

**GEOGRAPHIC DISTRIBUTION AND HABITAT USE BY CERULEAN  
WARBLER (*DENDROICA CERULEA*) IN NATURAL VEGETATION  
AND AGRO-ECOSYSTEMS IN NORTHERN COLOMBIA**

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# **GEOGRAPHIC DISTRIBUTION AND HABITAT USE BY CERULEAN WARBLER (*DENDROICA CERULEA*) IN NATURAL VEGETATION AND AGRO-ECOSYSTEMS IN NORTHERN COLOMBIA**

## **1. OBJECTIVES**

- To document geographic and elevational occurrence of the Cerulean Warbler in areas with few or no records through a wide range in Northern Colombia.
- To locate important areas of concentration of Cerulean Warbler populations in Northern Colombia.
- To describe and characterize habitats where Cerulean Warbler is recorded.
- To evaluate the use of habitat of the Cerulean Warbler in remnants of native forests and in shade plantations.
- To assess site fidelity of the Cerulean Warbler based on banded individuals.
- To apply innovative field techniques for censusing and capturing Cerulean Warbler in tropical wintering habitats (canopy nets, playbacks and surveys).

## **2. ACTIVITIES UNDERTAKEN**

Twenty field trips conducted during 136 days were achieved by the main investigators and four field assistants to thirty-three study sites on the Western, Central and Eastern Andes, and the Panama-Colombia boundary on the Caribbean, distributed in Antioquia, Choco, Valle del Cauca, Santander, Cundinamarca and Norte de Santander provinces. Surveyed habitats were shade coffee plantations, shade cardamomo (*Elettaria cardamomum*) plantations, mature and second growth forests and early sucesional stages. The study sites were monitored since late August to middle December 2005, and since early January to April 2006.

At the beginning of the fall season, the project was directed to record the arrival dates of the Cerulean Warbler in Northern Colombia in three localities, Darien, Jerico and Chinacota sites, Choco, Antioquia and Norte de Santander provinces, respectively. After this, most of the time was dedicated to visit both former locations to confirm the presence of the species and new sites with no records.

First efforts were directed to locate suitable areas and to obtain their GPS coordinates. Subsequently, observations were conducted to gather data on occurrence and habitat use of the Cerulean Warbler, and mist netting was conducted in two areas –Darien and Jerico - with verified presence of the species.

## **3. METHODS**

### **3.1 Duration of research**

136 surveying days were conducted between middle August 2005 and early April 2006.

## 3.2 Study sites

Thirty - three locations were visited to conduct the research (Figure 1 & 2). In only two locations, Jerico and Darien, mist netting was conducted. As a first approach, the location was searched for one day evaluating both the presence of the species and the type of habitat. According to this, some places were only surveyed for a maximum of two to three days, and habitat use and occurrence of the species was the only information registered, and no mist netting was conducted.

Most of the new locations represent areas on the Eastern Andes that still have extensive areas of coffee planting under shading conditions.

Surveyed locations will be presented by municipalities.

### 3.2.1. Jerico

Town and municipality settlement located on the Western slope of the Western Andes. One location was selected in this site (18 N 0411393, 0642382. Location accuracy: 10 m.) Average elevation is 1500 m. There are two main land covers: patches of remnant forests on steep slopes above 1800 m, and a shaded cardamomo plantation (*Elettaria cardamomum*), which cover together approximately 300 ha. This type of plantation corresponds to a shade monoculture with different shading species, such as *Inga* spp., *Cordia alliodora*, *Persea cerulea*, *Persea americana*, *Tabebuia rosea*, *Spathodea campanulata*, *Ochroma pyramidale*, *Cecropia* spp. and *Albizia carbonaria*. The area covered by the monoculture was originally dedicated to cattle rising. This location is limited by a corporative preserve of mountain forest in good conservation condition, called *Bosque de las nubes*, with 1,556 ha. Slope: 100 %. Aspect of the slope: E (90°). This site presents one of the most important concentrations of Cerulean Warbler in the Western Andes in an agroecosystem. Unfortunately, Decisions taken by the directive board of the owners based on the instability of the Cardamomo international market have lead to put on sale part of the farm. At present, some areas previously covered with shading trees have been cut off and converted into pastures for cattle rising.

### 3.2.2.. Fredonia

This study site is located 10 km west from Fredonia town, on the eastern slope of the Central Andes. This study site is in La Mina hamlet (18 N 0418628, 0652940. Location accuracy: 7 m). Altitude varies from 1300 m to 1550 m. Main land cover is shade coffee plantation, with patches of secondary forest and riparian corridors that connect the covers with dry forests in lower elevations, with approximately 50 ha of area. Slope: 100%. Aspect of the slope: W (270°).

### 3.2.3.. Chinacota

The study sites in this area are distributed around Chinacota town, on the Eastern Andes, Norte de Santander province, near the Colombia-Venezuela boundary. (18

N 0764750, 0842612. Location accuracy: 8 m). Two sites, Manzanares and Guayabal hamlets, were surveyed since middle august in order to establish the arrival dates for the species in this area. Altitude varies from 1100 m to 1600 m. Surveyed habitats are shaded coffee plantations of different areas (more than 5 ha), with small patches of natural vegetation and agricultural systems. Slope: 80%. Aspect of the slope: E (90°).

#### **3.2.4. La Mesa de Santos**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province, located approximately 20 km southwestern Bucaramanga city. One location was selected in UTM 18 N 0689275 0774318; 1670 m).

#### **3.2.5. Zapatoca**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province. 18 N 0689355 0752199` Altura1670 m. Two locations were selected in this area, one near the airport that corresponded to second growth forest and riverine covers. The second location corresponds to a private preserve, named Milton Natural Reserve. This location is dominated by riverine forest in good conservation level along the Zapatoca River, and high-density shade coffee plantations, dominated by guamo and Pizquin. This area presents high conservation priority due to the presence of Niceforo's Wren (*Thryotorus nicefori*; endemic; Cr) and Chesnut-bellied Hummingbird (*Amazilia castaneiventris*; endemic; Cr). Slope: 80%. Aspect of the slope: W (270°).

#### **3.2.6. El Socorro**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province. One location was selected in Porqueras II farm, around an area named Alto de la Cruz. 18 N 0693942 0716631; 1389 m. High-density shade coffee plantation, dominated by guamo and Pizquin. This farm is certified due to the production of organic coffee, as well as another farms around it. Slope: 80%. Aspect of the slope: W (270°).

#### **3.2.7. La Hondita hamlet – Charalá Town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province. This area presents good habitats for Cerulean Warbler, dominated by shade coffee plantations and good patches of secondary forests in different sucesional stages, below 2,000 m. 18 N 0704008 0694863; 1274 m. This location is dominated by high – density shade coffee plantations with shading trees such as guamo and pizquin, and secondary forest in the highest altitudes (1,700 m – 2,000 m). Slope: 90%. Aspect of the slope: W (270°).

#### **3.2.8. Virolín hamlet – Charalá Town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province. This location is 30 km away from Charalá town. This area is part of the buffer zone of the Santuario de Flora y Fauna Guanenta Alto río Fonce. The habitat is dominated by premontane forest with patches dominated by Montane Oak (*Quercus humboldtii*). The area surveyed is along a main road surrounded by forest between 1,700 and 1,900 m. 18 N 0699951 0671823 Altitude: 1828 m. Slope: 90%. Aspect of the slope: W (270°).

### **3.2.9. Puente Nacional**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province, a few kilometers away from Boyacá Province. The location selected corresponds to the EMCODA farm, a certified farm with organic coffee with shading. Main habitats are shade coffee plantations, riverine forests and patches of natural forest. This farm is a 12 –families’ community, interested in using organic coffee, and other products such as chickens and milk. This farm has a 15 years process of clean production and recovery of native forest and protection of the environment. 18 N 0439254 0689367; 1649 m. Slope: 70%. Aspect of the slope: SW (210°).

### **3.2.10. San Juan Hamlet – Rionegro town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province, approximately 8 km North from Bucaramanga city. 18 N 0702980 0803668; 1617 m. Main habitat is shade coffee plantation. The town presents more areas with shading plantations, but the access is limited by public disorder. Slope: 80%. Aspect of the slope: SW (210°).

### **3.2.11. Matanza**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province, approximately 15 km North from Bucaramanga city, near the town of Rionegro. Main habitat is shade coffee plantation and some cacao plantations. The town presents more areas with shading plantations, but the access is limited by public disorder 18 N 0710346 0815124; 1383 m. Slope: 100 %. Aspect of the slope: W (270°).

### **3.2.12. Rionegro hamlet – Encino town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province. 18 N 0710119 0681118 1456 m. Most of the area is located between premontane and montane forest. Main habitats are shade coffee plantations and riverine forests. Slope: 100 %. Aspect of the slope: W (270°).

### **3.2.13. Mogotes**

Town and municipality settlement located on the Western slope of the Eastern Andes, Santander province. The density of shading plantations is lower than the other locations in this province, and the landscape is dominated by cattle rising. 18 N 0724968 0719057; 1453 m. The study site is a shade coffee plantation dominated by guamo tree, connected to a secondary forest. Slope: 90 %. Aspect of the slope: W (270°).

#### **3.2.14. La Vega Hamlet - Convención town**

Town and municipality settlement located on the Eastern slope of the Eastern Andes, 18 P 0679283 0936848; 1100 m. This site represents the furthest North location where Cerulean Warbler was searched. Most of the primary habitat has been destroyed, and few forests and coffee plantations remain. The study site is located 4 km West of the town. A 2 ha shade coffee plantation isolated in a matrix of open fields. Slope: 90 %. Aspect of the slope: E (90°).

#### **3.2.15. La Laguna Hamlet - Convención town**

Town and municipality settlement located on the Eastern slope of the Eastern Andes, 18 P 0678870 0940410; 1350 m. This site represents the furthest North location where Cerulean Warbler was searched. Most of the primary habitat has been destroyed, and few forests and coffee plantations remain. Approximately 7 km North of the town. A 1 ha low - density shade coffee plantation, with some other coffee plantations around, as well as open fields. Slope: 70 %. Aspect of the slope: E (90°).

#### **3.2.16. El Silencio Farm – Convención town**

Town and municipality settlement located on the Eastern slope of the Eastern Andes, 18 P 0681659 0939070; 1150 m. This site represents the furthest North location where Cerulean Warbler was searched. Most of the primary habitat has been destroyed, and few forests and coffee plantations remain. Approximately 3 km North of the town. A 2 ha shade coffee plantation, with some other coffee plantations around, as well as open fields. Slope: 100 %. Aspect of the slope: E (90°).

#### **3.2.17. Acandi (Darien)**

This banding station is located on the east side of the Gulf of Uraba, Choco province, Northern Colombia, 3 miles west from the Atlantic coast. Altitude: 220 m. Coordinates: 18 P 0264843, 0927878 (Accuracy: 8 m). Main land cover is tropical lowland forest, mainly secondary and mature forest. Area: 500 ha. Slope: 100%. Aspect of the slope: N (0°). This area has been important to both capture Cerulean Warbler during fall migration and to document the passage time through this important corridor of landbird migration.

#### **3.2.18.. El Rosario Hamlet – Yarumal town**

18 N 455535, 781225. Altitude: 1430 m. This low-explored site is located in the furthest North part of the Central Andes in Antioquia province cover by premontane forest. This location embraces one of the latest remnants of Andean forest in this part of the Central Andes with approximately 200 ha. This area has important endemic and threatened species, such as the Yellow-eared Parrot (*Ognorhynchus icterotis*) and the Red-bellied Grackle (*Hypopyrrhus pyrohypogaster*), as well as several species of Tanagers. Slope: 90%. Aspect of the slope: NW (300°).

### **3.2.19.. San Fermin Hamlet - Yarumal town**

18 N 447771 783960. Altitude: 1685 m. This low-explored site is located in the furthest North part of the Central Andes in Antioquia province, cover by premontane forest. Main land covers are pastures for cattle rising and riparian Andean forest, embracing approximately 50 ha. Slope: 100%. Aspect of the slope: W (270°).

### **3.2.20. East Valle de Aburra - Medellin**

Capital of Antioquia province. The area is a narrow valley with an urbanized matrix, surrounded by patches of secondary forests and rural sectors. 18 N 435791 690403. Altitude: 1730 m. This area presents remnants of riparian corridors of natural covers along small streams and some small patches of shade coffee plantations, embracing approximately 50 ha. Slope: 90%. Aspect of the slope: E (90°).

### **3.2.21. Amalfi**

This study site is located 20 km North from Amalfi town, located on the eastern slope of the Central Andes, Northeastern Antioquia province. (18 N 0494081, 0770327. Location accuracy: 8 m). Altitude: 1600 m. It has more than 3500 mm of rain per year. It corresponds to a > 1,000 ha remnant of mature andean forest (*cloud forest*). Several endemic species are presented in this forest, including the Multicolored tanager (*Chlorochryssa nitidissima*), the White-mantled Barbet (*Capito hypoleucus*) and two recently discovered bird species, the Chestnut-capped Piha (*Lipaugus weberi*) and one of the latest new species described for the science, the Stiles' Tapaculo (*Scytalopus stilesi*; Cuervo *et al.* 2005). Slope: 90%. Aspect of the slope: E (90°).

### **3.2.22. Porce II Hidroelectrical dam – Yolombo town**

This study site is located 30 km SW Amalfi town, located on the eastern slope of the Central Andes, Northeastern Antioquia (18 N 498077, 729535. Location accuracy: 8 m). Altitude: 1200 m. Rainfall averages 3050 mm per year. The area corresponds to mature and secondary forests around a hydroelectric reservoir called Porce II. Forest cover in different sucesional stages embraces approximately 5500 ha.

### **3.2.23. La Cumbre**

Town and municipality settlement located on the Western slope of the Western Andes, Valle del Cauca province. One location was selected in the Chicoral hamlet. UTM 18 N 322410 396128. Location accuracy: 10 m. Altitude: 1650 - 1950 m. This area has species of flora and fauna from the biogeographic Choco. This site is connected on its highest zone (2000 m) with the forested areas of the Pacific slope. It has more than 3000 mm of rain per year. Main land covers are secondary forests, pastures, shade coffee plantations and inhabited areas. Shading of the coffee plantations is dominated by guamo (*Inga* spp.), carbonero (*Albizia carbonaria*) and barcino (*Callophilum* sp., from the Clusiaceae family). Slope: 80%. Aspect of the slope: W (270°). There is a 32 ha private reserve at 1900 m of elevation, where a migration monitoring station has been running for three seasons. It works with funds from the WWF and the Red de Reservas de las Sociedad Civil. Two records of Cerulean Warbler have been achieved by Luis German Naranjo and Richard Johnson. In order to use this information, permission is being obtained from the observers and Calidris Foundation.

### **3.2.24. Buga**

Town and municipality settlement located on the Western slope of the Central Andes, in the Cauca interandean valley, Valle del Cauca province. One location was selected in the Janeiro hamlet. UTM 18 N 367769 427174. Altitude varies from 1400 to 1800 m. The area presents secondary and mature forest in good conservation stage, being the dominating matrix. Other activities are cattle rising and shade coffee plantations. Shading of the coffee plantations is dominated by guamo (*Inga* spp.), carbonero (*Albizia carbonaria*). Main surveying route is located along the Janeiro river, which covers riparian forests and shade coffee plantations. This area presents a 102 ha private preserve from the Red de Reservas de la Sociedad Civil which protects these habitats. Typical mixed-species flock associates are Tropical parula, Tennessee and Canada Warbler, Blue-necked and Golden-naped Tanager, among others.

