



# Ecological Study of Bird Assembles in Cubanacan Protected Area, Villa Clara, Cuba

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## Research Article

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## Abstract

This paper describes an ecological study of bird assembling carried out in Cubanacán Protected Area in Villa Clara province, Cuba, in the months of June and July. The ornithological work was carried out in an area with xeromorphic shrub plant formation on serpentine soil. For the data collection, the area was sampled by the linear transects method, two in total, 250 m long and 15 m wide on both sides of the observer. A total of 4 counts were made in the months of June and July, which were executed by the visual and auditory method, supported by a binocular. The data obtained were quantified and the different ecological indexes were applied. In the study area, there are 22 bird species belonging to 12 families of 8 orders, Passeriformes being the best represented order with 5 families and 10 species. Of the total number of birds reported, 2 genera (25%), 5 species (53.8%) and 10 subspecies (14.0%) are endemic. In the plant formation, 7 trophic guilds are distinguished in the months of June and July. A density of 59.25 individuals / ha was found in June, while in July it was only 53.93. The similarity index between both months was 70%, very similar to that obtained in this plant formation for other months. The diversity was 2.22 and 2.52 for June and July, respectively, while the richness was 13.0 for both months. Equity varied very little 0.79 in June and 0.88 in July, so the distribution of the number of individuals is fairly uniform.

**Keywords:** Bird Fauna; Cubanacán Protected Area; Trophic Guilds; Xeromorph Scrub; Villa Clara

## Introduction

The ecological evaluation of the bird community or ornitocenosis is currently the focus of numerous research projects, which are very important to understand the role birds perform in different ecosystems, provided the great influence they exert on the ecological balance due to the great diversity of species [1-3].

The authors of this paper agree with Armiñana, et al. [4] in acknowledging the value of the results provided by other authors [5-13].

Birds (Gr. Ornith; Lat. Birds) are perhaps the most studied and best known group of vertebrate animals, men have given them their greatest attention, in addition, they are the easiest to recognize because of the feathers covering their

body (feature not present in the rest of the vertebrates). This makes the members of this class more similar among each other than the members of any other animal group [14,15].

According to Madrid, et al. [15] around 9,800 bird species have been registered in the world. In Cuba, 397 have been confirmed, included in 71 families and grouped into 26 orders, of which the most diverse are Paseriformes, Charadriiformes, and Anseriformes. Of the total number of species, 280 are considered common, some are exotic ones that have been naturalized, and the rest are very rare or occasional; 70% of the species are migratory [16,17].

Around 50% of the species registered in the Antilles are present in the Cuban birdlife [4]. At present, different factors are affecting the Cuban fauna and, of course, birds are not exempt from them: the destruction of habitats (identified as the main factor considering that many species are restricted to certain areas of the archipelago), poaching, the introduction of invasive alien species, illegal trading, and environmental pollution [18-22]. Additionally, different researchers like agree that climate change has modified natural habitats [23-27]. 30 bird species (8% of the total) are threatened, including some migratory species that have seen their breeding areas reduced in North America [28,29]. Out of the 9,917 bird species evaluated by the International Union for Conservation of Nature (IUCN), 12% have been categorized as threatened [30].

In the study of different bird communities in Cuba, conducted ornitocenosis research in a coastline mangrove of the eastern region of Cuba, obtaining a species richness of 16 [1,6,31]. When studying the structure of the bird community in a seasonal evergreen forest, in an area of the Sierra del Rosario in Pinar del Río, they obtained a density of 13.69 for April and of 15.14 for May,  $H' = 2.041$ ,  $J' = 0.869$  and a

dominance of 0.07.

Studying the fauna in two plant formations: coast line bushes and mangroves in Cayo Matías (Canarreos island group), in April and May, obtained that  $S = 21\%$  and  $17\%$ ;  $H' = 2,09$  and  $2,038$ ; and  $J' = 0.75$  and  $0.93$ , respectively in the coast line bushes, while in May for the mangrove,  $H = 1.47$ ,  $S = 22\%$  and  $J' = 0.94$  [8].

