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List of Birds Sigthed on Livestock Farms in Sucre, Colombia

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Keywords: birds, species richness, livestock farms, relative abundance.

I. Introduction

One of the causes of decreased biological diversity is habitat loss[1, 2]. Livestock and agriculture are considered a productive sector that causes a high environmental impact due to the necessary clearing, pollution, and soil compaction. According to surveys carried out by the National Administrative Department of Statistics in 2016, in 25 departments of Colombia, 80% of the area is dedicated to livestock, 7.6% to agricultural activity, and only 10.1% to forests. In the department of Sucre, cattle raising is the first line of the economy and 73,204 ha (6.9% of the department) are used for these purposes, while forests cover only 73,204 ha (1.02%). In this case, not only the clearing causes habitat loss, but wrong practices throughout the sector [3], and this does not allow the expected productivity [4]. Environmentalists try to reduce that impact through laws and other mechanisms.

It would be impossible to ensure that forests and other ecosystems transformed for use in livestock, agriculture, and other purposes can recovered for the restoration of biological diversity. Researchers are looking for alternatives that allow a balance between the conservation of biological diversity and agricultural production, both in Colombia [5] and in other countries, such as the Doñana National Park, in southern Spain [6].

Many livestock farms in Sucre have fragments of tropical dry forest, secondary vegetation, wells or jagüeyes, live fences, and pastures with numerous trees, which constitute a silvopastoral system[7]. This could contribute to the increase of biodiversity in these sites.

The investigations carried out on these aspects in the region refer to the birds sighted in artificial water reservoirs that the peasants build, called jagüeyes, to meet the needs of the livestock, small crops, and domestic chores. Several authors have highlighted the importance of jagüeyes for the maintenance of biological diversity[7, 8, 9]. Live fences are also important, especially for birds[10].

This paper aims to expand the information related to the birds present in livestock farms and highlights the possibility that these be considered protected areas, due to their importance for the conservation of biological diversity.

II. Materials and Methods

The places where we do the work are part of the ecosystem that prevailed in ancient times in Sucre. That is, they constituted a typical ecosystem of the Caribbean coastal plain, an Alternate Hydrotropic Zonobioma, also called Dry Tropical Forest (11). In Colombia they appear from the south of La Guajira to Córdoba, San Andres Island, Providencia and Santa Catalina, the canyon of the middle valley of the Cauca River and the high valley of the Magdalena River, as well as in some sectors of Cesar, north of Santander, Antioquia, Valle and Boyacá. They are forests with a prolonged period of drought, which coincides with the astronomical winter of the Northern hemisphere. Plants have water deficits, and most of the canopy woodland loses its foliage.

We carried out the work between November 2017 and the first half of March 2018, the dry season in Sucre.

The livestock farms considered were nine (Table 1), and in all of them the silvopastoral system is developed [4], with the presence of grasses, legumes, jagüeyes (artificial water wells), live fences, trees in the pastures and surroundings the homes of the peasants, as well as fragments of tropical dry forest with a greater or lesser degree of anthropic intervention.

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Table 1: The geographical location of livestock farms in the present work. FA: farm area

Name	Coordinates	FA(ha)
La Camorra	9°29'1.77''N; 75°25'11.67"O	240
Los Charcos	9°29'16.39"N; 75°28'5.72"O	260
La Loma	9°29'1.17"N; 75°27'50.65"O	120
El Vivero	9°28'33.78"N; 75°28'2.71"O	80
Versalles	9°29'50.98"N; 75°26'18.66"O	150
San José	9°27'19.76"N; 75°28'46.32"O	280
Doña Lucy	9°14'31.18"N; 75°23'59.68"O	180
Puerto Alto	9°14'41.48"N; 75°23'57.84"O	280
Villa Carmela	9°14'46.34"N; 75°24'08.26"O	120

The farms were georeferenced with a Garmin GPS (Fig. 1). We visited six farms in the municipality of Sincelejo, near the brick factory El Cinco and the others in the municipality of Toluviejo, near the Argos S. A. plant. There we register birds associated with different types of vegetation and bodies of water.