### **3.2.25. Yotoco**

Town and municipality settlement located on the Eastern slope of the Western Andes, Valle del Cauca province. 1500 mm of precipitation. One location was selected in the Natural Reserve of Yotoco forest, managed by the Universidad Nacional de Colombia and the Corporacion del Valle del Cauca (CVC). UTM 18 N 341418 429273. Altitude: 1515 m. This 554 ha reserve is one of the most important remnants of mature mountain forest in this slope of the Western Andes. There are three historical records in this location Orejuela et al. (1979), Alvarez (1988) and Silva (1996). Slope: 70-100 %. Aspect of the slope: W (270°).

### **3.2.26. La Balsita hamlet – Cañasgordas town**



Town and municipality settlement located on the western slope of the Western Andes, Antioquia province. 18 N 0384197 0748018. The study site correspond to a matrix of pastures with patches of secondary forest in different successional stages, between 2 and 10 ha, located between 1,200 and 1,600 m. There are some remnants of shade coffee plantations. There are some hamlets with tradition on coffee growing, but the access is limited because of public disorder. Slope: 90 %. Aspect of the slope: W (270°).

### **3.2.27. Frontino town**

Town and municipality settlement located on the Western slope of the Western Andes, Antioquia province. 18 N 0366250 0741069. This town is located near the buffer zone of the National Park Las Orquídeas, with some degree of public disorder. The area presents many important hamlets with natural forest and shade coffee plantations which deserve to be visited in the future. The study site corresponds to the Musinga hamlet, an area that we could reach thanks to the official personal of the National Park. The elevation surveyed was between 1400 m and 2170 m. Slope: 90 %. Aspect of the slope: W (270°).

### **3.2.28. El Hatillo hamlet – Guaduas town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Cundinamarca province. 18 N 0455535 0781225; 1431 m. The study site is a 40 ha farm named El Reposo, a certified farm by Rainforest Alliance with organic coffee. The farm protects a 20 ha secondary forest. Shading tree species are guamo, pizquin and nogal cafetero. Slope: 70 %. Aspect of the slope: E (90°).

### **3.2.29. El trigo hamlet – Guaduas town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Cundinamarca province. 18 N 0549950 0557818; 1721 m. The area presents several farms that grow coffee under shading conditions, dominated by guamo and pizquin. Other habitats are riverine forests. Slope: 90 %. Aspect of the slope: W (270°).

### **3.2.30. Naranjal hamlet – Cachipay town**

Town and municipality settlement located on the Western slope of the Eastern Andes, Cundinamarca province. (18 N 0560060 0520177; 1354 m). The area is traditionally of coffee plantations, but the tendency is to chance this crop to cattle rising and heliconias plantations under artificial shading. Most of the farms have a mosaic of coffee, cattle and heliconias. Slope: 70 %. Aspect of the slope: W (270°).

### **3.2.31. Campamento town**

Town and municipality settlement located on the Western slope of the Central Andes. (18 N 0464104 0772201; 1600 m). This location is one of the Northeast

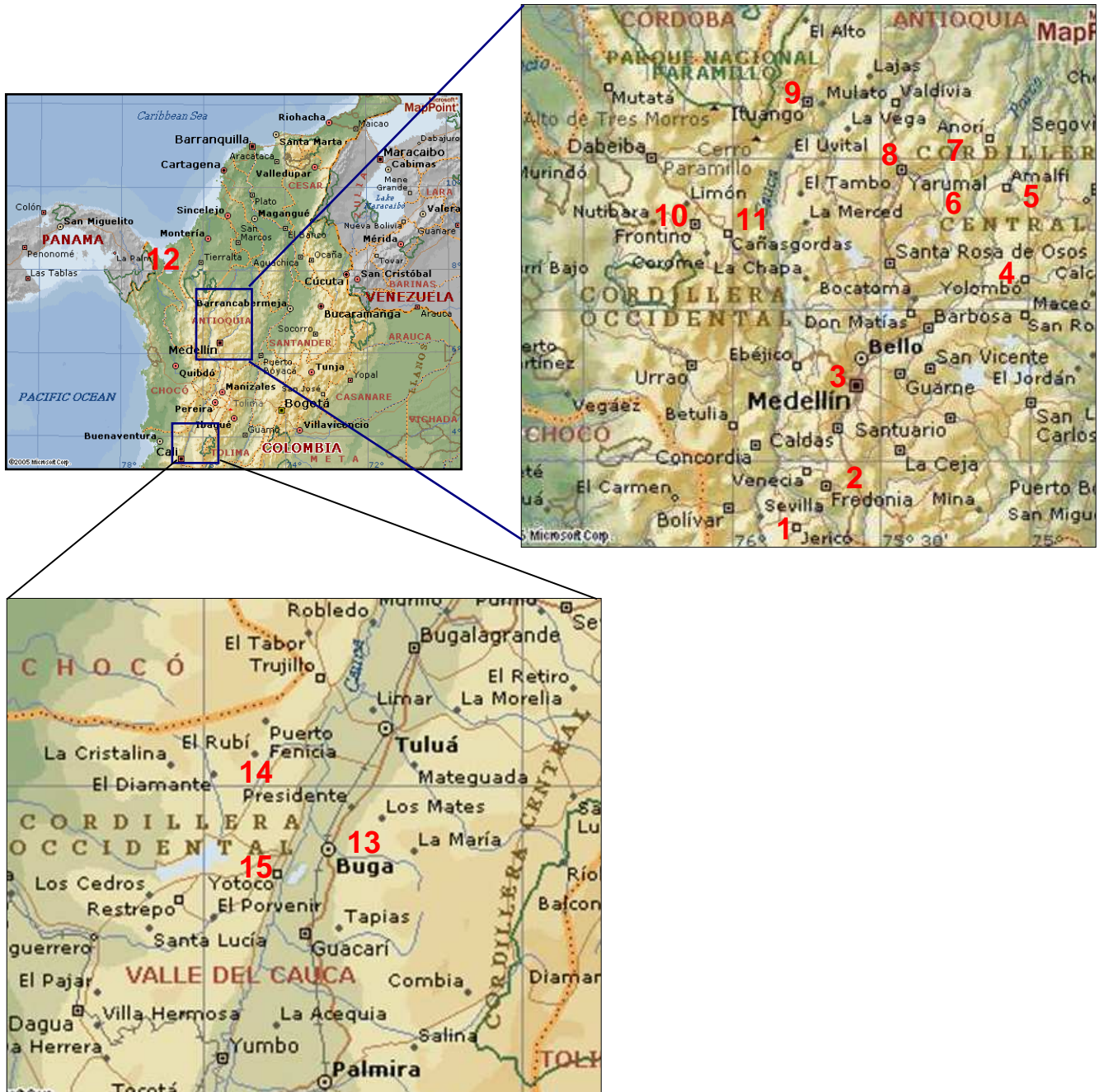
towns of the Central Andes. The landscape is dominated by cattle rising, with few patches of secondary forests and some farms of shade coffee plantations. One study site was selected in this town, named El Oso farm, a 10 ha shade coffee plantation. Slope: 70 %. Aspect of the slope: N (0°).

### **3.2.32. Angostura**

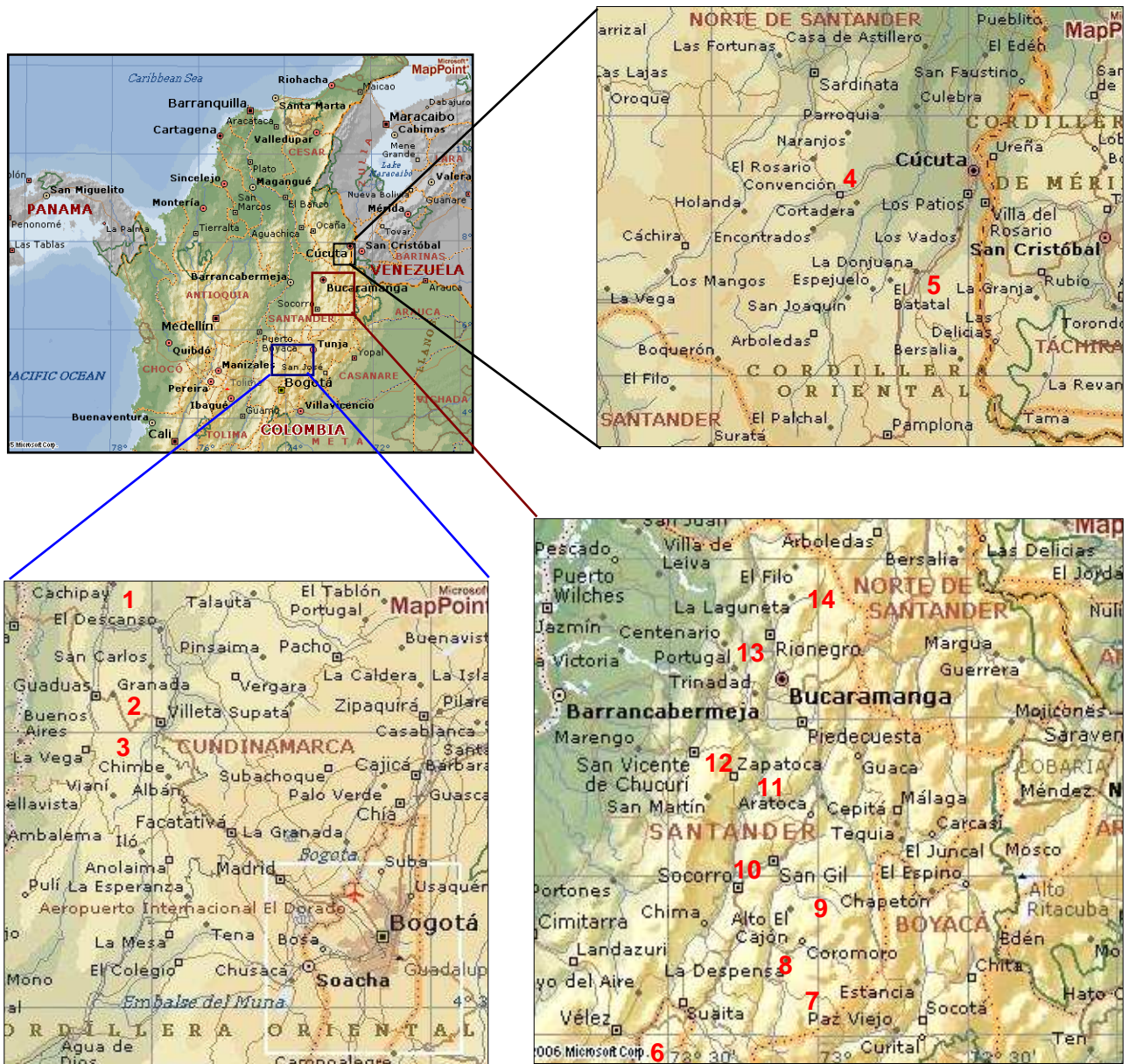
Town and municipality settlement located on the Western slope of the Central Andes (18 N 0461911 0761962; 1767 M). This location is one of the Northeast towns of the Central Andes. The landscape is dominated by cattle rising, with few patches of secondary forests and some farms of shade coffee plantations, in average of less than 5 ha. Main shading trees are guamo and nogal cafetero. Slope: 100 %. Aspect of the slope: N (0°).

### **3.2.33. Ituango**

Town and municipality settlement located on the Western slope of the Central Andes (18 N 0417090 0781217; 1450 m). The furthest North town visited in the Central Andes during this project. Main land uses are cattle rising, coffee plantation and inhabited areas. The town limits by North with the Parque Nacional Natural Paramillo. Most of the area is not accessible because of public disorder. Surveyed sites are secondary forests and shade coffee plantations surrounding the urbanized area. Slope: 100 %. Aspect of the slope: N (0°).



**Figure 1.** Study sites in the Western and Central Andes, and Panama-Colombia boundary. 1. Jericó 2. Fredonia 3. East Valle de Aburra 4. Porce II Hidroelectrical dam 5. Amalfi 6. Angostura 7. Campamento 8. San Fermin hamlet, Yarumal 9. Ituango 10. Frontino 11. Cañasgordas. 12. Acandí, Darien. 13. Buga. 14. La Cumbre. 15. Yotoco. (Source: msn.encarta).



**Figure 2.** Study sites in the Eastern Andes. 1. Cachipay 2. El Trigo hamlet-Guaduas 3. El Hatillo hamlet-Guaduas 4. Convención 5. Chinacota 6. Puente Nacional. 7. Encino 8. Charalá 9. Mogotes 10. El Socorro 11. La Mesa de Santos. 12. Zapatota 13. Rionegro. 14. Matanza. (Source: msn.encarta).

### 3.3 Methodology

This research involved two approaches: (1) the recognition of new wintering locations for the species as well as the confirmation of areas with no recent records in the three Andean ranges and the Colombia-Panamá border and (2) The continuation of the study of use of habitat by the species.

Two field techniques were employed for evaluating bird fauna: mist netting (ground and canopy mist nets, 12 m x 2,5 m), and point counts. Cerulean Warblers trapped were banded with color and numbered silver bands, and they were sexed (if possible), aged, measured, weighted, and fat, molt and feather conditions were registered according to standardized methods. All migrants were also banded with numbered bands for individual identification. Same morphometric and physiognomic information was recorded for resident species. Canopy nets as well as playbacks of the vocalization of the species were used in the trapping areas based on past experience. Site fidelity was assessed using Cerulean Warblers color banded during the 2003-2004 field season in Jericó site, as well as new banded birds during this research along the season.

Besides the use of mist nets in Jerico and Darien, point counts were used to gather demographic information of the species, particularly in Jerico where this technique has been applied since 2003. The point counts were conducted for 30 minute periods differentiated in two sections: 5 minutes for abundance information, when all the birds seen or heard were recorded, and another 25 minutes for general ecological observations (i.e. foraging behavior, food preferences and interactions with other species). 30-minutes censuses proved to be useful to detect and document habitat use of this species in the 2003-2004 field seasons. Sampling was conducted from sunrise to late afternoon.

Visits to areas with few or no recent records were conducted to the three Andean ranges and the Colombia-Panamá border. After locating suitable habitats and getting permissions, rapid not-systematic assessments were carried out during one or two days. If Cerulean Warbler was located, general information was taken related to GPS location, habitat type and ecology of the bird. After getting records in one location, new locations were searched for the species using the same technique.

## 4 DATA ON CERULEAN WARBLERS

### 4.1 Cerulean Warblersighting records

Fifty-two Cerulean Warblers were seen in thirty-nine occasions in the study sites previously described. Cerulean Warbler was detected in seventeen of thirty-three study sites surveyed (Table 1).

