

(RESEARCH ARTICLE)



Avifauna associated with two fragments of tropical dry forest located near airports in La Guajira – Colombia

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International Journal of Life Science Research Archive, 2022, 02(02), 106–116

Publication history: Received on 22 May 2022; revised on 24 June 2022; accepted on 26 June 2022

Article DOI: <https://doi.org/10.53771/ijlsra.2022.2.2.0050>

Abstract

Introduction: In Colombian territory, some aerodromes are close to natural areas, of which there is no information on their biodiversity. This research recorded the avifauna of two Tropical Dry Forests (TDF) near airports, becoming the first work of its kind in Colombia.

Objective: to establish an approximation of the avifauna and the conservation status present in TDF fragments near the airports in La Guajira - Colombia.

Materials and methods: linear transects were carried out in the TDF close to the Jorge Isaacs and Almirante Padilla airports, in addition, their avifauna was compared with that reported in two TDF of La Guajira, these were: Rancherías Itaka and Alto Pine (secondary source of information). The degree of similarity between the four TDF was determined by Jaccard's coefficient.

Results: In the TDF of the Jorge Isaacs airport, a total of 45 species were reported and for the Almirante Padilla airport, 34 species. Little affinity was obtained between the birds of the TDF de las Rancherías and the Almirante Padilla with the Jorge Isaacs, which could be related to the presence of human settlements near these forests, observing Hemisynanthropic birds. In the Jorge Isaacs, the environmental pressure was limited to that exerted by aeronautical activities, therefore, Anisanthrop species were recorded, which would indicate the maintenance of the vegetation cover.

Conclusion: The TDF near airports in La Guajira represent important sites for bird conservation, for this reason, it is necessary to continue studying them and seek strategies that guarantee their conservation.

Keywords: Bird; Vegetation; Nature Conservation; Endangered Species

1 Introduction

In Colombia there are 297 airports [1], some of them have been located in natural areas, this in order to build air terminals in places far from the urban area due to the availability of large surfaces and noise reduction [2]. However, this activity can result in the reduction and fragmentation of forest areas, which modifies the present biodiversity, even eliminating species that are incompatible with aeronautical activity [3].

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Among the species that may be sensitive to these modifications are birds, which, due to the disturbances caused by airport activities, may be forced to migrate to new areas [3], being able to collide with an aircraft during this movement, which means in addition, an imminent danger for people who use this type of transport, the above this corresponds to the denomination of bird or fauna danger [4, 5].

To prevent bird incidents, at the airports of the Colombian territory, updates are constantly being made in the control plans of the danger of fauna, these programs show the levels of danger of the birds that are in the aerodromes and in their approach area, as well as the activities and tools that should be used to disperse these birds [6]. However, in Colombia, there are no publications on monitoring that record the impact that airports may be causing to the avifauna associated with nearby wooded areas.

The department of La Guajira corresponds to one of the areas of Colombia with the greatest importance in avifauna, due to its diversity of habitats, reaching 802 species reported in this department [7], which is equivalent to 41% of those reported for Colombia [8].

In La Guajira there are three air terminals, El Almirante Padilla de Riohacha, El Jorge Isaacs de Albania and Puerto Bolívar, the latter two belonging to the company Carbones del Cerrejón Ltd. The airports of La Guajira are close to natural areas, for which there is no information on their biodiversity.

Within this framework of ideas, this research recorded the avifauna of the TDF near the Jorge Isaacs and Almirante Padilla aerodromes (La Guajira - Colombia), combining data obtained from primary sampling with secondary information as a reference of the avifauna of the TDF Guajiro, constituting itself in this way, in the first work in Colombia on birds associated with TDF fragments near airports and in addition to the knowledge of forest areas little sampled in the region of La Guajira.

2 Material and methods

2.1 Study area

Fragment TDF airport Jorge Isaacs. It is located in the vicinity of the Jorge Isaacs Airport, which is located at km 18 of the highway that leads from Albania to Maicao (La Guajira, Colombia). The temperature of the place varies between 22 °C and 33 °C and winds blow from east to west [9]. The life zone corresponds to tropical dry forest (TDF), according to the Holdridge system [10]. The studied TDF fragment is georeferenced between 11°13'48.76"N and 72°28'51.76"W.

Among the plant species found in the TDF fragment located on the perimeter of the air terminal are: *Vachellia farnesiana*, *Gonopterodendron arboreum*, *Handroanthus ochraceus*, *Haematoxylum brasiletto*, *Prosopis juliflora*, *Calotropis procera*, and *Stenocereus griseus*, *Cordia collococca*, *Handroanthus billbergii*, *Senegalia polyphylla*, *Bursera simaruba*, *Gliricidia sepium*, *Pseudobombax septenatum*, and *Ceiba pentandra* [9, 11, 12]. *Bombacopsis quinata*, *Capparis indica*, *Cynophalla flexuosa*, *Sapindus saponaria* and *Lecythis minor* can also be found in the TDF fragments of the area [13].