Taking into account all the above, the present paper aims to provide the main ecological characteristics of birdlife in an area with xeromorphic scrub plant formation on streamer soil, in Cubanacán protected area in Villa Clara, Cuba.

## Materials and Methods

### Study Area

To carry out the research, an area with xeromorphic scrub plant formation on streamer soil was selected in Cubanacán Protected Area. This is framed within the Heights of Cubanacán in the province of Villa Clara, occupying areas of Santa Clara and Placetas municipalities. It is part of the serpentine axis that crosses the island from east to west. It has an extension of 7237 ha, which corresponds entirely to land area. The reserve extends in the form of a trapeze from the Central Road to the National Highway, being wider in its southern portion.

It limits on the North with the Central highway at kilometer 306, on the Northeast with areas belonging to the Forestry Company, on the Southeast with farms of an Agricultural Production Cooperative (APC), on the South with another APC, on the Southwest with Revacadero town, and with private lands that extend all the way to the north as part of an area known as Llanos de Agabama (Figure 1).



**Figure 1:** Satellite view of the Cuban Protected Area.

As natural values of the area, metamorphic rocks can be found as part of a tectonic matrix of serpentinites in which

they form dense clusters that could be either blocks or small chains of heights. In Sierra Alta de Agabama mountain range,

abundant large blocks of these rocks have been identified. Serpentine rocks are differentiated by their structural peculiarities and mineral composition.

The geographic relief of the area is diverse, from slightly plain to undulating or with hills, pre-mountains, or low mountains ranging between 100 and 475 meters above the sea level. The highest elevations form a central core with steep slopes that have been strongly modified by erosional processes, surrounded by a ring of hills that becomes flatter towards the periphery. The plant formations present in the area (Capote and Berazaín 1984) [32] are:

### Thorny Xeromorphic Scrub on Serpentinities (Cuabal)

It is characterized by presenting a dense shrub layer between 2 and 4 meters high and occasionally between 4 and 6 meters, the herbaceous formations are dispersed and there is a large number of palm trees, epiphytes, and lianas. The flora at Cuabales area comprises 426 different species) with a high level of endemism, among which 14 are local [33].

### Subthorny Scrub on Shales

It is developed on shales in more humid areas and on some slopes close to Palma Sola and Sierra Alta de Agabama hills. It is characterized by vegetation influenced by elements of the Cuabal, but with abundant species.

### Gallery Forest

It develops on the banks of streams and rivers and it is characterized by the presence of abundance of palm trees. This formation is influenced by floristic elements present in the Cuabal.

### Secondary Vegetation

It is present in areas altered by fire, forest planting or other anthropic actions. The entire area was either directly or indirectly linked to the historical events related to the settlement of the founders of Santa Clara migrating from San Juan de los Remedios village. The area was the basis for the economic and agricultural support of the city, it provided the resources to build it with the use of slave forces and, therefore, it was the scenario of their struggles, as well as of the activities related to the independence wars.

A total of 426 spermatophyta species belonging to 286 genera and 90 families (48.6% of the families represented in Cuba) are reported in the area. The genus-family ratio is 3.17 and the species-genus ratio is 1.48. The families represented by the largest number of genera are: Poaceae (26); Fabaceae

and Rubiaceae (18), Asteraceae (14), Euforbiaceae (12) and Orquidaceae (10). The greatest diversity of species by genus occurs in Tillandsia (9), Eugenia and Croton (7), Erythroxylon and Zanthoxylum (6), Cassia, among others [33].

The serpentine district of Santa Clara has a high level of endemism, out of the 739 endemic genera, 6 are represented. 30.17% are endemic; 14 are local, 17 are endemic to Central Cuba, 59 are national endemic, which corroborates what was stated about the endemism found on this substrate in Cuba. The area constitutes one of the main evolution centers of plant species in Central Cuba with 1 genus and 14 local endemic species.

To collect the data in the study area, it was sampled using the linear transects method, two in total, with a length of 250 m and a width of 15 m on both sides of the observer.

A total of four counts were made, which were made from 7:00 am until 10:30 am, and were performed by the visual and auditory method, supported by a TENTO ETPZ Soviet binocular 2, 7x50.