**Table 1.** Cerulean Warbler observations during the first field season, November-December 2005 – January 2006.

Location	Province	Visits (days)	Species recorded	Cerulean Warbler observations
Jerico	Antioquia	25	129	10
Fredonia	Antioquia	2	112	1
Chinacota	Norte de Santander	21 (fall)- 20 (spring)	70	11
La Vega - Convencion	Norte de Santander	1	20	-
La Laguna - Concepción	Norte de Santander	1	14	-
El Silencio – Convención	Norte de Santander	1	21	-
Mogotes	Santander	1	45	1
Mesa de Santos	Santander	1	48	2
Zapatoca	Santander	2	42	1
La Hondita - Charalá	Santander	2	40	1
Virolin - Charalá	Santander	2	38	1
El Socorro	Santander	1	39	3
Puente Nacional	Santander	1	45	1
Matanza	Santander	1	41	-
Rionegro	Santander	1	40	1
Encino	Santander	2	35	1
Darien	Chocó	20	58	1
Porce	Antioquia	2	110	-
San Fermín	Antioquia	1	60	-
El Rosario	Antioquia	4	63	-
East Valle de Aburra	Antioquia	4	50	-
Amalfi	Antioquia	2	84	-
La Cumbre	Valle del Cauca	2	111	-
Buga	Valle del Cauca	2	104	-
Yotoco Reserve	Valle del Cauca	2	107	-
Cañasgordas	Antioquia	2	65	1
Frontino	Antioquia	2	89	1
Campamento	Antioquia	2	40	
Angostura	Antioquia	2	29	

**Table 1.** Cerulean Warbler observations during the first field season, November-December 2005 – January 2006.

Location	Province	Visits (days)	Species recorded	Cerulean Warbler observations
Cachipay	Cundinamarca	1	62	1
El Hatillo - Guaduas	Cundinamarca	2	65	1
El trigo - Guaduas	Cundinamarca	1	38	-
<b>TOTAL</b>		<b>136</b>	<b>-</b>	<b>39</b>

Observations of Cerulean Warbler will be presented by location.

**A. Jerico.** Cultivares farm. Ten records: The first official report of the species for the Western Andes in this project.

September 07/2005. 8:05 AM. One adult male Cerulean Warbler (no banded) foraging slowly on insects in a mixed-species flock on high density shade cardamomo plantation. 8 m above ground on a legume tree (*Albizia carbonaria*). Associated species: Tropical parula, Spot-crowned Woodcreeper, Rusty-margined Flycatcher, Bananaquit, Golden-faced Tyrannulet, Blue-gray, Scrub, Guira, and Summer Tanager. The observations lasted for approximately 10 minutes. This record corresponds to the first sighting of the species in this site in the Central Andes for this research. Previous visits in early September were done, but no individuals were recorded up to this date. Altitude: 1,395 m. Slope: 70 %. Aspect of the slope: E (90°).

January 12/2006. 6:40 AM. One adult male Cerulean Warbler (no banded) foraging on insects in a mixed-species flock on a nogal tree (*Cordia alliodora*) and tachuelo (*Zanthoxylum* spp.) of a shade cardamomo plantation. 5 m above ground. Observation lasted for one minute. Associated species: Golden-crowned and Blackburnian Warbler, Golden-faced Tyrannulet, White-winged Becard, Spot-crowned Woodcreeper, Blue-gray, Scrub and Summer Tanager, Yellow-throated Vireo, Tropical Parula. Altitude: 1,420 m. Slope: 100 %. Aspect of the slope: E (90°).

January 13/2006. 9:15 AM. One adult female Cerulean Warbler (no banded) in a mixed species flock foraging on insects in a *Juan Blanco* tree (*Aegiphila grandis*) in a secondary forest border. 3 m above ground. Observation lasted for 2 minutes. Associated species: Tropical Parula, Blackburnian Warbler, Scrub and Bay-headed Tanager, Thick-billed Euphonia. Altitude: 1,430 m. Slope: 100 %. Aspect of the slope: E (90°).

January 18/2006. 10:30 AM. One female Cerulean Warbler (no banded) in a mixed species flock foraging on insects in a guamo tree (*Inga* spp.) on a high-density shade cardamomo plantation. 6 m above ground. Associated

species: Tropical Parula, Blackburnian Warbler, Scrub Tanager. Altitude: 1,450 m. Slope: 100 %. Aspect of the slope: E (90°).

January 20/2006. 14:30. One male Cerulean Warbler (no banded) in a mixed species flock foraging on insects in a guamo tree (*Inga* spp.) in a secondary forest border. 7 m above ground. Associated species: Blackburnian Warbler, Blue-gray, Scrub and Bay-headed Tanager. Altitude: 1,450 m. Slope: 80 %. Aspect of the slope: E (90°).

February 8/2006. 9:00. One male Cerulean Warbler in a mixed species flock foraging on insects in a guamo tree (*Inga* spp.). 6 m above ground. This individual is a bird silver-banded by PROAVES in October 2005 that apparently stayed in the area. Associated species: Blackburnian Warbler, Golden-faced Tyrannulet, Summer, Guira, Palm, Blue-gray, Blue-necked, Scrub and Bay-headed Tanager, Swainson's Thrush, Red-headed Barbet and White-winged Becard. Altitude: 1,450 m. Slope: 100 %. Aspect of the slope: E (90°).

February 21/2006. 16:30. One male Cerulean Warbler following a mixed species flock apparently no foraging. The bird was initially sighted in a guamo tree (*Inga* spp.), 7 m above ground. This individual is a bird silver-banded by PROAVES in October 2005 that apparently stayed in the area. Associated species: Blackburnian Warbler, Golden-faced Tyrannulet, Guira Tanager, and Red-headed Barbet. Altitude: 1,550 m. Slope: 100 %. Aspect of the slope: E (90°).

February 22/2006. 8:02. One male Cerulean Warbler in a mixed species flock foraging on insects in a Juan Blanco tree (*Aegiphila* spp.), 4 m above ground. The bird presented full male breeding plumage. This male produced chipping calls while foraging. Associated species: Blackburnian Warbler, Golden-faced Tyrannulet, Mountain Elaenia and Red-headed Barbet. Altitude: 1,550 m. Slope: 100 %. Aspect of the slope: E (90°).

March 7/2006. 14:20. One male Cerulean Warbler in a mixed species flock foraging on insects in a guamo tree (*Inga* spp.). 10 m above ground. Associated species: Rose-breasted Grosbeak, Golden-faced Tyrannulet, Summer, Guira, and Bay-headed Tanager, Black and White Warbler, Black-billed and Swainson's Thrush, Red-headed Barbet, Streaked Saltator and White-winged Becard. Altitude: 1,450 m. Slope: 100 %. Aspect of the slope: E (90°).

March 26/2006. 9:50. One female Cerulean Warbler alone foraging on insects in a guamo tree (*Inga* spp.). 7 m above ground. Altitude: 1,500 m. Slope: 100 %. Aspect of the slope: NE (70°). This corresponded to the last observation of the species in this location. Further observations at the end of the month and at the beginning of April produced no sightings of the species.



**B. Fredonia.** One record:

November 19/2005. 10:20 AM. One adult male Cerulean Warbler foraging in a mixed-species flock, in a high density shade coffee plantation. The individual was moving among legume trees (*Inga* spp.), foraging on insects. Associated species: Blue-gray and Palm Tanager, Guira Tanager, Golden-faced Tyrannulet, and Rusty-margined Flycatcher. 5 m above the ground. Altitude: 1,450 m. Slope: 100 %. Aspect of the slope: NW (290°).

**C. Acandi (Darien).** First observation for the Colombia-Panama boundary during this project. One record:

1. October 3/2005. 7:10 AM. One adult male in a mixed-species flock dominated by migratory bird species. Secondary forest border. The bird was actively foraging on insects on a *guasimo* tree (*Guazuma ulmifolia*). 5 m above ground. Associated species: Red-eyed vireo, Blackburnian, Yellow and Canada Warbler. The observation lasted for two minutes, after which the bird continued foraging into the forest with the flock. Altitude: 190 m. Slope: 100 %. Aspect of the slope: N (0°).

**D. Chinacota.** The first official report of the species for the Western Andes and for Colombia during this project. More than 30 individuals were seen in this location during the whole season. Eleven records:

August 26/2005. 09:20 AM. Guayabal hamlet. (18 N 765762, 845059). Earliest arrival date of the species for Colombia during this project. One juvenile Cerulean Warbler foraging on insects on a guamo tree in shade coffee plantation joining a mixed-species flock. 8 m above the ground. The Cerulean Warbler was attacked by a Golden-faced Tyrannulet. Altitude: 1,160 m. Associated species: Speckled, Blue-necked, Bay-headed, Crimson-backed, Hepatic, Fulvous-headed, Guira and Burnished-buff Tanager, Spot-crowned Woodcreeper, Rufous-browed Peppershrike, Red-eyed Vireo, Tropical Parula, Bananaquit, Three-striped Warbler, Smoky-brown Woodpecker, Plain-brown Woodcreeper, Cinereous Becard and Mouse-colored Tyrannulet. Slope: 90 %. Aspect of the slope: E (90°).

August 29/2005. 6:20 AM. Guayabal hamlet. One juvenile Cerulean Warbler foraging on insects on a guamo tree. 8 m above the ground. Altitude: 1,160 m. Slope: 100 %. Aspect of the slope: E (90°).

August 31/2005. 6:50 AM. Manzanares hamlet. (18 N 766081, 841217. Location accuracy: 8 m). One juvenile Cerulean Warbler foraging on insects on a nogal tree, joining a mixed-species flock. 7 m above the ground. Altitude: 1,460 m. Associated species: White-winged, Bay-headed and

Guira Tanager, and Golden-faced Tyrannulet. Slope: 100 %. Aspect of the slope: E (90°).

September 5/2005. 6:20 AM. Manzanares hamlet. One juvenile Cerulean Warbler foraging on insects on a guamo tree, joining a mixed-species flock. 10 m above the ground. Altitude: 1,460 m. Associated species: American Redstart, Guira, Bay-headed and White-winged Tanager, and Golden-faced Tyrannulet. Slope: 100 %. Aspect of the slope: E (90°).

September 5/2005. 7:20 AM. Manzanares hamlet. One juvenile Cerulean Warbler foraging on insects on a nogal tree, joining a mixed-species flock. 12 m above the ground. Altitude: 1,460 m. Associated species: American Redstart, Bay-headed Tanager, and Golden-faced Tyrannulet. Slope: 100 %. Aspect of the slope: E (90°).

September 6/2005. Manzanares hamlet. One juvenile Cerulean Warbler foraging on insects on a nogal tree, joining a mixed-species flock. 15 m above the ground. Altitude: 1,460 m. Associated species: American Redstart, Guira, Bay-headed, Fawn-breasted and White-winged Tanager, Spot-crowned Woodcreeper, Rufous-browed Peppershrike, Red-eyed Vireo, Tropical Parula, and Bananaquit. Slope: 100 %. Aspect of the slope: E (90°).

September 8/2005. Guayabal hamlet. First adult bird seen in this location this season. One adult male Cerulean Warbler foraging on a guamo tree on a mixed-species flock. 8 m above the ground. Altitude: 1,160 m. Associated species: Bananaquit, Spot-crowned Woodcreeper, Rufous-browed Peppershrike, Red-eyed Vireo, Tropical Parula, Bay-headed, Guira and Blue-necked Tanager. Slope: 100 %. Aspect of the slope: E (90°).

March 3/2006. 9:45. Guayabal hamlet. One adult male Cerulean Warbler foraging on insects on a mixed-species flock. 8 m above ground. Altitude: 1,160 m. Associated species: American Redstart, Tennessee and Blackburnian Warbler, Summer and Guira Tanager, Red-eyed Vireo. Slope: 90 %. Aspect of the slope: E (90°).

March 23/2006. 6:20. Guayabal hamlet. Three Cerulean Warblers, two males and one female, foraging on insects on a guamo tree in shade coffee plantation, joining a mixed-species flock. 7 m above ground. Altitude: 1,160 m. Associated species: Blue-necked, Bay-headed, Crimson-backed, Hepatic, Guira and Burnished-buff Tanager, Spot-crowned Woodcreeper, Rufous-browed Peppershrike, Red-eyed Vireo, Tropical Parula, Bay-breasted Warbler, Bananaquit, Three-striped Warbler, Cinereous Becard and Mouse-colored Tyrannulet. Slope: 90 %. Aspect of the slope: E (90°).

March 23/2006. 8:30. Guayabal hamlet. Three Cerulean Warblers, two males and one female, foraging on insects on a guamo tree in shade coffee plantation, joining a mixed-species flock. 6 m above ground. Altitude: 1,160

m. Associated species: Speckled, Guira and Burnished-buff Tanager, Spot-crowned Woodcreeper, Red-eyed Vireo, Tropical Parula, Bay-breasted Warbler, Bananaquit and Cinereous Becard. Slope: 90 %. Aspect of the slope: E (90°).

April 06/2006. 09:20 AM. Guayabal hamlet. Latest date of observation of the species for Colombia during this project. One juvenile Cerulean Warbler foraging on insects on a guamo tree in shade coffee plantation joining a mixed-species flock. 8 m above the ground. Altitude: 1,160 m. Associated species: Speckled, Blue-necked, Bay-headed, Crimson-backed, Fulvous-headed, and Guira Tanager, Spot-crowned Woodcreeper, Rufous-browed Peppershrike, Red-eyed Vireo, Tropical Parula, Bananaquit, Three-striped Warbler, Cinereous Becard and Mouse-colored Tyrannulet. Slope: 90 %. Aspect of the slope: E (90°).

**Guaduas.** One record.

March 20/2006. 08:50. El Hatillo hamlet. 18 N 0455535 0781225. One adult male Cerulean Warbler foraging on insects on a nogal cafetero tree in a high-density shade coffee plantation joining a mixed-species flock. 6 m above the ground. Altitude: 1431 m. Associated species: Bananaquit, Golden-faced Tyrannulet, Tennessee and Blackburnian Warbler, Scrub Greenlet, Blue-gray and Blue-necked Tanager, Rufous-browed Peppershrike. Slope: 70 %. Aspect of the slope: W (270°).

**Cachipay.** One record.

March 22/2006. 08:50. Naranjal hamlet. 18 N 0560060 0520177. One female Cerulean Warbler foraging on insects on a Chachafruto tree (*Erythrina edulis*) in a high-density shade coffee plantation joining a mixed-species flock. 7 m above the ground. Altitude: 1,354 m. Associated species: Golden-faced Tyrannulet, Blue-necked Tanager, Common Tody-Flycatcher, Blackburnian Warbler, Slaty-capped, and Yellow-bellied Elaenia. Slope: 60 %. Aspect of the slope: W (270°).

**Mesa de Santos.** Two records.

February 05/2006. 09:54. Two females Cerulean Warbler foraging on larvae on a mixed-species flock on a *Ficus* spp. tree in secondary forest border near a stream. 5 m above the ground in the middle canopy. Altitude: 1,369 m. Associated species: Slate-throated Whitestart, Scrub, Speckled, and Black-capped Tanager, Black and White, Canada and Tennessee Warbler, and Tropical Parula.

February 05/2006. 16:36. One adult male and one juvenile male Cerulean Warbler foraging alone on insects in a secondary forest border on a *Ficus* spp. tree. Altitude: 1,370 m.