The forest area within the perimeter of the aerodrome has an area of 1.95 km², which corresponds to 71% of the area of this airport, this forest fragment continues on the outside of the air terminal, reaching an area greater than 100 km², comprising in its surroundings agricultural areas and human settlements such as Rancherías that have fragmented it into several forested patches [14].

TDF patch near Almirante Padilla airport. It is located towards the south side of the Almirante Padilla Airport in Riohacha (La Guajira, Colombia). It is geographically located between the coordinates 11°31'28.84"N and 72°56'1.73"W, close to the Nuevo Milenio neighborhood. This forested patch has an approximate extension of 1.80 km², however, in its interior you can see roads and a few scattered houses, close to it there are other forest fragments that are separated by unpaved roads, crops and human settlements.

Analysis techniques and indicators. In the study areas, fauna monitoring was carried out using the linear transect method [15], which consists of traversing an area in a straight line while counting and recording all the bird species that are observed within a radius that does not exceed 50 m from the observer [16]. For the case of this investigation, transects of a length of 1000 m were used.

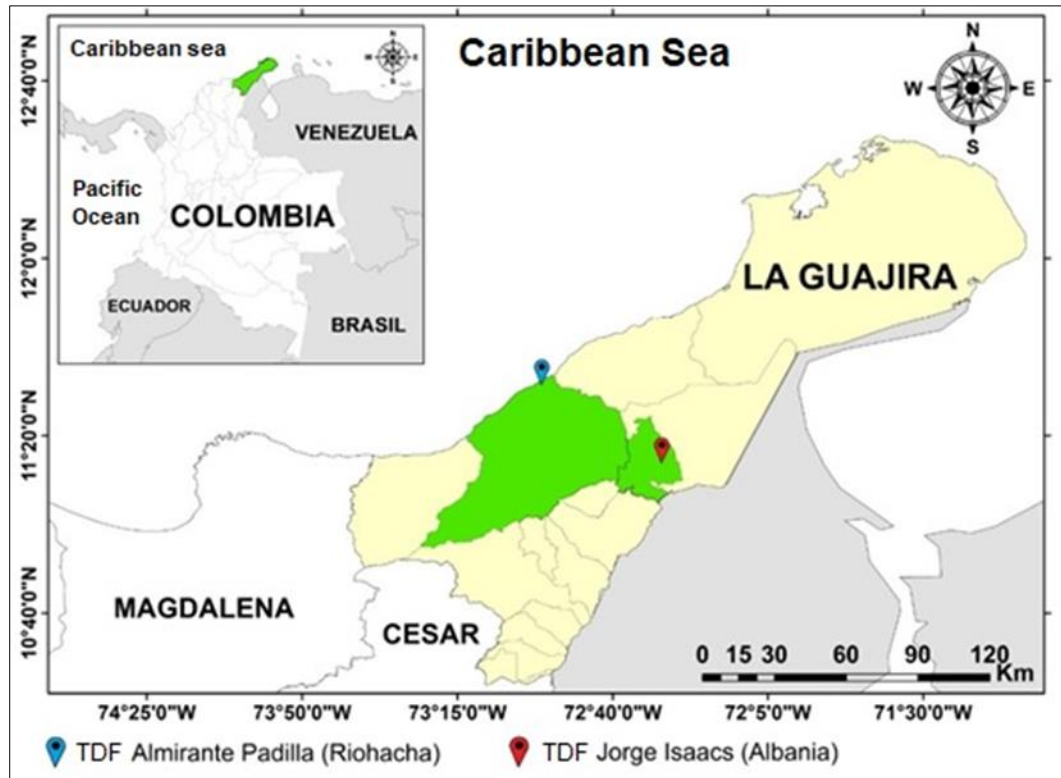


Figure 1 Map of the study areas: location of the TDF fragments of the airports under study in the department of La Guajira, Colombia. Jorge Isaacs (Albania) and Almirante Padilla (Riohacha) airports.



Figure 2 Aerial photographs of the TDF near the Jorge Isaacs (Albania) and Almirante Padilla (Riohacha) airports, department of La Guajira, Colombia. Source: Adapted from Google Earth

For the TDF fragment near the Jorge Isaacs airport, a monthly sampling was carried out for 6 months between June and November 2014, for the case of the TDF patch near the Almirante Padilla airport, 4 bird samplings were carried out for 2 months between December 2010 and January 2011. Bird observations were made between 06:00 and 08:00 hours, taking into account that birds are more active in this range [17, 18].

2.2 Analysis of data and information collected

Given that the data come from works carried out with different sampling intensities, descriptive and similarity analyzes based on incidence were chosen, in addition, the composition of avifauna of the forests under study was compared with that reported by Arteta & Lázaro [19] in two forests of the same region, which will serve as reference areas.

- Fragment of TDF near Rancheria Itaka (Albania-La Guajira). Located approximately at a distance of 16 km from the TDF of the Jorge Isaacs airport. It is located between the geographic coordinates 11°24'11.1"N - 72°31'27.8"W.
- Fragment of TDF near Rancheria Alto Pino (Maicao-La Guajira). Located at an approximate distance of 24 km from the study area, between the geographic coordinates 11°26'29.0"N - 72°32'37.5"W.