The data obtained were quantified and the ecological indexes listed below were applied:

**Similarity:** Index used to compare the degree of similarity between two samples and between two assembling.

$$S = \frac{2CPq}{CP+Cq} \times 100 \text{ Sorensen (1948)}$$

**Dissimilarity:** To compare the degree of difference between two samples and between communities.

$$S' = 100 - S \text{ Sorensen (1948)}$$

**Diversity:** It associates two concepts, the richness of species and the number of individuals by species, that is, richness based on the number of species in the ornitocenosis. Diversity includes both variables in the diversity index.

$$H' = -\sum P_i \ln P_i \text{ where } P_i = \frac{N_i}{N} \text{ Shannon - Weaver (1948)}$$

The richness of species or variety of species is contemplated in the index:

$$d_1 = \frac{s-1}{\ln s} \text{ Margalef (1958)}$$

**Equity:** It takes into account the distribution of the number of individuals by species, it is measured by the index:

$$J' = \frac{H'}{H_{\max}} \text{ Pielou (1966)}$$

**Prevalence:** Dominant effect exerted by a population in the

community and it is measured by the index:

$$e = \frac{N_i}{N} \text{ Simpson (1949)}$$

In addition to the previous ecological indexes, the density or abundance estimator parameters were calculated, represented by a population size referred to the unit of species.

The birds reported for the study area were systematically located, which were organized in guilds or trophic groups [34,35]. According to the criteria:

- **Granivores:** species that feed primarily on grains.
- **Ground insectivores:** species that feed on insects captured on the ground.
- **Perch insectivores:** species that feed on insects captured on the fly, starting from a resting position on a branch or perch.
- **Foliage insectivores:** species that capture their prey within the foliage.
- **Trunk insectivores:** species that feed on insects captured on or inside tree trunks.
- **Fruit insectivores:** species that feed on insects and fruit.
- **Nectarivores:** birds that feed on the nectar of flowers, completing their diet with some insects.
- **Predators:** Members of this group eat insects and vertebrates or only vertebrates.

The success in the use of guilds for the systematic sampling of the assembling is highly dependent on the criteria of aggregation chosen, on the need for a particular resource or habitat component for the target group of organisms, and on the relationship between the type and particular intensity of the disturbance and the afore mentioned resource [36]. Assures that, in general, the arrangement of species in guilds with an ecological value allows a more realistic characterization of the structure of the communities, as well as the inference of their intrinsic functioning models [37].

## Results and Discussion

### Systematic Composition

The avifauna present in the plant formation comprises a total of 8 orders (Table 1) out of the 26 present in the Cuban fauna (30.7%), 12 families out of the 71 reported (16.9%) (Table 2), and 22 species out of the 397 confirmed for the Cuban archipelago (5.5%) (Table 3).

The best represented order in families (5) and species (10) is Passeriformes. It is important to point out that the

study was carried out during the summer, when winter migratory species are not found and that the Cuban birdlife is composed of approximately 70% of these migratory species.

Among the birds in this plant formation, there are species of great importance for their endemism, beauty, color, hunting value, and for the ecological function they perform in the ecosystem (Table 4).

Two genera: *Glauclidium* and *Xiphidiopicus*; five species: *Glauclidium siju*, *Priotelus temnurus*, *Todus multicolor*, *Xiphidiopicus percussus*, and *Vireo gundlachii*, and 10 subspecies, are endemic.

The species with significant hunting value are only three belonging to the Columbiformes order: *Paloma Rabiche*, *Paloma Aliblanca*, and *Torcaza Cuellimorada*; however, due to the characteristics of the plant formation and the population density, there are no possibilities to perform sport hunting in the area.

Among the birds that stand out for their ecological function are the two wood peckers (the Bobito and the Pitirre) that step in the balance of the ecosystem by consuming a large number of insects. In addition, they prepare places for the nesting of different species such as the Sijú Platanero, the Toco-ro-ro, among others. Several species with aesthetic value for their beautiful colors and for their melodious sounds are present in the study area, including the Humming Bird or Zunzún, the Cuban Trogon or Toco-ro-ro, the Cuban Tody or Cartacuba, the Yellow-faced Grassquit or Tomeguín de la Tierra and the Cuban Bulfinch or Negrito.