**Zapatoca.** One record.

February 7/2006.7:03. One male and one female Cerulean Warbler foraging on insects in a mixed species flock on a *Ficus* spp. tree, in a high-density shade coffee plantation. 18 N 0689355 0752199 Altura1670 m. The flock was dominated by migratory bird species. Associated species: Blackburnian, Black and White, Tennessee and Canada Warbler and Common Yellowthroat. The observation lasted for 3 minutes.

**El Socorro.** Three records.

February 8/2006. 6:34. One adult female and one juvenile female Cerulean Warbler foraging slowly on insects in a mixed species flock on a Pizquin tree, in a shade coffee plantation. 8 m above ground. 18 N 0693942 0716631. Altitude: 1389 m. The flock was dominated by migratory bird species. Associated species: Blackburnian, Black and White, Tennessee and Canada Warbler, Tropical Parula, Scrub, Black-capped and Speckled Tanager, and Slate-throated Whitestart.

February 8/2006. 8:42. One juvenile male and one adult female Cerulean Warbler foraging slowly on insects in a mixed species flock on a Guamo tree, in a shade coffee plantation. The birds were foraging at the end of the flock. 3 m above ground. 18 N 0694602 0717171. Altitude: 1448 m. The flock was dominated by migratory bird species. Associated species: Blackburnian, Black and White, and Tennessee Warbler, Scrub, and Speckled Tanager.

February 8/2006. 10:33. One juvenile female Cerulean Warbler foraging on insects in a mixed species flock on a Pizquin and a *Ficus* spp. trees, in a shade coffee plantation. 8 m above ground. 18 N 0705445 0699476. Altitude: 1282 m. The observation lasted for 7 minutes. Associated species: Blackburnian and Black and White Warbler, Scrub and Speckled Tanager, and Slate-throated Whitestart.

**La Hondita hamlet – Charalá town** One record.

February 10/2006. 6:34. One female Cerulean Warbler foraging on insects in a mixed species flock on Guamo and *Ficus* spp. trees, in a shade coffee plantation. 7 m above ground. 18 N 0704008 0694863. Altitude: 1274 m. The bird was foraging through short hops. Associated species: Canada, Tennessee, and Black and White Warbler, Scrub and Speckled Tanager. Slope: 90%. Aspect of the slope: W (270°).

**Virolín hamlet – Charalá Town.** One record.

February 12/2006. 6:45. One adult female and one adult male Cerulean Warbler foraging on insects in a mixed species flock in the canopy of a low-disturbed mature forest border. 18 m above ground. 18 N 0699951 0671823. Altitude: 1828 m. Associated species: Canada, Tennessee, and Black and White Warbler, Scrub and Speckled Tanager. Slope: 90%. Aspect of the slope: W (270°).

**Puente Nacional.** One record.

February 13/2006. 7:00. One adult female and one juvenile (?) female Cerulean Warbler foraging on insects in a mixed species flock in a shade coffee plantation 100% covered with Guamo trees. 8 m above ground. 18 N 0716723 0655763; 1369 m. High density of migratory species. The observation lasted for 3 minutes. Associated species: Canada, Tennessee, Bay-breasted and Black and White Warbler, Scrub, Summer and Speckled Tanager. Slope: 70%. Aspect of the slope: SW (210°).

**San Juan Hamlet – Rionegro town.** One record.

February 15/2006. 6:45. One adult female and one juvenile male Cerulean Warbler foraging on insects in a mixed species flock in a shade coffee plantation in Chiminango tree (*Phitecellobium dulce*)..6 m above ground. 18 N 0702980 0803668; 1617 m The observation lasted for 3 minutes. Associated species: Canada, Tennessee, Bay-breasted and Black and White Warbler, and other species of resident Tanagers. Slope: 80%. Aspect of the slope: SW (210°).

**Rionegro hamlet – Encino town.** One record

March 17/2006. 7:20. One adult female and one juvenile male Cerulean Warbler foraging slowly in a mixed species flock in a shade coffee plantation in Pizquin tree. 8 m above ground. 18 N 0710119 0681118; 1456 m. The observation lasted for 8 minutes. Associated species: Canada, Tennessee, and Black and White Warbler, Tropical Parula, Scrub, Summer, Black-capped and Speckled Tanager, and Slate-throated Whitestart. Slope: 100%. Aspect of the slope: W (270°).

**Mogotes town.** One record.

March 19/2006. 7:00. One juvenile male Cerulean Warbler foraging slowly in a mixed species flock in a shade coffee plantation in Guamo tree. The shading plantation was dominated by Guamo trees. 7 m above ground. 18 N 0724968 0719057; 1453 m. The observation lasted for 2 minutes. Associated species: Canada, Tennessee, and Black and White Warbler, Tropical Parula, Scrub, Black-capped and Speckled Tanager, and Slate-throated Whitestart. Slope: 90%. Aspect of the slope: W (270°).

**Frontino town.** One record. This corresponds to the highest record in elevation of the species achieved during this project.

March 24/2006. 11:00. One adult male Cerulean Warbler foraging in a mixed species flock in a border of a well-preserved secondary forest. The bird was foraging on insects in lianas of a Yarumo tree (*Cecropia* spp.). 10 m above ground. 18 N 0366250 0741069. Altitude: 2014 m. The observation lasted for 4 minutes. Associated species: Blackburnian Warbler, Chesnut-breasted Chlorophonia, Metallic-green, Golden-naped, and Saffron-crowned Tanager, Slope: 100 %. Aspect of the slope: W (270°).

### **Cañasgordas town**

March 23/2006. 13:15. La Balsita hamlet. One adult male and one female Cerulean Warbler foraging slowly in a mixed species flock in a fragment of secondary forest of about 1 ha, which was connected to other patches of similar sizes. The bird was foraging on a Guamo tree. 8 m above ground. The observation lasted for 7 minutes. 18 N 0384197 0748018; 1230 m. Associated species: Rose-breasted Grosbeak, Blackburnian, Tennessee, and Black and White Warbler, Red-eyed Vireo, and Red-headed Barbet. Slope: 80 %. Aspect of the slope: W (270°).

#### **4.1.2 Cerulean Warbler captures**

Mist netting was conducted in Darien and Jerico localities where Cerulean Warbler has been continually reported, monitored and captured since 2003.

Three Cerulean Warblers were captured during the 2005-2006 field season, one in Darien and two in the study site of Jerico (Table 2, 4 & 5). The individual captured in Darien was using ground mist nets, meanwhile those captured in Jericó were with canopy mist nets. No recaptures or observations of banded Cerulean Warblers were achieved, besides one sighting of one bird silver-banded by PROAVES in October 2005 in Jerico, which was seen again in the same study site in February 21<sup>st</sup>.

The mist-netted individual in Darien during fall 2005 was captured the same date than the capture in 2004 in this site. Additionally, the observation of the species in this site was achieved just three days later (see above).

**Table 2.** Cerulean Warbler individuals trapped during the 2005-2006 field season.

Location	Sex	Status	Band number	First date of capture (mm/dd/yy)	Recapture date	Feather collected
Darien	female	New	226071443	09/30/2005	-	Y
Jerico	male	New	226071517	01/19/2006	-	Y
Jerico	female	New	226071528	03/07/2006	-	Y

**Table 3.** Bird species and individuals trapped during the field season September 2005 - March 2006.

<b>Location</b>	<b>Mist Net hours*</b>	<b>Resident species captured</b>	<b>Resident Individuals captured</b>	<b>Migrant species captured</b>	<b>Migrant individuals captured</b>	<b>Cerulean Warblers captures</b>
Jericó	645	37	220	8	39	2
Darien	1050	55	410	21	489	1
<b>TOTAL</b>	<b>1272</b>	<b>82</b>	<b>630</b>	<b>21</b>	<b>528</b>	<b>3</b>

Less Cerulean Warblers were captured in Jerico site per mist-net hour during the 2005-2006 season; it was necessary to run a little bit more than 300 hour-net to capture one individual. We hypothesis that habitat loss in the area due to the logging of the shading trees in some parts of the study site (Cultivares farm) could possibly be affecting the presence of the species. Additionally, inter annual variation in the population of birds that come to this site could affect these results. In this case, we consider that the continue monitoring of this location is highly important in order to have information not only on inter annual capture and recapture rate but, based on the information gather through the census points, density of the species in this important wintering ground can be follow year after year. This is the third year of continue monitoring in this study site, so it is becoming an important medium-term wintering ground monitoring station not only for the Cerulean Warbler, but for other migrants. We have recorded and banded other migratory birds of interest in this location, such as Canada and Golden-winged Warblers.

The first bird captured in Darien along with the observation achieved in this location around the same dates (late September – early October) represent an interesting data because it follows the pattern presented during last years of capture around the same dates in this migratory route. The birds caught in this study site in 2003 (2 individuals) and in 2005 (one individual) were captured within the same three days every year. As the species arrives its wintering grounds as early as late August, we suggest conducting trapping in this area starting in this month, in order to try to stablish an additional pattern of passage through this region.

First set of feathers collected in Darien in September 2005 were delivered to Mr. Hamel in the Cerulean Warbler Workshop in Quito, Ecuador in November 2005. Additional feathers will be sent together.

**Table 4.** Data on Cerulean Warbler capture. Darien site, Choco province, Colombia. Categories for skull, fat, body and flight feather molt, and flight feather wear are based on Ralph et al. 1993.

Band number	Age	How aged	Sex	How sexed	Skull	Fat	B. molt	F.F. Molt	F.F. Wear	Wing (cm)	Tail (cm)	Exp. (mm)	Culmen (mm)	Tarsus (mm)	Weight (g)	Month/year	Day	Hour	Capture height (m)
226071443	J <sup>1</sup>	S <sup>2</sup> ,P <sup>3</sup>	F	P	4	1	0	N	1	62	43	10.2	16.5	8.2	09 / 2005	30	7:30	2	

**Table 5.** Data on Cerulean Warbler capture. Jerico site, Antioquia province, Colombia. Categories for skull, fat, body and flight feather molt, and flight feather wear are based on Ralph et al. 1993.

Band number	Age	How aged	Sex	How sexed	Skull	Fat	B. molt	F.F. Molt	F.F. Wear	Wing (cm)	Tail (cm)	Exp. (mm)	Culmen (mm)	Tarsus (mm)	Weight (g)	Month/year	Day	Hour	Capture height (m)
226071517	A <sup>1</sup>	S <sup>2</sup> ,P <sup>3</sup>	M	P	6	1	2	N	1	64	44	10,5	15.6	9	01/ 2006	19	13:30	8	
226071528	A	S <sup>2</sup> ,P	F	P	6	1	0	N	2	62	42	-	-	9	03/2006	07	10:20	8	

1. J: juvenile bird. A: Adult bird.
2. Skull.
3. Plumage.



## ECOLOGICAL INFORMATION ON THE CERULEAN WARBLER

### Generalities about the distribution of Cerulean Warbler in Northern Colombia

After visiting both shade coffee plantations and natural forests as suitable habitats for the species, Cerulean Warbler was widely found in the Eastern Andes (Cordillera Oriental), and neither the Western nor the Central Andes presented the species in the frequency of the former Cordillera. Most of the visited locations in the Eastern Andes (90 %) presented the species. A future study based on a quantitative approach in the three Andean ranges using field techniques, will provide important and interesting information on population densities per Cordillera which conduct to understand more deeply the general distribution of the species on its wintering grounds.

Particularly Norte de Santander and Santander provinces represent a strategic area for Cerulean Warbler, not only for wintering grounds, but possibly as a corridor of migration. Santander province has extensive areas of shade coffee plantations, compared to other provinces such as Antioquia, Caldas and Valle. The availability of more habitats in this Cordillera could be determining the actual distribution and abundance of the species in this region. In addition to the importance of this province in terms of habitats, several programs related to the growing of organic coffee friendly with the environment are being developed. Other localities in this area can be relevant to protect habitat for Cerulean Warbler, such as the Serranías de los Yariquíes, the corridor between San Gil and Charalá towns and other municipalities included in the project Corredor de Robles, that presents both coffee areas and natural forests.

Data on capture-recapture, as well as field surveys with standardized techniques will allow to conduct demographic analysis in the near future, in terms of relative abundances per locality selected and available habitat. To study population trends for migratory species is difficult due to the fact that they are open populations, violating basic assumptions of the classic demography. In spite of this, while this species is in the Neotropics, and as we determined that the species can stay in one location during the whole wintering season (intraseasonal site fidelity), this data can be studied and analyzed year after year, producing a general trend or pattern of populations changes per locality (Jose Jaime Zuñiga, Brigham Young University, Utah, *pers. Comm.*).

On the other hand, the visit to some localities at the North end of the Andean ranges was an interesting challenge in this project. On the Eastern Cordillera, the furthest North location with suitable habitat was Convencion town. Unfortunately, public disorder in the area limited the access to some hamlets that have more natural forest and shade coffee plantations, and no records were achieved in this location. Likewise, several visits to the Central Andes to the towns of Campamento, Angostura and Amalfi gave no records for the species, in spite of the presence of good extensions of habitat for the species. Average rainfall in the

area is very high, more than 3,000 mm, and this probably could act as a constraining factor.

Finally, we obtained two important records in the furthest North area of the Western Andes (Frontino and Cañasgordas towns), including an observation at 2,000 m of elevation. Both observations were achieved at the end of March, during spring migration, so it will be important to revisit this region during the beginning of the next fall season and in December to confirm if the species is a regular winter resident or Cerulean Warbler uses this area as a corridor for migration only. This is an interesting sighting also because no previous recent record have been obtained in this location, demonstrating that this area in North Western Andes, could be a route for other populations of the species (less numerous?) coming from the south of Colombia and other countries such as Ecuador and Peru.

### **Use of habitat in wintering grounds**

Our data suggest that shading plantations and in particular shading trees such as Legume trees (*Inga* spp.) could harbor and support Cerulean Warblers as forest does, based on frequency of observation and foraging ecology. Several of our observations in forested habitats are in borders, where the species apparently forages actively, even in secondary growth covers. Further systematics observations could be directed to compare the occurrence of the species in borders vs. inner forest. Based on the observations obtained during this season, more evidences are gathered to conclude that habitat requirements for the Cerulean Warbler on its wintering grounds are definitely quite different to those on its breeding areas. During the winter season, the Cerulean Warbler shows no special preference and exclusivity to mature subtropical forests as suggested before, and probably no large areas of this habitat are needed, as those on its breeding habitat (Hamel 2000, Robbins *et al.* 1992).

Additionally, our observations of Cerulean Warbler in locations with small patches of forest (i.e. Cañasgordas, Fredonia and Chinacota) suggest that patch size is not acting as a limiting factor at least in some localities, and other factors such as connectivity and food availability could be acting more strongly. The latter factor could be determining not only the presence of the species, but the relative abundances in an area, along with patch size.

Most of the observations of the species (99%) corresponded to foraging activities; apparently, the species spends virtually the whole time of observation chasing and catching food preys. As it was proved in previous reports, the species is apparently not dependable on the density of the shading trees, and more important than this is the real availability of food preys. In this case, the species must search for tree species that provide enough preys, and this tendency could be extended to the natural forest. The longest time a Cerulean Warbler has been seen foraging in a single tree is 30 minutes. The quality and abundance of food preys, particularly those of lepidopteran larvae, must be evaluated in the main shading species,

particularly Guamo tree and Pisquin (*Inga spp.* and *Albizia carbonaria*, respectively), where most of the Cerulean Warblers records have been obtained.