The degree of similarity between the transects located in the TDF fragments near the Jorge Isaacs and Almirante Padilla airports with the TDF areas studied by Arteta & Lázaro [19] was calculated using the Jaccard coefficient:

$$\text{Jaccard coefficient: } C_j = J / (a + b + J)$$

a= number of species present at site A.

b= number of species present at site B.

c= number of species present at both sites.

The coefficient measures the differences in the presence or absence of species in a certain area, being 0 absence and 1 presence [20].

The scientific nomenclature and taxonomic arrangement follow the current taxonomic trends used by Remsen et al. [8]. Residence categories are based on Avendaño et al. [21] and Chaparro et al. [22] and the threat categories according to the International Union for Nature Conservation -IUCN [23].

3 Results

3.1 Richness and abundance of avifauna present in the TDF areas near the two airports

A total of 59 species distributed in 23 families were found in the dry forest fragments near the two airports in La Guajira. A total of 45 species of birds were recorded on the DTF Jorge Isaacs airport (43 residents and 2 migratory) were recorded, made up of 21 families and a total abundance of 197 individuals. The species with the highest abundance were: *Eupsittula pertinax* (Brown-throated Parakeet) with an average of 26 individuals per day, *Ortalis ruficauda* (Rufous-vented Chachalaca) with 19 individuals and *Thectocercus acuticaudatus* (Blue-crowned Parakeet) with 16 individuals (Appendix 1, Figure 3). Regarding the forest patch near the Almirante Padilla airport, a total of 34 species of birds (30 residents and 4 migratory) were reported, grouped into 16 families and a total abundance of 212 individuals, the species with the highest abundance were: *Quiscalus lugubris* (Carib Grackle) with an average of 32 individuals per day (Figure 4).



Figure 3 Abundant psittacines in the TDF of Jorge Isaacs airport, La Guajira, June - November 2014. Left: *Forpus passerinus*, center: *Eupsittula pertinax*, Right: *Thectocercus acuticaudatus*. Photographs: Leyn Castro-Vasquez

In the Jorge Isaacs TDF fragment, the presence of *Picumnus cinnamomeus* (Chestnut Piculet) *Cardinalis phoeniceus* (Vermilion Cardinal) (Figure 4), *Thamnophilus melanonotus* (Black-backed Antshrike) and *Synallaxis candei* (White-whiskered Spinetail), almost-endemic to the Colombian Caribbean and Venezuela, migratory species were also observed in this forest fragment, which were: *Sporophila bouvronides* (Lesson Seedeater) and *Setophaga petechia* (Mangrove Warbler) (Figure 4). In the forest fragment of Almirante Padilla, the almost-endemic species *C. phoeniceus*

was recorded, with respect to the migratory species, four species were reported: *Coccyzus americanus* (Yellow-billed Cuckoo), *S. petechia*, *Protonotaria citrea* (Prothonotary Warbler) and *Tyrannus dominicensis* (Grey Kingbird) (Figure 4).



Figure 4 a) *Cardinalis phoeniceus* and b) *Picumnus cinnamomeus*, almost endemic species recorded in the Jorge Isaacs airport TDF. c) *Setophaga petechia* and d) *Sporophila bouvronides*, migratory species observed in the TDF of the Jorge Isaacs airport. e) *Tyrannus dominicensis*, a migratory species sighted in the TDF of the Almirante Padilla airport. f) *Quiscalus lugubris*, species with greater abundance in the TDF near the Almirante Padilla of Riohacha airport. Photographs: Leyn Castro-Vásquez

3.2 Similarity between the bird species recorded in the TDF fragments near the airports of La Guajira and the control TDF fragments

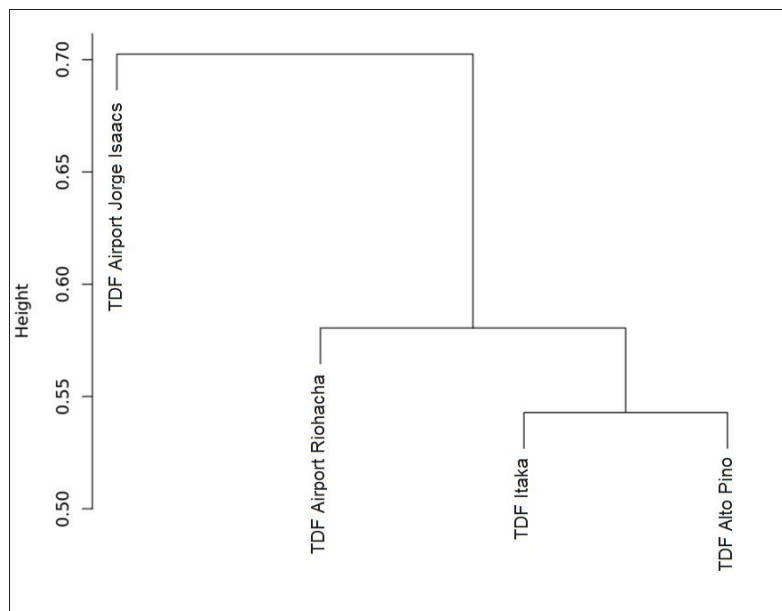


Figure 5 Similarity of Jaccard species between the TDF fragment from Jorge Isaacs's airport and those from Riohacha, Rancheria Itaka and Alto Pino airports