Source: Google Earth, free version.

Fig. 1: Geographical location of livestock farms where we carry out this investigation. Above, in the vicinity of the Argos S. A. Plant, municipality of Sincelejo; below, municipality of Toluviejo, near the brick factory El Cinco.

Three samplings were carried out on each farm, at times between 0600 and 1000 and between 1600 and 1800. Three professionals participate in the sampling and use the fast ecological method [12, 13]. Species identification was "in situ" and when this was not possible, using specialized bibliography [14, 15, 16] and expert consultations, using photos (Canon EOS Redel XS and a 70 - 300 mm lens) and descriptions. The food guild (FG) to which the birds belong and the migratory species (M), were also consulted in the scientific bibliography [14, 17].

We record the birds sighted, in the following biotopes: open areas (Oa: pastures with trees and live fences), water reservoir (Aca: jagüeyes, puddles, lagoons and vegetation of the riverbank), and forests (F: fragments of the tropical dry forest). The sightings were made using Tasco binoculars (10 x 50 mm).

We perform the data processing, joining the information obtained in the different biotopes of all farms, since they have the same characteristics of the livestock farm.

We constructed the species accumulation curve to establish the sampling efficiency (18), and used the ACE Chao 1, Chao 2 and Bootstrap (19, 20) estimators, based on presence-absence. We combine the results of the different samples, so that an accumulation curve of a single species appears.

We measured the relative abundance (RA) of birds as the frequency of sighting over the total sampling in all farms, and the proportions thus obtained allowed us to establish the following categories for different species: rare (R) (<69%), frequent (C) (70-89%) and abundant (A) (+ 90%).

We made a Contingency Table (X2) to determine if there is an association between the abundance of the species and the biotope in which we see them and also with the type of food they consume. We use the Sorensen Index (21) to make a matrix of similarity between the species present in the different biotopes in which we observe them.

III. Results

The birds we spot on the nine farms belong to 19 orders, 30 families, and 103 species (Table 2 and Fig. 2). The best-represented order is Passeriformes with eleven families (57.9%) and 36 species (34.9%), followed by Pelecaniformes with three families (15.8%) and twelve species (11.6%) and Psittaciformes, one family and eight species. The rest of the orders appear with two or one families and between one and seven species.

The best-represented families are Ardeidae (Pelecaniformes) with nine species, Thraupidae and Tyrannidae (Passeriformes), both with eight species, as well as Psittacidae (Psittaciformes).

Table 2: Bird species observed in nine livestock farms in the department of Sucre between November 2017 and March 2018. RA: relative abundance (R: rare; C: frequent; A: abundant); FG: food guild F: Frugivorous; G: granivore; N: nectarivore; Fi: folivorous; I: insectivore; C: carnivore; P:piscivorous; Sc: scavenger; M: microphage; O: omnivorous); Bi: Biotope: Open areas (Oa: pastures with trees and living fences), water reservoir (Aca: jagüeyes, puddles, lagoons and vegetation of the riverbank) and forests (F: fragments of tropical dry forest)