Of the species reported in the xeromorphic bush on serpentinites, one is part of the Red Book of Cuban Vertebrates, the Negrito or *Melopyrrha nigra nigra* (Figure 2), whose main threat factors are: illegal trade, fragmentation and habitat loss, tourism development, fires and hurricanes.



**Figure 2:** *Melopyrrha nigra nigra*.

*Melopyrrha nigra* is the only living species of its kind, with a distribution restricted only to the Caribbean, specifically to Cuba (*M. n. Nigra*) and Grand Cayman (*M. n. Taylori*) [38].

The subspecies *M. n. Nigra* (Negrito) is widely distributed in Cuba, including Isla de la Juventud, different keys along the north coast and Cayo Cantiles on the south coast. It can be found from sea level to moderate altitudes in different types of forests, including evergreen forest, semi-deciduous forest, rainforest, pine forest and mangrove. In addition, it is common in shrubs and secondary vegetation [16].

However, the number of plant formations where the

reproduction of the species has been verified is lower, as preliminary studies suggest [39,40].

The reproductive season comprises the months from March to August. The nest, globular in shape and with a lateral entry, is built at a height that fluctuates between 1 and 5 m, usually on a substrate consisting of spiny plants.

It lays from 3 to 5 off-white eggs, with spots ranging from brown to lilac and concentrated towards one end. The incubation period is about 12 to 13 days and the nestlings leave the nest between 14 and 16 days [41-43].

Orders	No. Of families	%
Columbidae	1	100
Cuculidae	1	100
Strigidae	1	50
Micropodidae	1	50
Trogonidae	1	100
Coraciidae	1	50
Picidae	1	100
Passeridae	5	31

**Table 1:** Systematic composition of the diurnal terrestrial birdlife in the plant formation.

Families	No. Of species	%
Columbidae	4	36
Cuculidae	2	40
Strigidae	1	20
Trochilidae	1	33
Trogonidae	1	100
Todidae	1	100
Picidae	2	33
Tyrannidae	2	13
Turdidae	1	10
Vireonidae	2	5
Icteridae	3	5
Fringillidae	2	10.5

**Table 2:** Systematic composition of the diurnal terrestrial birdlife in the plant formation.

Families	Scientificname	Vulgar name
Columbidae	<i>Patagioenas squamosa</i> (Bonnaterre, 1792)	<i>Torcaza Cuellimorada</i> / Scaly-naped Pigeon
	<i>Zenaida macroura</i> (Linneo, 1758)	<i>Paloma Rabiche</i> / Mourning Dove
	<i>Zenaida asiatica</i> (Linneo, 1758)	<i>Paloma Aliblanca</i> / White-winged Dove
	<i>Columbina passerina</i> (Linneo, 1758)	Tojosa / Common Ground-Dove
Cuculidae	<i>Coccyzus merlini</i> (d'Orbigny, 1839)	Arriero / Gread Lizard-Cuckoo ***
	<i>Crotophaga ani</i> Linneo, 1758	Judío / Smooth-billed Ani
Strigidae	<i>Glaucidium siju</i> (d'Orbigny, 1839)	Sijú Platanero / Cuban Pygmy-Owi *
Trochilidae	<i>Chlorostilbon ricordii</i> (Gervais, 1835)	Zunzún / Cuban Emerald ***
Trogonidae	<i>Priotelus temnurus</i> (Temminck, 1825)	Tocororo / Cuban Trogon *
Todidae	<i>Todu smulticolor</i> Gould, 1837	Cartacuba / Cuban Tody ***
Picidae	<i>Melanerpes superciliaris</i> (Temminck, 1827)	<i>Carpintero Jabado</i> / West Indian Woodpecker ***
	<i>Xiphidiopicus percussus</i> (Temminck, 1826)	<i>Carpintero Verde</i> / Cuban Green Woodpecker *
Tyrannidae	<i>Tyrannus dominicensis</i> (Gmelin, 1788)	<i>Pitirre Abejero</i> / Gray Kingbird
	<i>Contopus caribaeus</i> (d'Orbigny, 1839)	<i>Bobito Chico</i> / Cuban Pewee ***
Turdidae	<i>Turdus plumbeus</i> Linneo, 1758	<i>Zorzal Real</i> / Red-legged Thrush ***
Vireonidae	<i>Vireo altiloquus</i> (Vieillot, 1807)	Bien TeVeo / Black-whiskered Vireo
	<i>Vireo gundlachii gundlachii</i> Lembeye, 1850	Juan Chiví / Cuban Vireo ***
Icteridae	<i>Quiscalus niger</i> (Boddaert, 1783)	Chichinguaco / Greater Antillean Grackle ***
	<i>Agelaius humeralis</i> (Vigors, 1827)	Mayito / Tawny-shouldered Blackbird
	<i>Icterus melanopsis</i> (Wagler, 1829)	Solibio / Cuban Oriole ***
Thraupidae	<i>Tiaris olivaceus</i> (Linneo, 1766)	Tomeguín de la Tierra / Yellow-faced Grassquit
	<i>Melopyrrha nigra nigra</i> (Linneo, 1758)	Negrito / Cuban Bulfinch ***