The forest fragments near the Jorge Isaacs airport in Albania and the Almirante Padilla airport in Riohacha, presented a low percentage of similarity, which was 30.5%. When comparing the Fragment of TDF of the Jorge Isaacs airport with that of the Rancheria Itaka, Albania - La Guajira, a similarity of 30.2% (16 species in common) was obtained as a result, in the same way, the forest patch of the Rancheria Alto Pino, Maicao - La Guajira had a similarity of 28.6 % (16 species in common) with the Jorge Isaacs TDF, which indicates that these two areas share few species. (Appendix 1). In relation

to the Almirante Padilla de Riohacha airport, this had greater similarity with the forest fragments of the Rancherías, with values of 40% (16 species in common) and 43.

4 Discussion

Airport activities cause negative environmental impacts that affect biodiversity, such as noise pollution and modifications of natural areas due to infrastructure construction [3, 24], however, the forest fragments studied play an important role for the conservation of birdlife, given the number of species reported with some category of threat according to the IUCN and with a restricted range of distribution for Colombia and Venezuela, such as: *P. cinnamomeus*, *S. candei*, *T. Melanonotus* and *Cardinalis phoeniceus*. *Saltator orenocensis* has also been reported in the area [11], a species that is also restricted to the countries mentioned [25, 26].

Within the species of restricted range, *C. phoeniceus* was the only one that was reported both in the study areas and in the other forest fragments compared in this research, so it can be a flagship species in environmental education programs and campaigns aimed at the conservation of the fauna and flora of the fragments of TDF in Albania and La Guajira in general [14], taking into account that it is recognized by the residents of this department and of importance in the Guajira culture [14, 27], in addition, it is a bird that is in the Vulnerable category on the IUCN red list [23].

According to Alonso & Ruiz [3], the approach areas of the airports cause an environmental impact by interfering with the routes of migratory birds, however, the following migratory species could be sighted at the airports under study: *S. bouvronides*, *S. petechia*, *C. americanus*, *T. dominicensis*, *S. petechia* and *P. citrea*, which could show that the aeronautical work carried out in these areas is not directly affecting migratory species. At the Riohacha airport, after this study, the frequencies of existing routes and the opening of new flights have been increasing [28], which denotes the need to carry out a follow-up study of these birds, to know if they are migrations being affected.

In the case of the Jorge Isaacs airport, the birds present in the TDF are mostly birds that remain within this vegetation [14], this may be related to the fact that airport activities limit them to the wooded area or on the contrary, could be due to the fact that these are characteristic birds of TDF and due to the continuous coverage of this plant formation within the perimeter of the aerodrome, they find in this site a place of refuge where they can carry out their vital functions [14].

In contrast, the Almirante Padilla airport shares bird species with the forest fragment, such as *Q. lugubris*, *C. cheriway*, *C. passerina* and *C. talpacoti* [29], these species are associated with human activities, which may be explained by the degradation of this forest due to the presence of isolated houses, roads, crops and goats. However, most of these bird species do not report avian incidents at the aerodrome, except for *C. passerina* and *C. cheriway*, which have historical records of the occurrence of this type of incident [30, 31], being considered for airports Colombians *C. cheriway* as a highly dangerous bird [32].

The low occurrence of bird incidents in Almirante Padilla could be related to two factors: 1. The annual update of the Risk Management Program for the control of fauna danger [29], 2. The adaptation of the birds to the activities According to [4], some species of birds get used to these activities, coexisting in the air terminals, however, it is essential to study whether these adaptations can affect the survival of resident birds at the population level to modify their circadian cycle, influencing extremely important activities such as singing schedules, as reported by Gil et al. [33] at airports in Spain.

In the forest fragment of the Jorge Isaacs airport, the abundance of *E. pertinax* coincides with that reported by Arteta & Lazarus [19] in another nearby forest fragment, located in the Ranchería de Alto Pino, Albania, this may be due to the fact that it is common to observe this species in large flocks [34, 35, 36] and its feeding habits include plant species such as *Caesalpinia* sp., *Cassia* sp., *Tabebuia* sp., *Handroanthus* sp. and *Gliricidia* sp. [35], genera that can be found in the mentioned TDF, for the particular case of the Jorge Isaacs forest fragment, genera that can be found in the mentioned TDF, for the particular case of the Jorge Isaacs forest fragment, plant species are recorded, such as *Handroanthus ochracea*, *Handroanthus billbergii* and *Gliricidia sepium*, which may be constituting an important part of the diet of this specie.

Another abundant species in this forest was *T. acuticaudatus*, which was not recorded for the Alto Pino and Itaka forest fragments. The abundance of this species in the Jorge Isaacs forest fragment could also be related to the availability of food resources and the state of conservation of the Forest that could favor the survival of these Psittacidae in the area [14].