Order	Family	Species	RA	FG	Bi
ACCIPITRIFORMES	Occipitridae	*Busarellusnigricollis*	A	P, I, M	Aca, Oa, F
		Rupornismagnirostris	A	P, C, I, M	Oa, F
		Elanusleucurus	R	C	Oa
		Buteogallusanthracinus	R	M, C, Sc	F, Aca
		Buteogallusmeridionalis	R	C,I	Oa
		Rostrhamussociabilis	A	M, C	Aca, Oa
	Pandionidae	*Pandionhaliaetus*	R	P	Aca, Oa
CATHARTIFORMES	Cathartidae	*Cathartes aura*	A	Sc, C	F, Oa
		Coragypsatratus	A	Sc, C	Oa
FALCONIFORMES	Falconidae	*Falco rufigularis*	R	C	F, Oa
		Falco sparverius	C	C, I	Oa
		Herpetotherescachinnans	R	C	F, Oa
		Milvago chimachima	A	O	Oa, Aca
		Caracaracheriway	R	Sc, C, M	Oa
ANSERIFORMES	Anatidae	*Anasdiscors*	C	G. M	Aca
		Dendrocygnaautumnalis	R	Fi, G, M	Aca
		Dendrocygna bicolor	C	Fi, G, M	Aca
APODIFORMES	Trochilidae	*Amaziliatzacatl*	A	N, I	Oa
		Anthracothoraxnigricollis	C	I	F, Oa
CAPRIMULGIFORMES	Caprimulgidae	*Nyctidromusalbicollis*	C	I, M	F, Oa
CHARADRIIFORMES	Charadriidae	*Vanelluschilensis*	A	I, M	Oa
	Jacanidae	*Jacana jacana*	A	I,M	Aca
	Scolopacidae	*Actitismacularius*	C	I, M, P	Oa, Aca
	Recurvirostridae	*Himantopusmexicanus*	C	M, P	Aca
COLUMBIFORMES	Columbidae	*Patagioenascayennensis*	A	G	F, Oa
		Columbina minuta	A	G	Oa, F

		Columbina talpacoti	A	G	Oa
		Leptotilaverreauxi	C	G	F, Oa
CORACIIFORMES	Alcedinidae	*Megaceryletorquata*	A	P, M, C	Aca
		Chloroceryle amazona	A	P	Aca
	Momotidae	*Momotussubrufescens*	C	I	Oa, F
CUCULIFORMES	Cuculidae	*Crotophagaani*	A	O	Oa
		Crotophagamajor	A	O	Oa, F
		Tapera naevia	C	I	Oa
GALLIFORMES	Cracidae	*Ortalis garrula*	A	Fi, F	F, Oa
	Odontophoridae	*Colinuscristatus*	C	O	Oa, F
GRUIFORMES	Aramidae	*Aramus guarauna*	R	M, C	Oa, Aca
	Rallidae	*Aramidescajaneus*	R	M	F, Oa
		Porphyriomartinica	C	O	Aca
PASSERIFORMES	Corvidae	*Cyanocoraxaffinis*	A	M	F, Oa
	Dendrocolaptidae	*Dendroplexpicus*	R	I	F, Oa
	Thamnophilidae	*Sakesphoruscanadensis*	R	I, M	Aa
	Furnariidae	*Furnariusleucopus*	A	I, G	Oa, Aca
	Hirundinidae	*Progne tapera*	A	I	Oa, Aca
		Progne chalybea	A	I	Oa, Aca
	Icteridae	*Chrysomusicterocephalus*	C	I, G	Oa, Aca
		Icterusnigrogularis	A	I, F, N	Oa, F
		Molothrusbonariensis	A	I, G	Oa
		Quiscalusmexicanus	C	O	Aca, Oa
		Psarocoliusdecumanus	A	F,N, I	Oa, F
	Mimidae	*Mimusgilvus*	C	O	Oa
	Parulidae	*Mniotilta varia*	C	I, M	Oa, F
		Protonotaria citrea	R	I, M	Oa, Aca
		Oreothlypis peregrina	R	I	Oa
		Setophagaruticilla	C	I	F, Oa
	Thraupidae	*Nemosiapileata*	R	O	Oa
		Ramphocelusdimidiatus	C	I, F	Oa, F
		Thraupisepiscopus	A	F, I, M	Oa
		Thraupispalmarum	A	F, I	F, Oa
		Sicalisflaveola	C	G, I	Oa
		Volatiniajacarina	A	G, I	Oa
		Sporophila intermedia	A	G, M	Oa
		Saltatorcoerulescens	A	F, Fi, G, I	Oa, F
	Troglodytidae	*Campylorhynchusgriseus*	A	I	Oa
		Campylorhynchuszonatus	A	I	Oa
		Donacobiusatricapilla	A	I	Aca, Oa
		Troglodytesaedon	A	I, M	Oa
	Tyrannidae	*Arundinicolaleucocephala*	A	I	Aca
		Elaeniaflavogaster	A	I, F	F, Oa
		Machetornisrixosa	A	I, M	Oa
		Megarynchuspitangua	C	O	F, Oa, Aca
		Pitangussulphuratus	A	O	Oa
		Tyrannusmelancholicus	A	O	Oa
		Tyrannussavana	A	I, F	Oa
		Fluvicola pica	A	I	Aca
PELECANIFORMES	Ardeidae	*Ardeacocoi*	C	P, M	Aca
		Ardeaherodias	R	P, M	Aca
		Ardea alba	C	P, M	Aca
		Bubulcus ibis	A	I, M, C	Oa, Aca
		Butoridesstriata	C	P, M, C	Aca
		Egrettacaerulea	C	P, M, C	Aca
		Egrettathula	C	P,M, C	Aca