Except during migration when the species can be seen even by sea level, our observations on its wintering ground limits the altitudinal distribution of the species to a narrow line, as literature suggests. The lowest record was at 1160 m in Chinacota, Norte de Santander province, and the highest record was at 2014 m, in Frontino, Antioquia province, altitude never recorded before in this project.

**Sociability and Mixed-species Flock observations**

Cerulean Warbler continues its tendency to occur in mixed-species assemblages that forage in fairly cohesive units on its wintering areas, but with an interesting change in the diversity of resident species by Cordillera. In addition to this, Cerulean Warbler shows no preference for either insectivorous or frugivorous mixed-species flocks, or resident/migrant bird species flocks.

Based on our data, this species is an occasional to regular attendant species, which stays with the flock from short to long periods of time, but do not stimulate the formation or maintenance of flocks.

Nineteen and twenty-one bird species associated to mixed-species flocks where Cerulean Warbler was detected, were found to be exclusive to the Eastern and the Western Andes, respectively, meanwhile no species were exclusive to the Central Andes. New species associated to Cerulean Warbler’s flocks were detected particularly in the locations in Northern Western Andes (Frontino and Cañasgordas towns, Antioquia province) and in the Eastern Andes in Santander province. In the case of the Western Andes, these species are Chesnut-breasted Chlorophonia, Metallic-green, Golden-naped and Saffron-crowned Tanager. In this particular case, most of the differences in bird composition are associated to the avifauna from a higher elevation where Cerulean was reported (above 2,000 m).

These new species, along with the data collected in previous researchs, offer a list of seventy-three bird species found in mixed species flocks where Cerulean Warbler has been detected, showing an impressive wide range of flocking species and its ability to join virtually any foraging group of birds in Colombia, according to the diversity of bird fauna in the country (Table 6).

Typical flocking species in the foraging groups among the three Andean ranges were Golden-faced Tyrannulet, Guira Tanager, Blue-gray Tanager and Bananaquit as resident species, and Tennessee, Blackburnian and Black and White Warblers as migratory species.

<b>Table 6.</b> Bird species associated to Cerulean Warbler in mixed-species flocks in three Andean Ranges of Colombia.			
<b>Bird species</b>	<b>Eastern Andes</b>	<b>Western Andes</b>	<b>Central Andes</b>
Blackburnian Warbler	X	X	X
Tennessee Warbler	X	X	X

**Table 6.** Bird species associated to Cerulean Warbler in mixed-species flocks in three Andean Ranges of Colombia.

<b>Bird species</b>	<b>Eastern Andes</b>	<b>Western Andes</b>	<b>Central Andes</b>
Black and White Warbler	X	X	X
Bay-breasted Warbler	X		
Tropical Parula	X	X	X
Canada Warbler	X	X	
Yellow Warbler	X		
American Redstart	X	X	
Slate-throated Whitestart	X		
Common Yellow Throat	X		
Golden-crowned Warbler		X	
Three-striped Warbler	X		
Green honeycreeper		X	X
Swainson´s Thrush		X	
Slaty-backed Nightingale Thrush		X	
Black-billed Thrush		X	
Red-eyed Vireo	X	X	X
Brown-capped Vireo		X	
Rufous-browed Peppershrike	X		
Bananaquit	X	X	X
Pale-breasted Spinetail		X	
Yellow-bellied Seedeater		X	
Crimson-rumped Toucanet		X	
Streaked Xenops		X	
Spot-crowned Woodcreeper	X	X	X
Plain-brown Woodcreeper	X		
Golden-olive Woodpecker		X	
Smoky-brown Woodpecker	X		
Grayish Piculet		X	
Red-headed Barbet		X	X
Common Tody-Flycatcher	X		
Yellow-olive Flycatcher		X	X
Streaked Flycatcher		X	
Slaty-capped Flycatcher	X	X	
Yellow-bellied Elaenia	X	X	
Golden-faced Tyrannulet	X	X	X
Mouse-colored Tyrannulet	X		
Rusty-margined Flycatcher		X	X
Eastern wood-pewee		X	
Steely-vented Hummingbird		X	X
Gray-breasted Wood-wren		X	X
Yellow-backed Oriole		X	
Scrub Greenlet	X		

**Table 6.** Bird species associated to Cerulean Warbler in mixed-species flocks in three Andean Ranges of Colombia.

<b>Bird species</b>	<b>Eastern Andes</b>	<b>Western Andes</b>	<b>Central Andes</b>
Rufous-naped Greenlet		X	
Guira Tanager	X	X	X
Burnished-buff Tanager	X		
White-winged Tanager	X		
Speckled Tanager	X		
Blue-necked Tanager	X	X	
Bay-headed Tanager	X	X	
Scrub Tanager	X	X	X
Black-capped Tanager	X		
Palm Tanager		X	X
Blue-gray Tanager	X	X	X
Golden Tanager		X	
Fulvous-headed Tanager	X		
Fawn-breasted Tanager	X		
Hepatic Tanager	X		
Summer Tanager	X	X	X
Crimson-backed Tanager	X	X	
Blue and Black Tanager		X	
Metallic-green Tanager		X	
Golden-naped Tanager		X	
Saffron-crowned Tanager		X	
Thick-billed Euphonia		X	X
Orange-bellied Euphonia		X	
Chestnut-breasted Chlorophonia		X	
Streaked Saltator		X	
Rose-breasted Grosbeak		X	X
Yellow-throated Bush-Finch		X	
Yellow-faced Grassquit		X	
Cinereous Becard	X		
White-winged Becard		X	X

Further research and new information on these species assemblages will be of interest in terms of resource partitioning and interspecific behavior and competition. For example, if the composition of mixed-species flocks in each Cordillera can be a limiting factor for the Cerulean Warbler presence, remains unclear.

Tanagers were the most diverse group presented in mixed-species foraging flocks of the Cerulean Warbler, with 23 different species, followed by Warblers with 10 species, and Flycatchers with 9 species.

Most of the observations of Cerulean Warblers in mixed-species flocks corresponded to solitary birds (73%; 28 observations), followed by couples (21%; five observations) and three individuals (6 %; 2 observations). No more than three individuals have been seen together in any location during these years of research. Cerulean Warbler could assemblage bigger conspecific groups during migration (Parker 1994, GJC *pers. obsv.* during field work in Honduras), but it seems that this behavior is not common on its wintering grounds.

### **Interspecific behavior**

Interspecific interactions between the Cerulean Warbler and the flock members were rare. Only in two occasions Cerulean Warbler was seen interacting with other species, once with a Chestnut-sided Warbler and once with a Golden-faced tyrannulet. In this first case, the Chesnut-sided attacked the Cerulean Warbler while foraging. The level of the attack was significant to cause the Cerulean to move to another branch. After this, the Cerulean seemed to continue foraging without any problem.

### **Food Habits**

#### **Feeding**

The Cerulean Warblers continue showing a clear insectivorous food habits, and never has been seen exploiting another resources such as fruits or weed fields. Besides foraging on insects in branches and leaves, the species was seen visiting flowers of Legume trees in Chinacota, but not further information in the type of resource that it was exploiting is available (nectar or insects). During field work in Honduras in spring 2006, Melinda Welton and GJC observed a Cerulean Warbler with its throat painted with fucsia color (pollen?) which came from an unidentified plant. Other migrants such as Tennessee Warbler and Rose-breasted Grosbeak had the same pattern, that could be related to visits to flowers. In spite of this, no bird was seen drinking nectar from any plant. This information, along with that from partners in Venezuela (P.Ramondi and J. Jones) is important to take into account to create the doubt about the possibility of visits to flowers to drink nectar by the species.

In the shaded plantations, observations were conducted mainly on trees like guamo (*Inga* spp.), pisquín (*Albizia carbonaria*), and nogal cafetero (*Cordia alliodora*). Guamo tree is an important exploiting resource for the Cerulean Warbler, not only in monoculture plantations, but in natural covers. In secondary forest, the species was seen feeding on insects on lianas and vines, as well as different tree species such as Chiminango (*Pithecelobium dulce*) and other species of native Guamos (*Inga* spp.).

The average foraging time per observation was  $4 \pm 2,6$  minutes (N = 6).

## **Food capture and consumption**

Most of the records were in the canopy or subcanopy of trees in plantations or natural forests, even in borders of riparian corridors of natural vegetation, and a few scatter records on climbing vines and small trees.

The Cerulean Warbler is not a conspicuous species, but could be located by following mixed-species flocks through the upper vegetation. In terms of horizontal movements, the species moves slower compared to other species such as Blackburnian and Tennessee Warblers. A common behavior seen several times is that the species stays in one branch foraging while the flock moves ahead and, after a short while, when the individual Cerulean is almost by its own and the flock is far away, it flies to catch up the flock again. The slow motion of the species along with this particular behavior creates a general impression that it shows up at the end of the flocks.

During its foraging activity the Cerulean Warbler tends to move several times around the same foraging site in slow motion using short hops. The species tended to spend a lot of time (up to 30 minutes) within a single tree, splited in different branches of the tree.

The typical feeding pattern observed followed that described by Parker (1994) and Hamel (2000). The Cerulean Warbler foraged along branches in a slow motion towards the tip of small twigs, sometimes hovering for short periods to search under the surface of leaves and stems, and then taking a short flight to another branch of the same trunk, starting again its movement toward the tip of the branches and leaves. The species virtually never made any chipping note or song while foraging.

When the species takes preys of considerable size, such as 6-mm lepidopteran larvae, it stops the foraging movement to hit the prey against the branch, after which it starts to swallow it .

When the species feeds on climbing vines the usual behavior is to encircle the plant, working in a spiral movement towards the top of the plant.

## **Vocalizations**

### **Sounds**

One male Cerulean Warbler in full nupcial plumage produced chipping notes while in a mixed-species flock on February 22/2006 at 8:02 in the morning. No other sounds were registered to any Cerulean Warbler during the field season.

### **Response to playbacks**

The Cerulean Warbler showed particular attention to playbacks of male songs. At this time of the project, both males and females have been successfully captured using playbacks and canopy mist nets. In spite of this, the female captured in Jerico (band No. 226071528) was trapped when playbacks were not sounding. Based on this, field experiments in this topic are necessary to ensure any conclusion, eventhough the general trend of the species is to show any attention to

the playbacks, both on its wintering grounds (i.e. Jerico) and during spring migration (GJC, *pers. Obs.* in Honduras).

### **Site fidelity and territoriality**

Only new individuals of Cerulean Warblers were seen and captured, and no banded individuals were located in the study site of Jerico. Neither of the eight Cerulean Warblers color banded between 2003 and 2005 were seen in this location during the present field season.

The absence of observations of birds that were banded during the last years deserves further attention in interseasonal returning to a particular wintering location, and it must be explored in terms of (1) mortality or (2) Migration to other wintering grounds near the area or to another areas. One reason could be related to loss of habitat in the study site of Jerico.

One bird that was banded by PROAVES in the study site of Jerico in October 2005, was seen in the field twice, once in February 8/2006 and once in February 21 of the same year. In terms of intraseasonal stay in one area, previous observations during last years plus the new observation of the banded bird from PROAVES, continue supporting the hypothesis that the species can stay in one wintering location probably for the whole non-breeding season, reinforcing the view of the Cerulean Warbler as a philopatry species to its wintering site.

In terms of populations of origin, there is significant amount of feathers collected in the location of Jerico since 2003 which deserves to be studied by the technique of stable isotopes. This will raise new data on the populations which these individuals are coming from latitudinally.

### **Migration**

#### **Timing of migration**

For the first time in the project conducted by our team, we were able to determined precisely the entire cycle of a population of Cerulean Warbler in one location; since the beginning of August, daily visits were conducted to coffee plantations in the study site of Chinacota, Norte de Santander province, up to the end of the season in early April. In this way, the first date of observation of the species in the area was August 26<sup>th</sup>/2005 when a juvenile Cerulean Warbler was seen foraging along with a mixed-species flock. Other migratory species such as American redstart, Tennessee Warbler and Blackburnian Warbler were detected first that the Cerulean Warbler. One interesting fact that deserves further analysis is the proportion of age classes. Only juvenile individuals were detected since the first arrival up to the 8<sup>th</sup> of September, when adult birds started to show up.

During the spring season, daily visits in the same locations revealed that the Cerulean Warbler disappeared the 6<sup>th</sup> of April of 2006, date of the last observation of the species in the area. Based on this, the Cerulean Warbler stayed in this location for approximately 226 days during its non-breeding season.



In Jerico site, the first observation of an individual in the fall was achieved the 7<sup>th</sup> of September when an adult male was spotted. Last date of observation of the species was the 26<sup>th</sup> of March (200 days); further surveys at the end of the month and at the beginning of April produced no sightings of the species. These observations, compared to those made during last years, agree with the general pattern of departure of the species from this location in the Western Andes by late March and early April (April 3<sup>th</sup> in 2004 and March 28<sup>th</sup> in 2005). Further observations will clarify if juveniles or females can arrive to its wintering ground earlier than adult birds, or if adults may migrate further south than juveniles, as occurs with other bird species (i.e. Broad-winged Hawk).

Based on this information, total length of stay of the species averaging both locations was 213 days. It is important to notice that this information does not take into account birds that probably started to fly in some other areas and passed through the study site, probably enlarging the real time a particular population stays in one location.

### **Premigratory body condition**

Body molt could be the most important physiological information derived from our data of captures during this season because of its intraseasonal variation. While there was not evidences of heavy fat storage or severe weight changes in the captured individuals, body molt continue the pattern showed during last years, adding an important bird captured at the end of the spring season. The first bird captured in January/2006 had significant body molt (Bird No. 226071517; 33% body molt), meanwhile the other individual (Bird No. 226071528) presented a complete absense of body molt by March 07/2006.

Based on the latter bird, this could be the first evidence of completicion and cese of body molt for the species during the pre-migratory season on its wintering grounds before starting to migrate to the breeding areas in North America.

Based on the birds captured since 2003, a general pattern of body molt can be recognized. A first, post fall migration molt during September and probably part of November, followed by few or not molt on birds in the middle of the wintering season during December and early January. Finally, a premigratory molt (nupcial molt) in late January and February, and a cese of molting by March before starting the spring migration.

New observations and captures in the future with individuals of both sexes and different age classes across the wintering season, will give new information about their patterns of body molt.

## DAILY ACTIVITY

Cerulean Warbler is active during most part of the day, but little activity was recorded at midday and no activity was recorded after 16:30 in late afternoon. The earliest record was obtained in Chinácota at 6:20 AM, and the latest record was done at 16:30 in Jerico.

In terms of captures, Cerulean Warblers were virtually caught during the whole day, but it was never captured early in the morning before 7: 00 AM. This could be related to the time of the day of configuration of bird flocks where Cerulean Warbler has shown to be an active member. Mixed-species flocks tend to be assembled a few hours after sunrise, when birds start to meet each other and move through the habitats.