The high abundance of common birds in open, semi-open and crop areas found in the TDF near the Almirante Padilla airport as *Q. lugubris*, *C. sulcirostris* and *C. squammata*, can be explained by the degree of transformation of this forest, which has an urban matrix and crop areas.

From the similarity analyses, the forest fragments of the Itaka and Alto Pino Rancherías and the bordering forest of the Almirante Padilla airport, obtained a greater affinity between them with respect to the TDF of the Jorge Isaacs airport. In the case of the Almirante Padilla airport, the low affinity with the Jorge Isaacs TDF may be due to the proximity to populated centers and human activities such as crops and goat farming, which is how a greater number of Hemisynanthropic birds are recorded in this area.

For the Jorge Isaacs TDF fragment, the environmental pressure is lower, being limited to that exerted by aeronautical activities, in addition, a large part of said fragment is protected within the airport, with little external disturbance, which was reflected by the presence of Anisynanthropic bird species [14], which could denote that airport activities are not directly affecting the birds of the Perimeter Forest, unlike the Forest adjacent to the Almirante Padilla airport in Riohacha, where birds from open areas and with marked anthropophily, such as *Q. lugubris* [37] and *Campylorhynchus griseus*, which could indicate a greater degree of disturbance, due to the presence of the airport and the use of the area for other human activities.

In the case of *Q. lugubris*, this is a common species to observe at the Maracaibo airport and other air terminals in Venezuela (pers. obs. R. Strewe) [37] and in Colombia it can be seen at airports such as Cerrejón [11, 12] and the Riohacha airport [26, 29].

It should be noted that the records of *Q. lugubris* at the Jorge Isaacs airport have been taken in the garden area and trees around the platform [9, 11] and at no time, within the forest fragment located in the aerodrome perimeter, taking this into account, and according to Strewe et al. [37], this species can be considered as an indicator of forest degradation in the Colombian Caribbean, the absence of this species in this forest area could mean a good state of conservation of it, on the contrary, the forest patch near the Riohacha airport is subject to greater intervention, so that, this species was observed in both the airport gardens [30] and in the wooded area near it.

Appendix 1 Affinity of bird species reported in the TDF fragment near Jorge Isaacs airport in relation to other forest fragments located in La Guajira, Colombia

Family	Species	State of residence (Chaparro et al., 2017)	Threat category	TDF Jorge Isaacs Airport	TDF Almirante Padilla Airport	TDF Itaka (Arteta-B & Lázaro- Molina, 2014)	TDF Alto Pino (Arteta-B & Lázaro- Molina, 2014)
Cracidae	<i>Ortalis garrula</i>	E	LC	0	0	9	0
Cracidae	<i>Ortalis ruficauda</i>	R	LC	18	0	0	0
Odontophoridae	<i>Colinus cristatus</i>	R	LC	11	15	0	7
Cathartidae	<i>Coragyps atratus</i>	R	LC	1	0	0	0
Accipitridae	<i>Buteo nitidus</i>	R	LC	1	0	0	0
Columbidae	<i>Columbina passerina</i>	R	LC	10	10	11	20
Columbidae	<i>Columbina talpacoti</i>	R	LC	11	15	0	4
Columbidae	<i>Columbina squammata</i>	R	LC	13	18	0	0
Columbidae	<i>Leptotila verreauxi</i>	R	LC	5	0	8	3
Columbidae	<i>Patagioenas corensis</i>	R	LC	2	2	4	3
Columbidae	<i>Zenaida auriculata</i>	R	LC	3	0	0	30