		Nycticoraxnycticorax	C	O	Aca
		Tigrisomalineatum	C	P,I,C	Aca, F
	Phalacrocoracidae	*Phalacrocoraxbrasilianus*	A	P, I, C	Aca
	Threskiornithidae	*Phimosusinfuscatus*	A	O	Aca
		Plegadisfalcinellus	R	I, P, M, C	Aca
PICIFORMES	Ramphastidae	*Ramphastossulfuratus*	C	F, I, C	Oa, F
	Picidae	*Campephilusmelanoleucos*	A	I, F	F, Oa
		Colaptespunctigula	A	I	Oa
		Dryocopuslineatus	R	I, G, N. F	F, Oa
		Melanerpesrubricapillus	A	I, F	F, Oa
GALBULIFORMES	Galbulidae	*Galbularuficauda*	A	I	F, Oa
PODICIPEDIFORMES	Podicipedidae	*Podilymbuspodiceps*	C	P, I, C	Aca
PSITTACIFORMES	Psittacidae	*Amazona amazonica*	A	F, G	Oa, F
		Amazona ochrocephala	A	F, I, G	Oa, F
		Ara ararauna	A	G, Fi, F	Oa, F
		Ara macao	A	G, N, Fi, F	F, Oa
		Ara severus	C	G, Fi	F, Oa
		Eupsittulapertinax	C	G, F, Fi	Oa, F
		Brotogerisjugularis	A	F, G, Fi	Oa, F
		Pionusmenstruus	A	F, G, N	F, Oa
STRIGIFORMES	Strigidae	*Bubo virginianus*	R	C, P, M	F, Oa

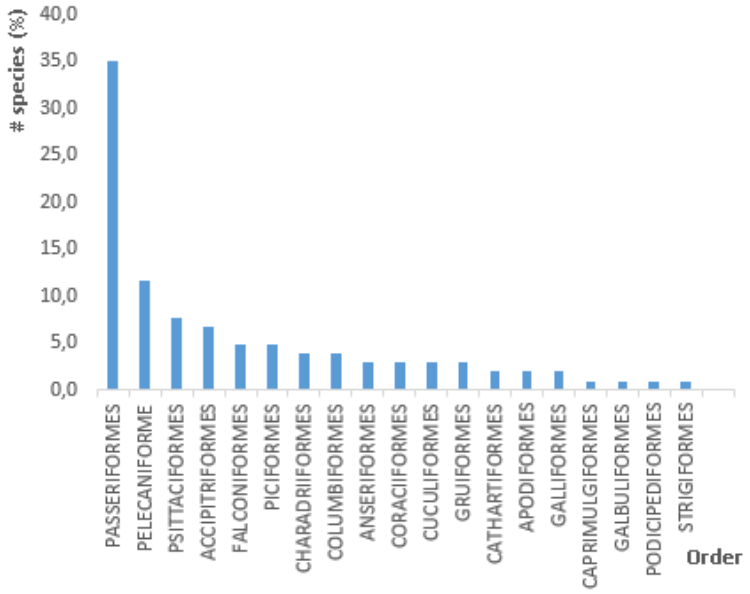

Fig. 2: Bird species (%) distributed in 19 orders, observed in 9 livestock farms in the department of Sucre.