Important ecological questions remains in terms of the use of different habitats during the day and where does the species roost during the night. Moreover, precise territory size estimations remain unclear for the species. Unfortunately, to follow an individual of this species (and virtually any passerine) through these habitats is extremely difficult due to the topography of the terrain. Based on the fact that the species is successfully captured with canopy mist nets, a project on telemetry can be initiated in the location of Jerico. One to three birds can be captured and armed with radios at the beginning of the wintering season in order to respond to questions on roosting habitats (¿are roosting habitats different from foraging habitats?), roosting tree species (¿Has Cerulean Warbler a particular preference for tree species while it roost, or it can roost in bushes and small trees?) and night activity.

## RECOMMENDATIONS AND FUTURE DIRECTIONS ON RESEARCH AND CONSERVATION

Important subjects have been detected which have research priority for Cerulean Warbler:

- (1) Long-term monitoring of populations of the species. Determination of relative abundances through Andean ranges. It is necessary to study more carefully the demography of the species on its wintering grounds in order to detect both changes among years and regions with important concentrations of the species. Additional to density information of the species per locality, this data must be related to an estimation of the suitable habitat present in each locality.
- (2) Search and location of new recording areas. The objective of this project to locate new areas with few or no records showed to be successful in terms of Cerulean Warbler detected vs. effort. Further search must be also directed to the south part of the three Andean ranges (i.e. Farallones de Cali, Cauca province), where coffee shade plantations and large areas of subtropical forest are still remaining. Main constrains to this search are problems related to public disorder. Conducting fast surveys (1-2 days) with trained people in suitable habitats is a tool that can be used for searching Cerulean Wablers in areas with few or non records of the species. Once important areas of concentration of the species are located, conservation strategies must be directed in those locations.
- (3) Continuation of basic research on different aspects of use of habitat of the species. Particularly, there is lack of information in terms of age and sex classes wintering ecology of the Cerulean Warbler, especially on the resource partitioning and the competitive dynamic of mixed-species flocks and conspecific flocks. It is also important to study the relationship between Bay-breasted Warbler and Cerulean Warbler in terms of interspecific competition. Both species can exclude each other from some locations and habitats, and this can be one of the historical reasons of the narrow line where the Cerulean Warbler winters in the Neotropics.
- (4) Fall migration ecology. Few data have been gathered related to fall migration, both in the wintering grounds and stopover areas in Central America. Data collected during this project in fall in the Darien region, can be a starting point to continue the documentation, in a larger scale, of this phenomenon of passage through this areas. Ideally, simultaneous monitoring stations should be run in two or three of the Cordilleras and in the North shore of Colombia in the Caribbean

(5) Apply the ecological information gathered during these seasons in conservation efforts, particularly in those areas with important concentrations of the species. One important decision to be made is related to the location of Jerico, Cultivares farm, in the Western Andes, which is right now under logging pressures because of economic reasons. Our surveys of the species along this Cordillera in Antioquia, Chocó, Valle del Cauca and Caldas provinces has shown that the species is more difficult to find in this Cordillera than in the Eastern Andes, except in Jericó, where the species concentrates in significant groups. Based in this, Jerico site must be considered as a priority location for the preservation of the species in this area.

## PROJECT EXPENSES DUE TO MAY 2006

Item	Justification	USD
Salaries, main investigators and Field Assistants	Salaries for the two main investigators, Mr. Cuadros and Mr. Colorado, and the research assistants during the project.	5,000
Field equipment	Color bands, pesolas, office and field supplies.	200
Food and lodging	Investigators and field assistants expenses during the field season.	2,000
In-country travel	Field trips to the three study sites in the Western Andes.	2,800
<b>Total</b>		<b>10,000</b>

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## APPENDIXES

### Appendix 1. Species list by location.

<b>Appendix 1a. Jericó study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Tinamidae	<i>Crypturellus soui</i>	Little Tinamou
Podicipedidae	<i>Podiceps dominicus</i>	Least Grebe
Cathartidae	<i>Coragyps atratus</i>	Black Vulture
	<i>Cathartes aura</i>	Turkey Vulture
Accipitridae	<i>Chondrohierax uncinatus</i>	Hook-billed Kite
	<i>Elanoides forficatus</i>	Swallow-tailed Kite
	<i>Buteo magnirostris</i>	Road-side Hawk
	<i>Buteo platypterus</i>	Broad-winged Hawk
	<i>Buteo swainsoni</i>	Swainson's Hawk
Falconidae	<i>Micrastur ruficollis</i>	Barred Forest-Falcon
	<i>Falco sparverius</i>	American Kestrel
	<i>Falco rufigularis</i>	Bat Falcon
	<i>Herpetotheres cachinnans</i>	Laughing falcon
Cracidae	<i>Ortalis columbiana</i>	Colombian Chachalaca
Rallidae	<i>Gallinula chloropus</i>	Common Moorhen
	<i>Laterallus albigularis</i>	White-throated Crake
Jacanidae	<i>Jacana jacana</i>	Wattled Jacana
Columbidae	<i>Columba fasciata</i>	Band-tailed Pigeon
	<i>Columba subvinacea</i>	Ruddy Pigeon
	<i>Columbina talpacoti</i>	Ruddy Ground-Dove
	<i>Leptoptila verreauxi</i>	White-tipped Dove
Psittacidae	<i>Aratinga wagleri</i>	Scarlet-fronted Parakeet
	<i>Pionus chalcopterus</i>	Bronze-winged Parrot
	<i>Forpus conspicillatus</i>	Spectacled Parrotlet
Cuculidae	<i>Piaya cayana</i>	Squirrel Cuckoo
	<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
	<i>Crotophaga ani</i>	Smooth-billed Ani
Nyctibiidae	<i>Nyctibius griseus</i>	Common Potoo
Caprimulgidae	<i>Nyctidromus albicollis</i>	Pauraque
Apodidae	<i>Streptoprocne zonaris</i>	White-collared Swift
Trochilidae	<i>Phaethornis guy</i>	Green Hermit
	<i>Phaethornis striigularis</i>	Striped-throated (Little) Hermit
	<i>Colibri delphinae</i>	Brown Violetear
	<i>Anthracotorax nigricollis</i>	Black-throated Mango
	<i>Ocreatus underwoodi</i>	Booted Racket-tail
	<i>Colibri thalassinus</i>	Green Violetear
	<i>Saucerottia saucerottei</i>	Steely-vented Hummingbird
	<i>Amazilia franciae</i>	Andean Emerald
	<i>Amazilia tzacatl</i>	Rufous-tailed Hummingbird

<b>Appendix 1a. Jericó study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Chlorostilbon mellisugus</i>	Blue-tailed Emerald
	<i>Calliphlox mitchellii</i>	Purple-throated Woodstar
	<i>Chalybura buffonii</i>	White-vented Plumeleteer
Momotidae	<i>Momotus aequatorialis</i>	Highland Motmot
Bucconidae	<i>Malacoptila mystacalis</i>	Moustached Puffbird
Capitonidae	<i>Eubucco bourcierii</i>	Red-headed Barbet
Ramphastidae	<i>Aulacorhynchus haematopygus</i>	Crimson-rumped Toucanet
Picidae	<i>Picumnus granadensis</i>	Grayish Piculet
	<i>Colaptes punctigula</i>	Spot-breasted Woodpecker
	<i>Veniliornis fumigatus</i>	Smoky-brown Woodpecker
	<i>Veniliornis kirkii</i>	Red-rumped Woodpecker
	<i>Melanerpes rubricapillus</i>	Red-crowned Woodpecker
	<i>Dryocopus lineatus</i>	Lineated Woodpecker
Dendrocolaptidae	<i>Lepidocolaptes affinis</i>	Spot-crowned Woodcreeper
Furnariidae	<i>Synallaxis albescens</i>	Pale-breasted Spinetail
	<i>Xenops rutilans</i>	Streaked Xenops
Thamnophilidae	<i>Taraba major</i>	Great Antshrike
	<i>Thamnophilus multistriatus</i>	Bar-crested Antshrike
Formicariidae	<i>Grallaria guatemalensis</i>	Scaled Antpitta
	<i>Grallaria ruficapilla</i>	Chesnut-crowned Antpitta
Cotingidae	<i>Pachyramphus polychopterus</i>	White-winged Becard
Tyrannidae	<i>Zimmerius chrysops</i>	Golden-faced Tyrannulet
	<i>Phaeomyias murina</i>	Mouse-colored Tyrannulet
	<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia
	<i>Elaenia chiriquensis</i>	Lesser Elaenia
	<i>Mionectes oleagineus</i>	Ochre-bellied Flycatcher
	<i>Leptopogon superciliaris</i>	Slaty-capped Flycatcher
	<i>Contopus borealis</i>	Olive-sided Flycatcher
	<i>Contopus virens</i>	Eastern Wood-pewee
	<i>Sayornis nigricans</i>	Black Phoebe
	<i>Machetornis rixosus</i>	Cattle Tyrant
	<i>Myiarchus tuberculifer</i>	Dusky-capped Flycatcher
	<i>Myiarchus cephalotes</i>	Pale-edged Flycatcher
	<i>Myiozetetes cayanensis</i>	Rusty-margined Flycatcher
	<i>Myiodynastes maculatus</i>	Streaked Flycatcher
	<i>Tolmomyias sulphurescens</i>	Yellow-olive Flycatcher
	<i>Pogonotriccus ophthalmicus</i>	Marble-faced Bristle-tyrant
	<i>Tyrannus melancholicus</i>	Tropical Kingbird
Hirundinidae	<i>Stelgidopteryx ruficollis</i>	Southern Rough-winged Swallow
Corvidae	<i>Cyanocorax affinis</i>	Black-chested Jay
Troglodytidae	<i>Thryothorus mystacalis</i>	Whiskered Wren
	<i>Troglodytes aedon</i>	House Wren
	<i>Henicorhina leucophrys</i>	Gray-breasted Wood-wren

<b>Appendix 1a. Jericó study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Sylviidae	<i>Polioptila plumbea</i>	Tropical Gnatcatcher
Turdidae	<i>Catharus fuscescens</i>	Veery
	<i>Catharus fuscater</i>	Slaty-backed Nightingale Thrush
	<i>Catharus ustulatus</i>	Swainson's Thrush
	<i>Turdus ignobilis</i>	Black-billed Thrush
	<i>Turdus grayi</i>	Clay-colored Thrush
Vireonidae	<i>Vireo olivaceus</i>	Red-eyed Vireo
	<i>Vireo leucophrys</i>	Brown-capped Vireo
	<i>Vireo flavifrons</i>	Yellow-throated Vireo
	<i>Hylophilus semibrunneus</i>	Rufous-naped Greenlet
Icteridae	<i>Molothrus bonariensis</i>	Shiny Cowbird
	<i>Icterus chrysater</i>	Yellow-backed Oriole
Parulidae	<i>Mniotilta varia</i>	Black-and-white Warbler
	<i>Vermivora peregrina</i>	Tennessee Warbler
	<i>Parula pitiayumi</i>	Tropical Parula
	<i>Dendroica aestiva</i>	Northern Yellow-Warbler
	<i>Dendroica cerulea</i>	Cerulean Warbler
	<i>Dendroica fusca</i>	Blackburnian Warbler
	<i>Setophaga ruticilla</i>	American Redstart
	<i>Seiurus noveboracensis</i>	Northern Waterthrush
	<i>Wilsonia canadensis</i>	Canada Warbler
	<i>Myioborus miniatus</i>	Slate-throated Whitestart
	<i>Basileuterus culicivorus</i>	Golden-crowned Warbler
	<i>Basileuterus fulvicauda</i>	Buff-rumped Warbler
Coerebidae	<i>Coereba flaveola</i>	Bananaquit
	<i>Chlorophanes spiza</i>	Green Honeycreeper
	<i>Diglossa sittoides</i>	Rusty Flower-Piercer
Thraupidae	<i>Chlorophonia cyanea</i>	Blue-naped Chlorophonia
	<i>Euphonia xanthogaster</i>	Orange-bellied Euphonia
	<i>Euphonia laniirostris</i>	Thick-billed Euphonia
	<i>Tangara cyanicollis</i>	Blue-necked Tanager
	<i>Tangara gyrola</i>	Bay-headed Tanager
	<i>Tangara vitriolina</i>	Scrub Tanager
	<i>Tangara arthus</i>	Golden Tanager
	<i>Tangara heinei</i>	Black-capped Tanager
	<i>Thraupis episcopus</i>	Blue-gray Tanager
	<i>Thraupis palmarum</i>	Palm Tanager
	<i>Ramphocelus dimidiatus</i>	Crimson-backed Tanager
	<i>Ramphocelus flammigerus</i>	Flame-rumped Tanager
	<i>Piranga flava</i>	Hepatic Tanager
	<i>Piranga rubra</i>	Summer Tanager
	<i>Tachyphonus rufus</i>	White-lined Tanager
	<i>Hemithraupis guira</i>	Guira Tanager



<b>Appendix 1a. Jericó study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Fringillidae	<i>Saltator atripennis</i>	Black-winged Saltator
	<i>Saltator albicollis</i>	Streaked Saltator
	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak
	<i>Atlapetes gutturalis</i>	Yellow-throated Brush-Finch
	<i>Tiaris olivacea</i>	Yellow-faced Grassquit
	<i>Sporophila schistacea</i>	Slate-colored Seedeater
	<i>Sporophila nigricollis</i>	Yellow-bellied Seedeater
	<i>Zonotrichia capensis</i>	Rufous-collared Sparrow
	<i>Buarremon brunneinuchus</i>	Chesnut-capped Brush-Finch
	<i>Carduelis psaltria</i>	Lesser Goldfinch

<b>Appendix 1b. Fredonia study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Tinamidae	<i>Crypturellus soui</i>	Little Tinamou
Cathartidae	<i>Coragyps atratus</i>	Black Vulture
	<i>Sarcoramphus papa</i>	King Vulture
	<i>Cathartes aura</i>	Turkey Vulture
Accipitridae	<i>Chondrohierax uncinatus</i>	Hook-billed Kite
	<i>Accipiter ventralis</i>	Plain-brested Hawk
	<i>Buteo brachyurus</i>	Short-tailed Hawk
	<i>Buteo albicaudatus</i>	White-tailed Hawk
	<i>Buteo magnirostris</i>	Road-side Hawk
	<i>Buteo platypterus</i>	Broad-winged Hawk
	<i>Buteo swainsoni</i>	Swainson's Hawk
Falconidae	<i>Falco sparverius</i>	American Kestrel
	<i>Falco rufigularis</i>	Bat Falcon
	<i>Milvago chimachima</i>	Yellow-headed Caracara
	<i>Polyborus plancus</i>	Crested Caracara
Columbidae	<i>Columba fasciata</i>	Band-tailed Pigeon
	<i>Columbina talpacoti</i>	Ruddy Ground-Dove
	<i>Leptoptila verreauxi</i>	White-tipped Dove
Psittacidae	<i>Aratinga wagleri</i>	Scarlet-fronted Parakeet
	<i>Pionus chalcopterus</i>	Bronze-winged Parrot
	<i>Forpus conspicillatus</i>	Spectacled Parrotlet
Cuculidae	<i>Piaya cayana</i>	Squirrel Cuckoo
	<i>Tapera naevia</i>	Striped Cuckoo
	<i>Crotophaga ani</i>	Smooth-billed Ani
Caprimulgidae	<i>Nyctidromus albicollis</i>	Pauraque
Apodidae	<i>Streptoprocne zonaris</i>	White-collared Swift
	<i>Panyptila cayennensis</i>	Lesser swallow-tailed swift
	<i>Chaetura pelagica</i>	Chimney Swift
Trochilidae	<i>Phaethornis guy</i>	Green Hermit