Psittacidae	<i>Eupsittula pertinax</i>	R	LC	26	16	15	28
Psittacidae	<i>Thectocercus acuticaudatus</i>	R	LC	16	0	0	0
Psittacidae	<i>Brotogeris jugularis</i>	R	LC	0	0	0	19
Psittacidae	<i>Forpus passerinus</i>	R	LC	10	5	7	0
Cuculidae	<i>Piaya cayana</i>	R	LC	1	0	0	0
Cuculidae	<i>Coccyzus americanus</i>	Bm	LC	0	1	5	0
Cuculidae	<i>Crotophaga sulcirostris</i>	R	LC	9	23	0	0
Cuculidae	<i>Crotophaga ani</i>	R	LC	0	3	0	0
Cuculidae	<i>Tapera naevia</i>	R	LC	1	0	2	0
Trochilidae	<i>Amazilia tzacatl</i>	R	LC	1	0	0	0
Trochilidae	<i>Glaucis hirsutus</i>	R	LC	0	0	0	5
Trochilidae	<i>Leucippus fallax</i>	NE	LC	0	0	1	3
Trochilidae	<i>Chlorostilbon cf. Mellisugus</i>	R	LC	1	0	0	0
Alcedinidae	<i>Chloroceryle aenea</i>	R	LC	0	0	1	0
Bucconidae	<i>Hypnelus ruficollis</i>	R	LC	0	0	14	7
Galbulidae	<i>Galbula ruficauda</i>	R	LC	1	0	0	0
Picidae	<i>Picumnus cinnamomeus</i>	NE	LC	1	0	0	0
Picidae	<i>Melanerpes rubricapillus</i>	R	LC	2	3	6	8
Falconidae	<i>Caracara cheriway</i>	R	LC	0	2	0	1
Falconidae	<i>Milvago chimachima</i>	R	LC	0	3	0	0
Thamnophilidae	<i>Sakesphorus canadensis</i>	R	LC	1	1	0	2
Thamnophilidae	<i>Thamnophilus doliatus</i>	R	LC	1	0	0	0
Thamnophilidae	<i>Thamnophilus melanonotus</i>	NE	LC	1	0	0	0
Thamnophilidae	<i>Formicivora grisea</i>	R	LC	2	0	0	0
Thamnophilidae	<i>Synallaxis candei</i>	NE	LC	1	0	3	0
Furnariidae	<i>Dendroplex picus</i>	R	LC	1	0	0	0
Furnariidae	<i>Furnarius leucopus</i>	R	LC	1	0	11	0
Tyrannidae	<i>Sublegatus arenarum</i>	R	LC	1	0	0	0
Tyrannidae	<i>Atalotriccus pilaris</i>	R	LC	1	0	0	0
Tyrannidae	<i>Todirostrum cinereum</i>	R	LC	1	0	0	0
Tyrannidae	<i>Myiozetetes similis</i>	R	LC	1	0	0	0
Tyrannidae	<i>Pyrocephalus rubinus</i>	R	LC	0	4	4	3
Tyrannidae	<i>Machetornis rixosa</i>	R	LC	0	3	0	0
Tyrannidae	<i>Pitangus sulphuratus</i>	R	LC	6	4	11	4
Tyrannidae	<i>Tyrannus melancholicus</i>	R	LC	0	8	0	2
Tyrannidae	<i>Tyrannus dominicensis</i>	Bm	LC	0	10	0	0
Tyrannidae	<i>Myiarchus tirannulus</i>	R	LC	1	0	0	0
Vireonidae	<i>Cyclarhis gujanensis</i>	R	LC	1	0	0	0

Troglodytidae	<i>Troglodytes aedon</i>	R	LC	0	1	0	0
Troglodytidae	<i>Campylorhynchus griseus</i>	R	LC	0	9	7	7
Poliopitilidae	<i>Poliopitila plúmbea</i>	R	LC	4	3	2	17
Mimidae	<i>Mimus gilvus</i>	R	LC	7	3	19	32
Thraupidae	<i>Eucometis penicillata</i>	R	LC	1	0	0	0
Thraupidae	<i>Thraupis episcopus</i>	R	LC	0	2	0	0
Thraupidae	<i>Coereba flaveola</i>	R	LC	3	3	7	21
Thraupidae	<i>Tiaris bicolor</i>	R	LC	7	0	0	0
Thraupidae	<i>Saltator coerulencens</i>	R	LC	0	3	0	0
Thraupidae	<i>Sicalis flaveola</i>	R	LC	0	0	0	1
Thraupidae	<i>Sporophila bouvronides</i>	Bm	LC	1	0	0	0
Thraupidae	<i>Sporophila intermedia</i>	R	LC	0	0	0	2
Thraupidae	<i>Sporophila minuta</i>	R	LC	0	0	0	3
Cardinalidae	<i>Cardinalis phoeniceus</i>	NE	VU	1	1	8	22
Parulidae	<i>Setophaga petechia</i>	Bm	LC	1	1	3	5
Parulidae	<i>Protonotaria citrea</i>	Bm	LC	0	3	0	0
Icteridae	<i>Icterus nigrogularis</i>	R	LC	7	4	16	10
Icteridae	<i>Quiscalus lugubris</i>	R	LC	0	32	24	0
Fringillidae	<i>Euphonia laniirostris</i>	R	LC	1	1	0	0
Total number of individuals				197	212	198	269
Total number of species				45	32	24	27

Conventions: R: Resident, E: Endemic, NE: Near-endemic, R: Resident, Bm: boreal migratory. LC: Least Concern, VU: Vulnerable.

5 Conclusion

In this investigation it was possible to determine that the TDF areas nearby the airports in La Guajira are important sites for the conservation of bird species, for this reason it is necessary to continue studying them and search for strategies that guarantee sustainable development, in favor of the conservation of the flora and fauna, since in the case of the Almirante Padilla de Riohacha airport, it is being degraded by human settlements and crops.

C. phoeniceus is a species of restricted range that was reported in the study areas and it is also an emblematic species from the department La Guajira, for this reason, it is recommended to be used as a flagship species for the protection of TDF fragments, like the ones studied in this research.

Compliance with ethical standards

Acknowledgments

To Biologist Rodian Fonseca Campuzano from the Universidad del Atlántico and Professor Gabriel Castaño Villa from the University of Manizales for their contributions in the development of this research. To Carbones del Cerrejón Ltd., in particular, to the administrative staff of the Jorge Isaacs Airport for their logistical support and to the runway staff for facilitating transportation to the study site.