The species accumulation curve showed that the average sampling efficiency was 85%, obtaining representativeness above 83% (Fig. 3).

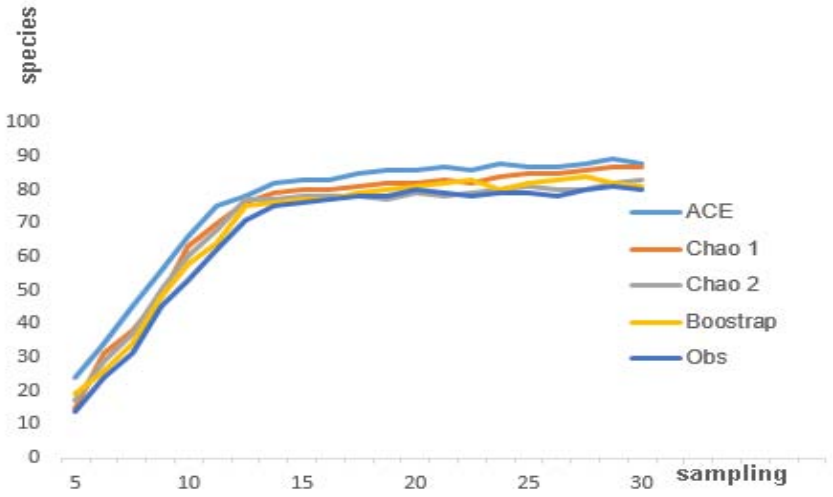

Fig. 3: Accumulation curve of bird species sighted in 27 samples taken in nine cattle farms in Sucre, Colombia

Most of the species observed during the work were abundant (51.4%) and frequent (30.1%), while the rare ones were 18.4%.

In open areas, 80 species (77.7%) were detected, 40 in the forested area (38.8%), and 38 in water reservoir (36.9%). The bird communities sighted in the three biotopes do not show similarity (Table 3).

Table 3: Similarity matrix (Sorensen index) among bird communities sighted in three biotopes of nine farms in the department of Sucre. Oa: open areas; F: forest; Aca: water reservoir.

	Oa	F	Aca
Oa	-	59%	24%
F	-	-	2,5%
Aca	-	-	-

Some species were sighted in only one of those biotopes, and others were detected in more than one. We observe some species in only one of these biotopes, and others detect them in more than one. The highest proportion of species in the different biotopes (Fig. 4) were seen in both open and forested areas (Oa-F) (38.8%), followed by those observed only in open areas (27.2%) and in water reservoirs (20.4%). We did not find species that appeared only in the wooded area.

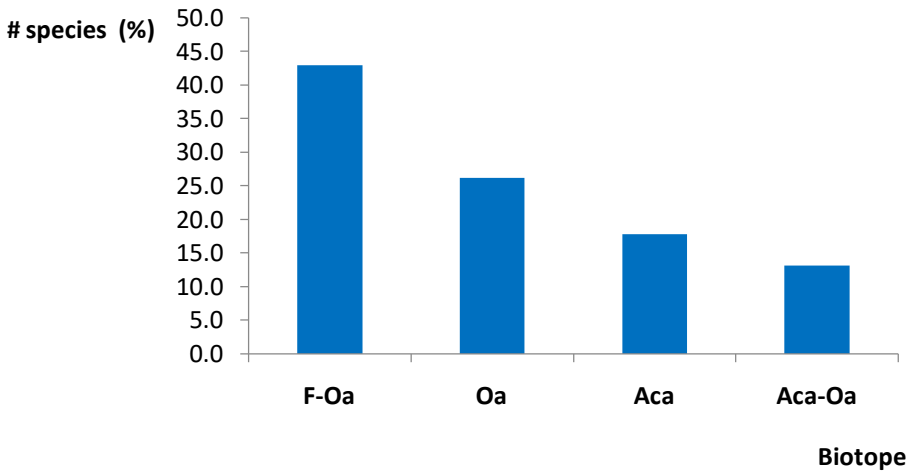

Fig. 4: The proportion of bird species in the different biotopes during the work period, in the nine cattle farms of Sucre, Colombia. Oa: open areas; Aca: water reservoir, F: forest.

