishment of the first Colombian conservation easement; discovery of three species new to science; establishment of three national, annual environmental awareness campaigns (Palm Sunday, Migratory Bird Festival and El Paujil Bird Festival; and the establishment of a network of 10 local ecological groups called “Amigos de las Aves”. Revenue sources include European and North American foundations, partner support, Colombian government grants and individual members.

Appendix 4. American Bird Conservancy

American Bird Conservancy (ABC) is a 501(c)3 not-for-profit organization dedicated to conserving wild birds and their habitats throughout the Americas (www.abcbirds.org). Founded in 1994, ABC is the only national, US-based group dedicated solely to conserving wild birds and their habitats throughout the Americas. Together, ABC and its more than 300 partners buy land, restore degraded habitats, remove invasive and non-native species from natural areas, and effect policy changes on behalf of birds and their habitats. In 2005, ABC provided funding and technical support to local partners for 43 land acquisitions in Colombia, Ecuador, and Peru to protect some of the worlds most endangered and vulnerable bird species such as the Colorful Puffleg, Jocotoco Antpitta, Dusky Starfrontlet, Long-whiskered Owlet, Lulu’s Tody-Tyrant, and Gorgeted Wood-Quail.
CONTACTS

We sent a total of 15 requests for information (Attachment 1) between May 24 and June 2 2006 by email or fax. Nine people answered the communication with detailed information from Prof Eulogio Chacón (Universidad de Los Andes, Venezuela) and Cesar Augusto Parra (CAM – Colombia). Other respondents did not provide information, but several referred to other people or resources that could be of use. No further requests were passed on because we considered this to be an ineffective manner of obtaining information. The major problems with the request were the breadth of the questions, the limited time that respondents had to collect and submit information, and the fact that most of the people are not familiar with the species and its requirements.

May 24 2006
2. *Catalina Tovar. (ctovar@lamonina.edu.pe) Centro de datos para la Conservación. Universidad Agraria La Molina. Lima – PERÚ.
4. UNISIG. (unisig@humboldt.org) Instituto de Investigación de Recursos Biológicos Alexander von Humboldt.
5. *Dr. Ian Davidson. (ian.davison@birdlife.org.ec). Director. Secretariado Americas. BirdLife International. Quito, ECUADOR.
6. Gabriel Alonso Ceballos Echeverri. (Fax: 57-1- ) Director General (e). Corporación Autonoma Regional Centro Antioquia – CORANTIOQUIA, COLOMBIA.
7. *Jorge Eduardo Botero. (jorge.botero@cafedecolombia.org) Coordinador Programa Biología Conservación. CENICAFE. COLOMBIA.
8. Álvaro Prada Prada. (Fax: 57-1-1 ) Director General Corporación Autónoma Regional Santander – CAS, COLOMBIA.

May 31 2006
10. *Prof. Eulogio Chacón. (eulogio@ula.ve) Universidad de los Andes. Mérida, VENEZUELA.
11. Prof. Julio César Centeno. (jcenteno@ula.ve) Universidad de los Andes. Mérida, VENEZUELA. Bogotá, D. C. - COLOMBIA.
13. *Jorge Eduardo Renjifo. (jreng174@yahoo.es) Corporación Autónoma Regional del Cesar - Corpocesar. COLOMBIA.

June 1 2006.
14. *Mauricio Ugarte Lewis. (mugartelewis@yahoo.com). PERÚ.

June 2 2006.

* indicates those who responded

List of Governmental organizations

Ecuador
Instituto Nacional de Meteorología e Hidrología (www.inamhi.gov.ec)
Ministerio del Ambiente - República del Ecuador (www.ambiente.gov.ec)
Instituto Ecuatoriano Forestal y de Áreas Naturales y de Vida Silvestre - INEFAN
Venezuela
Ministerios del Ambiente y los Recursos Naturales (www.marn.gov.ve)
Instituto Geográfico de Venezuela Simon Bolivar (www.igvsb.gov.ve)
Instituto Nacional de Parques - INPARQUES (www.inparques.gov.ve)
Áreas Bajo Régimen de Administración Especial - ABRAE
Instituto Agrario Nacional Agrario (www.ian.gov.ve)

Colombia
Ministerio Ambiente, Vivienda y Desarrollo Territorial. MAVDT.(www.minambiente.gov.co)
Instituto de Investigación de Recursos Biológicos.IAVH. (www.humboldt.org.co)
Corporaciones Autónomas Regionales (www.asocars.org.co)
Unidad Administrativa Especial Sistema Parques Nacionales Nacionales. UAESPNN
(www.parquesnacionales.gov.co)
Instituto de Hidrología, Metereología y Estudios Ambientales. IDEAM. (www.ideam.gov.co)
Instituto Geográfico Agustín Codazzi. IGAC. (www.igac.gov.co).

Peru
Instituto Nacional de Recursos Naturales. (www.inrena.gob.pe)
Consejo Nacional del Ambiente. (www.conam.gob.pe)
    Intendencia de Áreas Naturales Protegidas
    Intendencia Forestal
    Intendencia de Fauna Silvestre
Instituto Geográfico Nacional (www.ignperu.gob.pe)
Servicio Nacional de Meteorología e Hidrología del Perú (www.senamhi.gob.pe)