**Symbology:** (\*) Endemic genus (\*\*) Endemic species (\*\*\*) Species with endemic subspecies.

**Table 3:** Systematic relationship of birds in plant formation.

Taxon	Quantity	%
Genus	2	25
Species	5	23
Subspecies	10	14

**Table 4:** Endemism of birdlife.

### Trophic Groups or Guilds

All the bird species existing in the study area were separated by guilds, an aspect of utmost importance because between two trophic groups (even if they are related) there is no competition for food, allowing a high richness of species in the same habitat and, therefore, a good use of the food sources. This is very important to our bird fauna that receives many continental migratory species, especially during the winter, softening the competition effect.

As shown in Table 5, the birds were grouped into 8 guilds, each of them specifying the species. When analyzing

the plant formation, it is observed that the guild of the granivores increases by one in July, although the Tojosa is not reported that month, the three species that influence the variations are the pigeons that nest and find food in the area.

The perch insectivore guild undergoes variations from one month to another, three species in each month, although one of them, the *Pitirre abejero*, is not characteristic of that plant formation.

Frugivorous insectivores are not typical species of the plant formation in which the ornithological studies are carried out, however, they were located in the area mainly because it provides them with shelter and some food, especially some small fruits.

Only in July were carpenters reported species not representative of the place and members of the guild of trunk insectivorous. They were located occasionally, very likely in search of food.

Three predatory species were observed: the Arriero, the Judío and the Sijú Platanero, all find food in the area, especially insects, amphibians and reptiles. Only two species of foliage insectivorous birds are found in the area, one being

a resident (Juan Chiví) and the other a summer migratory species (Bien TeVeó), not reported in July, probably due to not having the proper vegetation (Table 5).

Trophic group	Species	June		July	
		No	%	No	%
Granivores	Paloma Rabiche	4	18.8	5	22.7
	Paloma Aliblanca				
	Tojosa				
	Torcaza Cuellimorada				
	Tomeguín de la Tierra				
	Negríto				
Hanger insectivores	Cartacuba	3	13.6	3	13.6
	Pitirre Abejero				
	Bobito Chico				
Soil insectivores	Zorzal Real	1	4.5	0	0
Fruit Insectivorous	Tocororo	3	13.6	3	13.6
	Mayito				
	Chichinguaco				
	Solibio				
Trunk insectivores	Carpintero Verde	0	0	2	9.9
	Carpintero jabado				
Foliage insectivores	Juan Chiví	2	9.9		
	Bien Te Veo				
Nectarivores	Zunzún	1	4.5	1	4.5
Predators	Judío	3	13.6	2	9.9
	Arriero				
	Sijú Platanero				

**Table 5:** Distribution of birds by trophic groups.

### Similarity and Dissimilarity

If the degree of similarity between both months in the plant formation is analyzed, the result is 70%, much higher than the 51% obtained by Artiles, et al. [44] in a Cuabal of the Cubanacán protected area during the months of April and May. Taking into account that the study was carried out during the summer months, June and July, where there are no reported entries or exits of migratory species, it can be stated that the factor determining the dissimilarity (30%) between both months is the presence of species that are not typical

but occasional.