We observe the same proportion of abundance (A, C and R) in the different biotopes ($X2 = 5.95$; $p > 0.01$; 8 df).

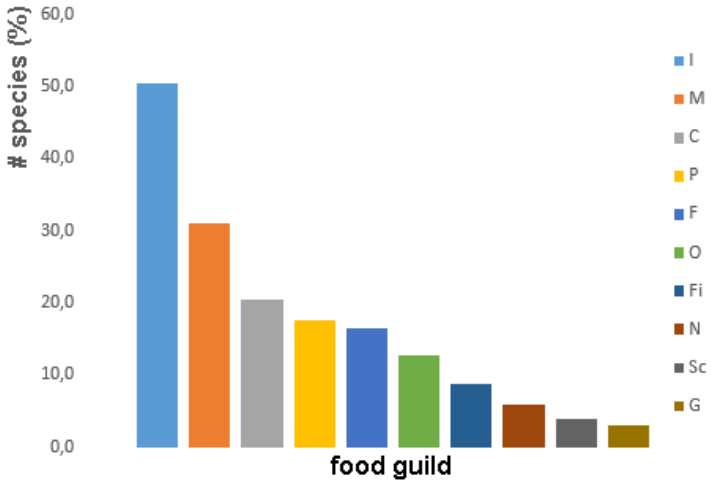

Fig. 5: Type of feeding strategies of birds sighted in 27 samplings in nine farms in Sucre, Colombia. F: Frugivorous; G: granivore; N: nectarivore; Fi: folivorous; I: insectivore; C: carnivore; P: piscivorous; Sc: scavenger; M: microphage; O: omnivorous)

In Fig. 5, we show the type of feeding used by the species observed in the nine farms. Insectivores appeared in greater proportion, followed by the rest of those who consume other types of animal food, while vegetarians generally appear in a smaller quantity. We also found that 30.1% of the species observed in this research could eat both plant and animal foods, although 21% of them are not considered omnivorous.

The type of feeding is not associated with the degree of abundance of the species in the case of those who eat food of animal origin ($X^2 = 15.1$; $p < 0.05$; 8 df), nor for those who eat food from plant origin ($X^2 = 5.1$; $p < 0.05$; 6 df).

As shown in Table 4, the migratory species are 2, and most of them are wintering species with permanent reproductive populations (PRP) (57.2%). In this case, the best-represented family is Ardeidae with six species. Non-reproductive wintering (NR) and local migratory (LM) represent 33.3% and 9.5%, respectively.

Table 4: Migratory species (M) [17] observed in the present investigation in nine farms of the department of Sucre. NR: non-reproductive winters; permanent reproductive wintering; LM: local migratory species.

Order	Family	Species	M
ACCIPITRIFORMES	Pandionidae	*Pandionhaliaetus*	NR
CATHARTIFORMES	Cathartidae	*Cathartes aura*	NR
ANSERIFORMES	Anatidae	*Anasdiscors*	PRP
		Dendrocygnaautumnalis	LM
CHARADRIIFORMES	Scolopacidae	*Actitismacularius*	NR
	Recurvirostridae	*Himantopusmexicanus*	PRP
GRUIFORMES	Rallidae	*Porphyriomartinicus*	LM
PASSERIFORMES	Hirundinidae	*Progne tapera*	NR
	Parulidae	*Mniotilta varia*	NR
		Protonotaria citrea	PRP
		Leiothlypisperegrina	NR
		Setophagaruticilla	NR
	Tyrannidae	*Tyrannusmelancholicus*	PRP
		Tyrannussavana	PRP
PELECANIFORMES	Ardeidae	*Ardeaherodias*	PRP
		Ardea alba	PRP
		Bubulcus ibis	PRP
		Egrettacaerulea	PRP
		Egrettathula	PRP
		Nycticoraxnycticorax	PRP
	Threskiornithidae	*Plegadisfalcinellus*	NR