Disclosure of conflict of interest

The authors declare that there are no conflicts of interest that jeopardize the validity of the results presented in this document.

References

- [1] Special Administrative Unit of Civil Aeronautics - UAEAC. Aerocivil Airports; Bogota D.C., Colombia: UAEAC; 2019. Available from: <http://www.aerocivil.gov.co/aeropuertos>
- [2] Otalora LM, & Zuluaga JA. The bird hazard in air operations in Colombia [Specialization essay]. Bogotá D.C., Colombia: New Granada Military University; 2010. 19p.
- [3] Alonso G, Ruiz A. The environmental impact of air transport and measures to mitigate it. In: Book of Abstracts of the X Congress of Transport Engineering. Grenada, Spain; 2012.
- [4] Godínez E. Birds and aircraft: risks and dangers (Third ed.). United States of America: Kindle, Amazon; 2018.
- [5] Annicchiárico LM. National program for the limitation of fauna in airports (Version II). (A. I. Paez, Ed.) Bogotá D.C., Colombia: Management System for Operational Safety (SIGESOA – FAUNA), Special Administrative Unit of Civil Aeronautics; 2008. 104 p.
- [6] Special Administrative Unit of Civil Aeronautics - UAEAC. National program for the limitation of fauna in the aerodrome. Bogotá D.C., Colombia: Operational Safety Management System – SIGESOA-FAUNA; 2016. 68 p.
- [7] Clements J, Schulenberg T, Iliff M, Billerman S, Fredericks T, Sullivan B, Wood C. World Bird Checklists: La Guajira. Avibase; 2021. Available from: <https://avibase.bsc-eoc.org/checklist.jsp?lang=EN&p2=1&list=clements&synlang=@ion=COLg&version=text&lifelists=&highlight=0>
- [8] Remsen JV Jr, Areta JI, Bonaccorso E, Claramunt S, Jaramillo A, Pacheco JF, et al. A classification of the bird species of South America. American Ornithological Society. South American Classification Committee; 2021. Available from: <http://www.museum.lsu.edu/~Remsen/SACCBaseline.htm>
- [9] Luke MG. Characterization of the bird species present at the Jorge Isaac de la Mina airport and their potential danger to air operations. Wildlife limitation program. [End report]. La Mina, Albania, La Guajira, Colombia: Carbones del Cerrejón Limited; 2010. 45p.
- [10] Holdridge LR. Ecology based on life zones. San José, Costa Rica: Inter-American Institute for Cooperation on Agriculture – IICA; 2000.
- [11] Castro-Vásquez L. Potential degree of bird hazard for air operations at Jorge Isaac de La Mina (Albania - La Guajira) and Puerto Bolívar (Uribe - La Guajira) airports [Technical report]. La Mina, Albania, La Guajira, Colombia: Biocavas S.A.S - Carbones del Cerrejón Limited; 2014.
- [12] Castro-Vásquez L. Characterization of the wildlife present at the Jorge Isaac de la Mina (Albania – La Guajira) and Puerto Bolívar (Uribe – La Guajira) airports and their potential danger to air operations [Final report]. La Mina, Albania, La Guajira, Colombia: Carbones del Cerrejón Limited; 2012. 77 p.
- [13] Prieto F. Dry ecosystems and fight against desertification and drought in the department of La Guajira. Environmental Meetings University of the North. Strategic ecosystems of the Colombian Caribbean. 2007; 3(5): 65-93.
- [14] Castro-Vásquez L. Environmental disturbance analyzed by means of bioindicators in a fragment of tropical dry forest (Bs-T) located in the perimeter area of Jorge Isaacs airport [Graduate work, Master degree]. Caldas, Manizales, Colombia: University of Manizales, Faculty of Accounting, Economic and Administrative Sciences; 2016. 85 p.
- [15] Bibby CJ, Burgess ND, Hill DA. Bird Census Techniques. London: Academic Press; 1992.
- [16] Burt EH. Manual of field and laboratory exercises for Ornithology. In: Burt JEH, editor. Impact of urban and suburban developments on bird populations. Delaware: The Ornithological Council, Wilson Ornithological Society's; 2002. p. 1-14
- [17] Villarreal H, Álvarez M, Córdoba S, Escobar F, Fagua G, Gast F, et al. Birds. In: Manual of methods for the development of biodiversity inventories. Bogotá D.C., Colombia: Biodiversity Inventory Program. Alexander von Humboldt Biological Resources Research Institute - IAvH; 2006. p. 91-148
- [18] Ralph CJ, Geupel PP, Martín TE, De Sante DF, Milá B. Manual of field methods for landbird monitoring. Albany, CA: Pacific Southwest Research Station, Forest Service, US Department of Agriculture; nineteen ninety six.
- [19] Arteta R, Lázaro L. Subtropical dry forest avifauna present in eight locations of the Colombian Media Guajira. Scientific Bulletin - Museum Center - Natural History Museum. 2014; 18(2): 125-137.