<b>Appendix 1b. Fredonia study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Phaethornis longuemareus</i>	Little Hermit
	<i>Anthracotorax nigricollis</i>	Black-throated Mango
	<i>Saucerottia saucerottei</i>	Steely-vented Hummingbird
	<i>Amazilia tzacatl</i>	Rufous-tailed Hummingbird
	<i>Chlorostilbon mellisugus</i>	Blue-tailed Emerald
Momotidae	<i>Momotus momota</i>	Blue-crowned Motmot
Bucconidae	<i>Malacoptila mystacalis</i>	Moustached Puffbird
Capitonidae	<i>Eubucco bourcierii</i>	Red-headed Barbet
Picidae	<i>Picumnus granadensis</i>	Grayish Piculet
	<i>Piculus rubiginosus</i>	Golden-olive Woodpecker
	<i>Veniliornis kirkii</i>	Red-rumped Woodpecker
	<i>Melanerpes formicivorus</i>	Acorn Woodpecker
	<i>Dryocopus lineatus</i>	Lineated Woodpecker
	<i>Chrysoptilus punctigula</i>	Spot-breasted woodpecker
Dendrocolaptidae	<i>Lepidocolaptes affinis</i>	Spot-crowned Woodcreeper
Furnariidae	<i>Synallaxis albescens</i>	Pale-breasted Spinetail
Formicariidae	<i>Thamnophilus multistriatus</i>	Bar-crested Antshrike
	<i>Grallaria ruficapilla</i>	Chesnut-crowned Antpitta
Cotingidae	<i>Pachyramphus polychopterus</i>	White-winged Becard
Tyrannidae	<i>Zimmerius crysops</i>	Golden-faced Tyrannulet
	<i>Phaeomyias murina</i>	Mouse-colored Tyrannulet
	<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia
	<i>Elaenia frantzii</i>	Mountain Elaenia
	<i>Leptopogon superciliaris</i>	Slaty-capped Flycatcher
	<i>Contopus borealis</i>	Olive-sided Flycatcher
	<i>Contopus virens</i>	Eastern Wood-pewee
	<i>Sayornis nigricans</i>	Black Phoebe
	<i>Machetornis rixosus</i>	Cattle Tyrant
	<i>Myiarchus cephalotes</i>	Pale-edged Flycatcher
	<i>Myiozetetes cayanensis</i>	Rusty-margined Flycatcher
	<i>Myiodynastes maculatus</i>	Streaked Flycatcher
	<i>Tyrannus melancholicus</i>	Tropical Kingbird
Hirundinidae	<i>Stelgidopteryx ruficollis</i>	Southern Rough-winged Swallow
Corvidae	<i>Cyanocorax affinis</i>	Black-chested Jay
Troglodytidae	<i>Thryothorus sp.</i>	Wren
	<i>Troglodytes aedon</i>	House Wren
	<i>Henicorhina leucosticta</i>	White-breasted Wood-wren
Sylviidae	<i>Polioptila plumbea</i>	Tropical Gnatcatcher
Turdidae	<i>Catharus fuscescens</i>	Veery
	<i>Catharus ustulatus</i>	Swainson's Thrush
	<i>Turdus ignobilis</i>	Black-billed Thrush
	<i>Turdus grayi</i>	Clay-colored Thrush
Vireonidae	<i>Vireo olivaceus</i>	Red-eyed Vireo
	<i>Vireo leucophrys</i>	Brown-capped Vireo
	<i>Vireo flavifrons</i>	Yellow-throated Vireo

<b>Appendix 1b. Fredonia study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Icteridae	<i>Molothrus bonariensis</i>	Shiny Cowbird
	<i>Icterus chrysater</i>	Yellow-backed Oriole
Parulidae	<i>Mniotilta varia</i>	Black-and-white Warbler
	<i>Vermivora peregrina</i>	Tennessee Warbler
	<i>Parula pitiayumi</i>	Tropical Parula
	<i>Dendroica aestiva</i>	Northern Yellow-Warbler
	<i>Dendroica cerulea</i>	Cerulean Warbler
	<i>Dendroica fusca</i>	Blackburnian Warbler
	<i>Setophaga ruticilla</i>	American Redstart
	<i>Wilsonia canadensis</i>	Canada Warbler
	<i>Myioborus miniatus</i>	Slate-throated Whitestart
	<i>Basileuterus culicivorus</i>	Golden-crowned Warbler
	<i>Basileuterus fulvicauda</i>	Buff-rumped Warbler
	Coerebidae	<i>Coereba flaveola</i>
<i>Chlorophanes spiza</i>		Green Honeycreeper
Thraupidae	<i>Euphonia musica</i>	Blue-hooded Euphonia
	<i>Euphonia laniirostris</i>	Thick-billed Euphonia
	<i>Tangara cyanicollis</i>	Blue-necked Tanager
	<i>Tangara vitriolina</i>	Scrub Tanager
	<i>Thraupis episcopus</i>	Blue-gray Tanager
	<i>Thraupis palmarum</i>	Palm Tanager
	<i>Ramphocelus dimidiatus</i>	Crimson-backed Tanager
	<i>Ramphocelus flammigerus</i>	Flame-rumped Tanager
	<i>Piranga flava</i>	Hepatic Tanager
	<i>Piranga rubra</i>	Summer Tanager
	<i>Tachyphonus rufus</i>	White-lined Tanager
<i>Hemithraupis guira</i>	Guira Tanager	
Fringillidae	<i>Saltator atripennis</i>	Black-winged Saltator
	<i>Saltator albicollis</i>	Streaked Saltator
	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak
	<i>Atlapetes gutturalis</i>	Yellow-throated Brush-Finch
	<i>Tiaris olivacea</i>	Yellow-faced Grassquit
	<i>Sporophila schistacea</i>	Slate-colored Seedeater
	<i>Zonotrichia capensis</i>	Rufous-collared Sparrow
	<i>Buarremon brunneinucha</i>	Chesnut-capped Brush-finch

**Appendix 1c. Amalfi study site.**

<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Tinamidae	<i>Crypturellus soui</i>	Little Tinamou
Cathartidae	<i>Coragyps atratus</i>	Black Vulture
	<i>Cathartes aura</i>	Turkey Vulture
Accipitridae	<i>Buteo magnirostris</i>	Road-side Hawk
	<i>Accipiter collaris</i>	Semicollared Hawk
Falconidae	<i>Micrastur ruficollis</i>	Barred Forest-Falcon
	<i>Falco sparverius</i>	American Kestrel
	<i>Falco rufigularis</i>	Bat Falcon
	<i>Herpetotheres cachinnans</i>	Laughing falcon
Cracidae	<i>Ortalis columbiana</i>	Colombian Chachalaca
	<i>Aburria aburri</i>	Wattled Guan
Columbidae	<i>Columba fasciata</i>	Band-tailed Pigeon
	<i>Columba subvinacea</i>	Ruddy Pigeon
	<i>Columbina talpacoti</i>	Ruddy Ground-Dove
	<i>Leptoptila verreauxi</i>	White-tipped Dove
Psittacidae	<i>Aratinga wagleri</i>	Scarlet-fronted Parakeet
	<i>Pionus chalcopterus</i>	Bronze-winged Parrot
	<i>Forpus conspicillatus</i>	Spectacled Parrotlet
	<i>Touit</i> sp.	Parrotlet
Cuculidae	<i>Piaya cayana</i>	Squirrel Cuckoo
	<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
	<i>Crotophaga ani</i>	Smooth-billed Ani
Nyctibiidae	<i>Nyctibius griseus</i>	Common Potoo
Caprimulgidae	<i>Nyctidromus albicollis</i>	Pauraque
Apodidae	<i>Streptoprocne zonaris</i>	White-collared Swift
Trochilidae	<i>Phaethornis guy</i>	Green Hermit
	<i>Phaethornis striigularis</i>	Striped-throated (Little) Hermit
	<i>Anthracotorax nigricollis</i>	Black-throated Mango
	<i>Doryfera ludoviciae</i>	Green-fronted Lancebill
	<i>Amazilia franciae</i>	Andean Emerald
	<i>Amazilia tzacatl</i>	Rufous-tailed Hummingbird
	<i>Heliodoxa jacula</i>	Green-fronted Brilliant
	<i>Thalurania colombica</i>	Purple-crowned Wood-nymph
	<i>Klais guimeti</i>	Violet-headed Hummingbird
Trogonidae	<i>Pharomachrus auriceps</i>	Golden-headed Quetzal
Momotidae	<i>Momotus aequatorialis</i>	Highland Motmot
Bucconidae	<i>Malacoptila mystacalis</i>	Moustached Puffbird
Capitonidae	<i>Eubucco bourcierii</i>	Red-headed Barbet
	<i>Capito hypoleucus</i>	White-mantled Barbet
Ramphastidae	<i>Aulacorhynchus haematopygus</i>	Crimson-rumped Toucanet
Picidae	<i>Colaptes punctigula</i>	Spot-breasted Woodpecker

<b>Appendix 1c. Amalfi study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Veniliornis fumigatus</i>	Smoky-brown Woodpecker
	<i>Piculus rubiginosus</i>	Golden-olive Woodpecker
	<i>Melanerpes rubricapillus</i>	Red-crowned Woodpecker
	<i>Dryocopus lineatus</i>	Lineated Woodpecker
Dendrocolaptidae	<i>Lepidocolaptes affinis</i>	Spot-crowned Woodcreeper
Furnariidae	<i>Premnoplex brunnescens</i>	Spotted Barbtail
	<i>Synallaxis albescens</i>	Pale-breasted spinetail
	<i>Syndactyla subalaris</i>	Lineated-foilage-Gleaner
	<i>Thripadectes virgaticeps</i>	Streak-capped Treehunter
	<i>Sclerurus mexicanus</i>	Tawny-throated leafscraper
	<i>Phylidor rufus</i>	Buff-fronted Foliage-gleaner
	<i>Hyloctistes subulatus</i>	Eastern Woodhaunter
	<i>Automolus rubiginosus</i>	Ruddy Foliage-gleaner
	<i>Glyphorhynchus spirurus</i>	Wedge-billed Woodcreeper
	<i>Xenops minutus</i>	Plain Xenops
Thamnophilidae	<i>Cercomacra parkeri</i>	Parker`s Antbird
	<i>Thamnophilus multistriatus</i>	Bar-crested Antshrike
	<i>Thamnophilus unicolor</i>	Uniform Antshrike
	<i>Dysithamnus mentalis</i>	Plain Antvireo
Formicariidae	<i>Grallaria guatemalensis</i>	Scaled Antpitta
	<i>Grallaria ruficapilla</i>	Chesnut-crowned Antpitta
Rhinocryptidae	<i>Scytalopus stilesi</i>	Stiles´ Tapaculo
Cotingidae	<i>Pachyramphus polychopterus</i>	White-winged Becard
	<i>Lipaugus weberi</i>	Chesnut-capped Piha
	<i>Querula purpurata</i>	Purple-throated Fruitcrow
Pipridae	<i>Masius chrysopterus</i>	Golden-winged Manakin
Tyrannidae	<i>Zimmerius chrysops</i>	Golden-faced Tyrannulet
	<i>Lophotriccus pileatus</i>	Scale-crested pygmy Tyrant
	<i>Phaeomyias murina</i>	Mouse-colored Tirannulet
	<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia
	<i>Elaenia chiriquensis</i>	Lesser Elaenia
	<i>Myiodynastes maculatus</i>	Streaked Flycatcher
	<i>Mionectes olivaceus</i>	Olive-striped Flycatcher
	<i>Leptopogon superciliaris</i>	Slaty-capped Flycatcher
	<i>Attila spadiceus</i>	Bright-rumped attila
	<i>Sayornis nigricans</i>	Black Phoebe
	<i>Myiarchus tuberculifer</i>	Dusky-capped Flycatcher
	<i>Myiarchus cephalotes</i>	Pale-edged Flycatcher
	<i>Myiozetetes cayanensis</i>	Rusty-margined Flycatcher
	<i>Myiodynastes maculatus</i>	Streaked Flycatcher
	<i>Tolmomyias sulphurescens</i>	Yellow-olive Flycatcher
	<i>Pogonotriccus ophthalmicus</i>	Marble-faced Bristle-tyrant
	<i>Phylloscartes superciliaris</i>	Sepia-capped Flycatcher

<b>Appendix 1c. Amalfi study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Tyrannus melancholicus</i>	Tropical Kingbird
Hirundinidae	<i>Stelgidopteryx ruficollis</i>	Southern Rough-winged Swallow
Corvidae	<i>Cyanocorax affinis</i>	Black-chested Jay
Troglodytidae	<i>Thryothorus spadix</i>	Sooty-headed Wren
	<i>Henicorhina leucophrys</i>	Gray-breasted Wood-wren
Sylviidae	<i>Polioptila plumbea</i>	Tropical Gnatcatcher
	<i>Ramphocaenus melanurus</i>	Long-billed Gnatwren
Turdidae	<i>Catharus fuscescens</i>	Veery
	<i>Platycichla leucops</i>	Pale-eyed Thrush
	<i>Catharus fuscater</i>	Slaty-backed Nightingale Thrush
	<i>Catharus ustulatus</i>	Swainson's Thrush
	<i>Turdus obsoletus</i>	Pale-vented Thrush
	<i>Myadestes ralloides</i>	Andean Solitaire
Vireonidae	<i>Vireo olivaceus</i>	Red-eyed Vireo
	<i>Vireo leucophrys</i>	Brown-capped Vireo
Icteridae	<i>Molothrus bonariensis</i>	Shiny Cowbird
	<i>Icterus chrysater</i>	Yellow-backed Oriole
Parulidae	<i>Mniotilta varia</i>	Black-and-white Warbler
	<i>Vermivora peregrina</i>	Tennessee Warbler
	<i>Parula pitiayumi</i>	Tropical Parula
	<i>Dendroica fusca</i>	Blackburnian Warbler
	<i>Seiurus noveboracensis</i>	Northern Waterthrush
	<i>Wilsonia canadensis</i>	Canada Warbler
	<i>Myioborus miniatus</i>	Slate-throated Whitestart
	<i>Basileuterus culicivorus</i>	Golden-crowned Warbler
	<i>Basileuterus tristriatus</i>	Three-striped Warbler
	<i>Basileuterus fulvicauda</i>	Buff-rumped Warbler
Coerebidae	<i>Coereba flaveola</i>	Bananaquit
	<i>Chlorophanes spiza</i>	Green Honeycreeper
	<i>Cyanerpes caeruleus</i>	Purple Honeycreeper
Thraupidae	<i>Chlorochrysa nitidissima</i>	Multicolored Tanager
	<i>Euphonia xanthogaster</i>	Orange-bellied Euphonia
	<i>Iridosornis porphyrocephala</i>	Purplish-mantled tanager
	<i>Euphonia laniirostris</i>	Thick-billed Euphonia
	<i>Tangara cyanicollis</i>	Blue-necked Tanager
	<i>Tangara gyrola</i>	Bay-headed Tanager
	<i>Tangara guttata</i>	Speckled Tanager
	<i>Tangara vitriolina</i>	Scrub Tanager
	<i>Tangara arthus</i>	Golden Tanager
	<i>Tangara heinei</i>	Black-capped Tanager
	<i>Thraupis episcopus</i>	Blue-gray Tanager
	<i>Thraupis palmarum</i>	Palm Tanager
	<i>Ramphocelus dimidiatus</i>	Crimson-backed Tanager