Almost half of these species (47.6%) are frequent in the locations studied, 28.6% are rare, and 23.8% are abundant. Only the ducks (*Anasdiscors* and *Dendrocygnaautumnalis*) ingest vegetables, which they can complement with small organisms. The rest of the migratory species consume mainly food of animal origin (insects, fish, invertebrates, small vertebrates, and carrion). We observe migratory birds in water reservoirs (71.4%) and open areas (52.4%), but in most cases, we spot them in more than one of the sampled biotopes (Fig. 6).

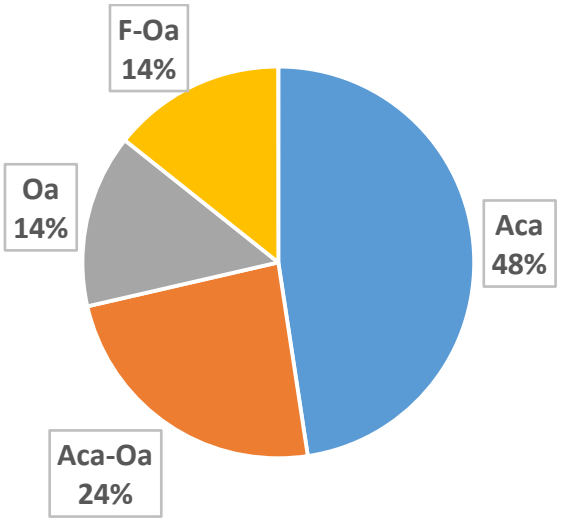

Fig. 6: The number of species (%) of migratory birds observed in different biotopes. (Aca: water reservoir; Aca-Oa: water reservoir and open areas; Oa: open areas; F-Oa: forest and open areas).

IV. Discussion

The species richness found in this work constitutes approximately 43.1%, of that reported for the Caribbean region [14, 15, 16], which gives value to these livestock farms as conservation areas. Sampling did not reach the highest values in number of species, possibly because we don't use fog nets and a significant quantity of species, especially of the Passeriformes order, which presents abundant groups of small size, are difficult to Detected by direct observation and may not have been sighted during sampling. The presence in the work area of migratory species increases the significance of these farms as possible areas for conservation.

The importance of grasslands, living fences, lagoons, jagüeyes, and urban areas for the conservation of biological diversity appears in several investigations [7, 9, 10, 22]. This research confirms that these anthropic ecosystems can serve as buffer zones and complementary to protected or reserve areas for local or migratory wildlife [23].

The little similarity between the different sampled biotopes is logical if one takes into account that birds use different types of resources according to their morphological, physiologica, and behavioral adaptations [24]. Most importantly, the species richness observed constitutes an indicator of the diversity of resources and possibilities of access to them that exist in these localities.

The passerines, which are the most diverse and abundant group[25], are the best represented in this work. Tyranids are the family with the highest number of species, possibly due to the varied food resources they can use and their possibilities to colonize different environments [14, 26, 27].

The absence of moisture in the region during the work period could explain that most of the birds sighted were insectivorous, followed by other consumers of food of animal origin and vegetarians, that in general, appear in a lesser proportion. However, we corroborate the same number of abundant, frequent and rare species, regardless of their preferred type of food resource.

None of the bird species detected are in any category of threat [28]; however, illegal hunting has increased, constituting an important item for the economy of this region, because of the use of wildlife for pet food and trade [29, 30].

Given the degradation suffered by forested areas in the department, a measure that could contribute to the protection of biological diversity could be to establish regional or local protected areas on farms that have the conditions for it, which has been suggested before for wildlife conservation in this region [31, 32].

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