- [20] Villarreal H, Álvarez M, Córdoba S, Escobar F, Fagua G, Gast F, et al. Methods for data analysis: an application for results from biodiversity characterizations. In: Manual of methods for the development of biodiversity inventories. Bogotá D.C., Colombia: Biodiversity Inventory Program. Alexander von Humboldt Biological Resources Research Institute; 2006. p: 185-226
- [21] Avendaño JE, Bohorquez CI, Rosselli L, Arzuza-Buelvas D, Estela FA, Crow AM, et al. Checklist of the birds of Colombia: A synthesis of the state of knowledge since Hilty & Brown (1986). *Colombian Ornithology*. 2017; 16(eA01): 1-8
- [22] Chaparro-Herrera S. Updated list of endemic and near-endemic birds of Colombia. Version 5.2. Alexander von Humboldt Institute for Biological Resources Research - IAvH. Global Biodiversity Information Facility - GBIF; 2017. Available from: <https://www.gbif.org/en/dataset/b08f433a-c35b-4e6d-8400-df5b84c3d379#description>
- [23] International Union for Conservation of Nature - IUCN. The IUCN Red List of Threatened Species., Version 2021-3; 2021. Available from: <https://www.iucnredlist.org/>
- [24] Mendez JC. Measurement of environmental impact at airports: proposal of indicators [Graduate work]. Madrid, Spain: National University of Distance Education - UNED, Universitat Jaume I - UJI; 2019. 52 p.
- [25] Lepage D. Orinocan Jumper, Jumper orenocensis Lafresnaye, 1846. Retrieved from Avibase; 2020. Available from: <https://avibase.bsc-eoc.org/species.jsp?lang=EN&avibaseid=4D6CD9F66387952D&sec=map>
- [26] Arango C. White-browed Saltator (*Saltator orenocensis*). Wiki Birds Colombia; 2014. Available from: http://www.icesi.edu.co/wiki_birds_colombia/tiki-index.php?page_ref_id=1265
- [27] Arteta R, Lázaro L. Socio-environmental diagnosis of the subtropical dry forest of the Rancheria river basin, La Guajira, Colombia. *Scientific Bulletin Center of Museums. Museum of Natural History*. 2016; 20(2): 57-81. <https://doi.org/10.17151/bccm.2016.20.2.5>
- [28] Soto M. 41 % increase in passengers mobilized the airport of Riohacha between January and April. *Eastern Airports*; 2019. Available from: <https://rch.aerooriente.com.co/41-increase-in-passengers-mobilized-riohacha-airport-between-january-and-april/>
- [29] Civil Aviation Special Administrative Unit - UAEAC. Avian and wildlife hazard control and prevention, Almirante Padilla International Airport, Riohacha, Colombia; 2017. Available from: <https://www.aerocivil.gov.co/navigation-services/environmental-management-and-wildlife-control/Airport%20Management/Admiral%20Padilla%20International%20Airport%20de%20Rioax.pdf>
- [30] Aquameunier Ltda. Improvement program for the prevention of avian hazard through the formulation and implementation of programs to reduce impacts with wildlife at national level airports – Airport Almirante Padilla de Riohacha. Bogotá D.C., Colombia: Civil Aeronautics of Colombia & Acuameunier Ltda; 2011. 113 p.
- [31] Special Administrative Unit se Civil Aeronautics – UAEAC, Center for Aeronautical Science Studies – CEA, Aeronautical Academic Research - IAA. Designing strategies for avian hazard prevention and mitigation. Feasibility study. Design and construction of an unmanned aerial vehicle [Research project]. Bogotá D.C., Colombia: Center for Aeronautical Science Studies – CEA; 2011. 124 p.
- [32] Civil Aviation Special Administrative Unit - UAEAC & Acuameunier Ltda. Improvement program for the prevention of danger to avian and wildlife. *Avian Hazard. (Guide)*. Bogotá D.C., Colombia: Acuameunier Ltd.; 2011.
- [33] Gil D, Honarmand M, Pascual J, Perez-Mena E, Macías C. Birds living near airports advance their dawn chorus and reduce overlap with aircraft noise. *Behavioral Ecology*. 2015; 26(2): 435–443. <https://doi.org/10.1093/behavior/language207>
- [34] Aldana-Dominguez J, Gomez C, Borja R. Northern University's Feathered Heritage. Field guide. Barranquilla, Colombia: University of the North Publishing; 2015.
- [35] Palace R. Perico Carisucio (*Eupsittula pertinax*). In: Johnston R., editor. Cali, Colombia: ICESI University. Wiki Birds Colombia; 2012. Available from: http://www.icesi.edu.co/wiki_birds_colombia/tiki-index.php?page_ref_id=1524.
- [36] Hilty SL, Brown WL. Guide to the birds of Colombia. American Bird Conservancy – ABC. Bogotá DC, Colombia: Imprebooks SA; 2001.
- [37] Strewe R, Villa-De Leon C, Lobaton G, Roza AM, Quiñones FA. Range extension of the Carib Grackle *Quiscalus lugubris* (Icteridae) in Colombia. *Intropica* 2006; 3: 109-1