### Density

As shown in Table 6, the density of the xeromorphic bush on serpentines oil in the study area was 59.26 individuals/ha for the month of June and 53.93 for the month of July. Comparing one month to the other, the difference is of 5.23 individuals / ha. Out of the total number of species, five are not reported in each month (Table 6).

Species	June	July
Torcaza Cuellimorada	0	1.33
Paloma Rabiche	4	3.33
Paloma Aliblanca	0	1.33
Tojosa	1.33	0
Arriero	4	4.66
Judío	2.66	0
Sijú Platanero	4.66	4.66
Zunzún	3.33	3.33
Tocororo	0	1.33
Cartacuba	5.33	4.66
Carpintero Jabado	0	2
Carpintero Verde	0	2.66
Pitirre Abejero	2.66	3.33
Bobito Chico	3.33	3.33
Zorzal Real	2.66	0
Bien Te Veo	1.33	0
Juan Chiví	4	4.66
Chichinguaco	2.60	0
Mayito	3.33	2
Solibio	4.66	3.33
Tomeguín de la Tierra	6.66	5.33
Negrito	2.66	2.66
	59.26	53.93

**Table 6:** Density (individuals / ha) of land birds in the spiny xeromorphic bush on serpentine soil.

### Equity

Equity is an index that varies little in both months, 0.79 for June and 0.88 for the month of July, very similar a formation in the Cubanacán protected area in the months of April and May that were 0.80 and 0.69. In the study

area, the distribution of the number of individuals is fairly uniform and stable in the two months and there is no marked dominance [44,45]. The dominant species (Table 7) for the month of June were the Cartacuba (0.0064), Sijú Platanero (0.0049), while in the month of July they were the Cartacuba, the Arriero and the Sijú Platanero, all with 0.0064.

Species	June	July
Torcaza Cuellimorada	0	0.0004
Paloma Rabiche	0.0036	0.0036
Paloma Aliblanca	0	0.0004
Tojosa	0.0004	0
Arriero	0.0016	0.0064
Judío	0.0036	0
Sijú Platanero	0.0049	0.0064
Zunzún	0.005	0.0036



Tocororo	0	0.0004
Cartacuba	0.0064	0.0064
Carpintero Jabado	0.08	0.0009
Carpintero Verde	0	0.0004
Pitirre Abejero	0.0016	0.0036
Bobito Chico	0.005	0.0036
Zorzal Real	0.0016	0
Bien Te Veo	0.0004	0
Juan Chiví	0.0036	0.0048
Chichinguaco	0.0016	0
Mayito	0.005	0.0009
Solibio	0.0045	0.0036
Tomeguín de la Tierra	0.001	0.001
Negrilo	0.0036	0.005

**Table 7:** Ecological predominance of bird species observed in the study area.

Taking into account the results obtained, it is concluded that in the study area there are 22 species of birds belonging to 12 families of 8 orders, the best represented order being the Passeriformes with 5 families and 10 species. Out of the total number of reported birds, 2 genera (25%), 5 species (53.8%), and 10 subspecies (14.0%) are endemic. In the plant formation, 7 trophic groups are distinguished in the months of June and July. A density of 59.25 individuals / ha was obtained in the month of June, and 53.93 in the month of July. The difference was caused by occasional species, since there were no migration effects when the study was conducted. The index of similarity obtained for both months (70%) is very similar to that obtained in this formation for other months of the year. The diversity for both months was 2.22 and 2.52, respectively and the wealth was the same for both 13.0. Equity varied very little in months, 0.79 and 0.88, so the distribution of the number of individuals is fairly uniform.

### Conflict of Interest Statement

The authors declare that they have no conflict of interest.

### Contribution

All the authors contributed substantially to the concrescence of the manuscript.

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