<b>Appendix 1c. Amalfi study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Piranga rubra</i>	Summer Tanager
	<i>Tangara icterocephala</i>	Siver-throated Tanager
	<i>Chlorospingus flavigularis</i>	Yellow-throated Bush-Tanager
	<i>Tachyphonus rufus</i>	White-lined Tanager
	<i>Hemithraupis guira</i>	Guira Tanager
Fringillidae	<i>Saltator atripennis</i>	Black-winged Saltator
	<i>Saltator albicollis</i>	Streaked Saltator
	<i>Cyanocompsa cyanoides</i>	Blue-black Grossbeak
	<i>Atlapetes gutturalis</i>	Yellow-throated Brush-Finch
	<i>Tiaris olivacea</i>	Yellow-faced Grassquit
	<i>Sporophila schistacea</i>	Slate-colored Seedeater
	<i>Sporophila nigricollis</i>	Yellow-bellied Seedeater
	<i>Zonotrichia capensis</i>	Rufous-collared Sparrow
	<i>Buarremon brunneinuchus</i>	Chesnut-capped Brush-Finch
	<i>Buarremon torquatus</i>	Striped-headed Brush-Finch
	<i>Carduelis psaltria</i>	Lesser Goldfinch

<b>Appendix 1d. Chinacota study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Tinamidae	<i>Crypturellus soui</i>	Little Tinamou
Cathartidae	<i>Coragyps atratus</i>	Black Vulture
	<i>Cathartes aura</i>	Turkey Vulture
Accipitridae	<i>Chondrohierax uncinatus</i>	Hook-billed Kite
	<i>Buteo magnirostris</i>	Road-side Hawk
	<i>Asturina nitida</i>	Gray-lined Hawk
Falconidae	<i>Falco sparverius</i>	American Kestrel
	<i>Milvago chimachima</i>	Yellow-headed Caracara
	<i>Caracara plancus</i>	Crested Caracara
Cracidae	<i>Ortalis ruficauda</i>	Rufous-vented Chachalaca
Charadriidae	<i>Vanellus chilensis</i>	Southern Lapwing
Columbidae	<i>Columbina talpacoti</i>	Ruddy Ground-Dove
	<i>Leptoptila verreauxi</i>	White-tipped Dove
Psittacidae	<i>Forpus passerinus</i>	Green-rumped Parrotlet
Cuculidae	<i>Piaya cayana</i>	Squirrel Cuckoo
	<i>Tapera naevia</i>	Striped Cuckoo
	<i>Crotophaga ani</i>	Smooth-billed Ani
Apodidae	<i>Streptoprocne zonaris</i>	White-collared Swift
	<i>Progne chalybea</i>	Gray-breasted Martin
Trochilidae	<i>Chalybura bufonii</i>	White-vented Plumeleteer
	<i>Anthracotorax nigricollis</i>	Black-throated Mango
	<i>Amazilia tzacatl</i>	Rufous-tailed Hummingbird
	<i>Chlorostilbon russatus</i>	Coppery Emerald
	<i>Phaethornis griseogularis</i>	Gray-chinned Hermit
Ramphastidae	<i>Aulacorhynchus haematopygus</i>	Crimson-rumped Toucanet
Picidae	<i>Picumnus olivaceus</i>	Olivaceous Piculet
	<i>Picumnus squamulatus</i>	Scaled Piculet
	<i>Colaptes punctigula</i>	Spot-breasted Woodpecker
	<i>Piculus rubiginosus</i>	Golden-olive Woodpecker
	<i>Veniliornis kirkii</i>	Red-rumped Woodpecker
	<i>Melanerpes rubricapillus</i>	Red-crowned Woodpecker
	<i>Dryocopus lineatus</i>	Lineated Woodpecker
	<i>Chrysoptilus punctigula</i>	Spot-breasted woodpecker
Dendrocolaptidae	<i>Lepidocolaptes affinis</i>	Spot-crowned Woodcreeper
	<i>Campylorhampus trochilirostris</i>	Red-billed Scythebill
Furnariidae	<i>Synallaxis albescens</i>	Pale-breasted Spinetail
	<i>Synallaxis cinnamomea</i>	Striped-breasted Spinetail
Formicariidae	<i>Thamnophilus multistriatus</i>	Bar-crested Antshrike
	<i>Grallaria ruficapilla</i>	Chesnut-crowned Antpitta
	<i>Dysithamnus mentalis</i>	Plain Antvireo
	<i>Craniroleuca subcristata</i>	Crested Spinetail
Cotingidae	<i>Pachyramphus polychopterus</i>	White-winged Becard



<b>Appendix 1d. Chinacota study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Pachyramphus rufus</i>	Cinereous Becard
Tyrannidae	<i>Phaeomyias murina</i>	Mouse-colored Tyrannulet
	<i>Zimmerius chrysops</i>	Golden-faced Tyrannulet
	<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia
	<i>Atalotriccus pilaris</i>	Pale-eyed Pygmy-Tyrant
	<i>Contopus borealis</i>	Olive-sided Flycatcher
	<i>Machetornis rixosus</i>	Cattle Tyrant
	<i>Myiarchus</i> sp.	Flycatcher
	<i>Megarhynchus pitangua</i>	Boat-billed Flycatcher
	<i>Myizetetes cayanensis</i>	Rusty-margined Flycatcher
	<i>Tyrannus melancholicus</i>	Tropical Kingbird
	<i>Todistrum cinereum</i>	Common Tody-Flycatcher
	<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher
Hirundinidae	<i>Stelgidopteryx ruficollis</i>	Southern Rough-winged Swallow
	<i>Notiochelidon cyanoleuca</i>	Blue and White Swallow
Troglodytidae	<i>Thryothorus rufalbus</i>	Rufous and White Wren
	<i>Troglodytes aedon</i>	House Wren
	<i>Henicorhina leucophrys</i>	Gray-breasted Wood-wren
	<i>Microcerculus marginatus</i>	Southern Nightingale-Wren
Mimidae	<i>Mimus gilvus</i>	Mockingbird
Turdidae	<i>Catharus aurantiirostris</i>	Orange-billed Nightingale Thrush
	<i>Turdus ignobilis</i>	Black-billed Thrush
	<i>Turdus nudigenis</i>	Bare-eyed Thrush
	<i>Platycichla flavipes</i>	Yellow-legged Thrush
Vireonidae	<i>Vireo olivaceus</i>	Red-eyed Vireo
	<i>Hylophilus flavipes</i>	Scrub Greenlet
	<i>Cyclarhis gujanensis</i>	Rufous-browed Peppershrike
	<i>Vireo flavifrons</i>	Yellow-throated Vireo
Icteridae	<i>Molothrus bonariensis</i>	Shiny Cowbird
	<i>Icterus auricapillus</i>	Orange-crowned Oriole
Parulidae	<i>Mniotilta varia</i>	Black-and-white Warbler
	<i>Vermivora peregrina</i>	Tennessee Warbler
	<i>Parula pitiayumi</i>	Tropical Parula
	<i>Dendroica aestiva</i>	Northern Yellow-Warbler
	<i>Dendroica cerulea</i>	Cerulean Warbler
	<i>Dendroica fusca</i>	Blackburnian Warbler
	<i>Setophaga ruticilla</i>	American Redstart
	<i>Basileuterus tristriatus</i>	Three-striped Warbler
	<i>Oporornis philadelphia</i>	Mourning Warbler
Coerebidae	<i>Coereba flaveola</i>	Bananaquit
Thraupidae	<i>Euphonia laniirostris</i>	Thick-billed Euphonia
	<i>Schistoclamys melanopis</i>	Black-faced Tanager
	<i>Pipraeida melanonota</i>	Fawn-breasted Tanager
	<i>Tangara cyanicollis</i>	Blue-necked Tanager

<b>Appendix 1d. Chinacota study site.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Tangara cyanoptera</i>	Black-headed Tanager
	<i>Tangara cayana</i>	Burnished-buff Tanager
	<i>Cissopis leveriana</i>	Magpie Tanager
	<i>Tangara gyrola</i>	Bay-headed Tanager
	<i>Thraupis episcopus</i>	Blue-gray Tanager
	<i>Thraupis palmarum</i>	Palm Tanager
	<i>Ramphocelus dimidiatus</i>	Crimson-backed Tanager
	<i>Piranga rubra</i>	Summer Tanager
	<i>Tachyphonus rufus</i>	White-lined Tanager
	<i>Hemithraupis guira</i>	Guira Tanager
Fringillidae	<i>Saltator maximus</i>	Buff-throated Saltator
	<i>Saltator striatipectus</i>	Streaked Saltator
	<i>Sicalis flaveola</i>	Saffron Yellow-Finch
	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak
	<i>Sporophila nigricollis</i>	Yellow-bellied Seedeater
	<i>Sporophila intermedia</i>	Gray Seedeater
	<i>Carduelis psaltria</i>	Lesser goldfinch
	<i>Volatinia jacarina</i>	Blue-back Grassquit
	<i>Zonotrichia capensis</i>	Rufous-collared Sparrow

<b>Appendix 1e. Study sites in Santander province.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
Cathartidae	<i>Coragyps atratus</i>	Black Vulture
Accipitridae	<i>Buteo magnirostris</i>	Road-side Hawk
Falconidae	<i>Caracara plancus</i>	Crested Caracara
	<i>Milvago chimachima</i>	Yellow-headed Caracara
Cracidae	<i>Ortalis ruficauda</i>	Rufous-vented Chachalaca
Columbidae	<i>Columbina talpacoti</i>	Ruddy Ground-Dove
	<i>Leptotila verreauxi</i>	White-tipped Dove
Cuculidae	<i>Piaya cayana</i>	Squirrel Cuckoo
	<i>Crotophaga ani</i>	Smooth-billed Ani
Trochilidae	<i>Saucerottia saucerrottei</i>	Steely-vented Hummingbird
	<i>Amazilia tzacatl</i>	Rufous-tailed Hummingbird
	<i>Amazilia castaneiventris</i>	Chesnut-bellied Hummingbird
Momotidae	<i>Momotus aequatorialis</i>	Highland Motmot
Picidae	<i>Melanerpes rubricapillus</i>	Red-crowned Woodpecker
	<i>Picumnus olivaceus</i>	Olivaceous Piculet
Dendrocolaptidae	<i>Lepidocolaptes affinis</i>	Spot-crowned Woodcreeper
Furnariidae	<i>Synallaxis albescens</i>	Pale-breasted Spinetail
Thamnophilidae	<i>Thamnophilus multistriatus</i>	Bar-crested Antshrike
Tyrannidae	<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia
	<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher

<b>Appendix 1e. Study sites in Santander province.</b>		
<b>Family</b>	<b>Latin name</b>	<b>English name</b>
	<i>Pitangus sulphuratus</i>	Great Kiskadee
	<i>Sayornis nigricans</i>	Black Phoebe
	<i>Todirostrum cinereum</i>	Common Tody-Flycatcher
	<i>Tyrannus melancholicus</i>	Tropical Kingbird
	<i>Machetornis rixosus</i>	Cattle Tyrant
	<i>Zimmerius crisops</i>	Golden-faced Tyrannulet
Hirundinidae	<i>Notiochelidon cyanoleuca</i>	Blue and White Swallow
Troglodytidae	<i>Thryothorus nicefori</i>	Niceforo's Wren
	<i>Troglodytes aedon</i>	House Wren
Mimidae	<i>Mimus gilvus</i>	Mockingbird
Turdidae	<i>Turdus grayi</i>	Clay-colored Thrush
	<i>Turdus ignobilis</i>	Black-billed Thrush
Vireonidae	<i>Cyclaris gujanensis</i>	Rufous-browed Peppershrike
Parulidae	<i>Parula pitiayumi</i>	Tropical Parula
	<i>Dendroica fusca</i>	Blackburnian Warbler
	<i>Mniotilta varia</i>	Black-and-white Warbler
	<i>Vermivora peregrina</i>	Tennessee Warbler
	<i>Dendroica cerulea</i>	Cerulean Warbler
	<i>Dendroica castanea</i>	Bay-breasted Warbler
	<i>Wilsonia canadensis</i>	Canada Warbler
Coerebidae	<i>Coereba flaveola</i>	Bananaquit
Thraupidae	<i>Euphonia lanirostris</i>	Thick-billed Euphonia
	<i>Piranga rubra</i> *	Summer Tanager
	<i>Tangara cyanicollis</i>	Blue-necked Tanager
	<i>Tangara arthus</i>	Golden Tanager
	<i>Tangara guttata</i>	Speckled Tanager
	<i>Tangara vitriolina</i>	Scrub Tanager
	<i>Thraupis episcopus</i>	Blue-gray Tanager
	<i>Thraupis palmarum</i>	Palm Tanager
	<i>Tachyphonus rufus</i>	White-lined Tanager
	<i>Ramphocelus dimidiatus</i>	Crimson-backed Tanager
Fringillidae	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak
	<i>Saltator maximus</i>	Buff-throated Saltator
	<i>Sicalis flaveola</i>	Saffron Yellow-Finch
	<i>Saltator striatipectus</i>	Streaked Saltator
	<i>Sporophila nigricollis</i>	Yellow-bellied Seedeater
	<i>Sporophila schistacea</i>	Slate-colored Seedeater
	<i>Tiaris olivacea</i>	Yellow-faced Grassquit
	<i>Volatinia jacarina</i>	Blue-back Grassquit
	<i>Zonotrichia capensis</i>	Rufous-collared Sparrow

**Appendix 2.** Pictures of the study sites and bird species



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Panoramic view of coffee shade  
plantations in Fredonia. The Cauca river  
at the bottom

Photographed by G.Colorado

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Canopy mist net at Jericó site  
installed on *guadua* poles

Photographed by S. Galeano

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Typical shade coffee plantation in Zapatoca, Santander  
Photographed by Pablo Florez

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Female *Dendroica cerulea*. March 2006.  
Photographed by Sandra Galeano

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Charalá town, Santander Province, with shade coffee plantations  
Photographed by Pablo Florez

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Natural forest in Virolin hamlet, Charalá town, Santander province  
Photographed by Pablo Florez

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Study site in San Fermin hamlet, Yarumal town, Antioquia province. Typical matrix of corridors of natural covers and pastures for cattle rising. Gabriel Colorado.

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Yotoco preserve, study site in Valle del Cauca, South of Central Andes. Pablo Florez.

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Male Cerulean Warbler captured in Jerico. January 2006. Sandra Galeano.

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Female Cerulean Warbler. Darien site. September 2005. Carolina Gomez.

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