

# Avifaunistic study in mangrove areas in a stretch of the São Caetano de Odivelas – Pará coast

Marceliano, Maria Luiza Videira<sup>1</sup>; Gomes, Andreza de Lourdes Souza<sup>2</sup>  
Gonçalves, Andrey Felipe Gomes<sup>3</sup>

<sup>1</sup> PhD in Biological Sciences, Zoology, Paraense Emílio Goeldi Museum / Zoology Coordination/Ornithology Sector. Belém, Pará, Brazil.

<sup>2</sup> PhD in Biological Sciences, Zoology, Pará Federal University/ Tocantins Campus /Cametá, Pará, Brazil.

<sup>3</sup> Master's Student in Zoology, Pará Federal University /Museu Paraense Emílio Goeldi. Belém, Pará, Brazil.

**Abstract**— The knowledge of the coastal avifauna is essential to understand the dynamics of the coastal ecosystem along the northern coast of Brazil, which is considered an area of high priority for the conservation of regional biodiversity. The Equatorial Region includes the coast of the States of Rio Grande do Norte to Amapá, and the coast of the States of Maranhão, Pará and Amapá is made up of mangroves, an ecosystem of transition between the terrestrial and marine environments, subject to the tidal regime, this ecosystem on the Amazon coast is of paramount importance because the States of Pará and Maranhão represent 57% of the mangroves in Brazil. This research aimed to determine the occurrence of resident and migratory coastal species, as well as their ecological importance and use in the mangrove ecosystem, the study site was São Caetano de Odivelas, in the locality of São Miguel, the methods of data collection used were: visual observation with the method by estimation in larger populations and open ornithological networks linearly from 6:00 a.m. to 11:00 p.m. and from 3:00 p.m. to 6:00 p.m. for two consecutive days totaling the sample effort amounted to 1.080 net hours. The results showed that 72 species of birds were recorded distributed in 27 families and 11 orders, being these residents, seasonal visitors from the northern hemisphere and other endemic to Brazil. It is concluded that there are several species recorded on the coast in São Caetano de Odivelas - Pará, such as endemic species, residents, and other seasonal visitors.

**Keywords**— Amazon, Brazil, Conservation, Avifauna, Mangrove forest.

## I. INTRODUCTION

The mangrove forest is one of the ecosystems with the greatest socioeconomic and ecological importance and one of the most productive on the planet. It presents high soil fertility, permanent humidity and high temperatures that generate favorable feeding, reproduction, and protection conditions for many marine species of commercial interest. The environment reduces the vulnerability of the coastal zone to global climate changes, such as changes in rainfall and temperature regimes, an increase in extreme events such as storms and extreme high tides, an increase in the average sea level in the coastal zone and an increase in the concentration of carbon dioxide [17,07,31].

The mangrove forest is defined as "a coastal ecosystem, of transition between terrestrial and marine environments, characteristic of tropical and subtropical regions, subject to tidal regimes" [45]. The global distribution of the mangrove forest reaches 137,760 km<sup>2</sup>, while in Brazil it is extremely significant for its extension and distribution

along the coastline occupying an area of 11,144 km<sup>2</sup> [28]. Brazil has 120 conservation units with mangroves in the interior (55 federal, 46 State and 19 municipal, of which 83% are for sustainable use and 17% for full protection) covering an area of 1,211,444 hectares, which represents 87% of the entire ecosystem in Brazil [31]. The northern region has more than 80% of the national mangrove areas, concentrated in the States of Amapá, Pará and Maranhão.

The Brazilian Amazon coast has the largest and most developed mangroves in the country, and all this magnitude is reflected in the diversity of habitats produced and, consequently, in the abundance of species of flora and fauna that occur in the mangroves in this region of Brazil [23]. This region constitutes one of the main routes of migratory bird species, highlighting, in the North of Brazil, the Amapá coast, the Pará salt marshes and recesses due to its extension, habitat diversity and productivity [37]. The Charadriiformes (blowpipes, batuíras, gulls and trintaréis) correspond to the group of birds with the highest

representation of northern migrant species and colonies of Ciconiiformes [44] using the coastal strip during their life cycle, for reproduction and obtaining food, because it provides the necessary resources for the continuation of biological processes such as feather seedlings, to later return to their areas of origin, thus completing their biological cycle, reproduction and landing area, being indicators of environmental conditions [09,16,11].

These environments present characteristic avifauna, with restricted species and reproductive strategies strongly influenced by the environmental conditions of the mangrove. This ecosystem is also used as nesting areas by colonies of several species of birds, with a strong hierarchical disposition in the occupation of the best places by the species considered stronger, such as the genus *Ardea* [33,47]. It is possible to observe all the phases of the reproductive process in the nest area, with a gradient that includes from couples in pre-nuptial ceremonies to pairs with already grown puppies. Adults can move at considerably long distances to capture food for the offspring.

In the neotropics the species of birds well represented in the mangrove area are among the stork families (Ciconiidae), herons and punches (Ardeidae) and spoonbills (Threskiornithidae), being represented by about 10 species almost all colonial. Several species of Neotropical Passeriformes demonstrated a trophic relationship with productivity in the mangrove swamp. The importance of mangrove food resources for this group, where data with different arthropod taxa show a temporal pattern like the pattern of abundance of Passeriformes during the annual cycle in mangrove areas in Venezuela. Studies highlight the importance of these environments for the conservation and maintenance of avifauna [02,42,54,04,23,26,05,06,18]. In this context the research aimed to determine the occurrence of resident and migratory coastal species, as well as their ecological importance and use in the mangrove ecosystem.

## II. MATERIAL AND METHODS

São Caetano de Odivelas is part of the Northeast region of the State of Pará and its main city is located at 00 °44 ' 33 'S and 48 ° 01' 03'W (SEPOF, 2011). It is limited to the north with the Atlantic Ocean; to the east with the municipality of Curuçá; to the west with the municipality of Vigia. It has an area of 724.10 km<sup>2</sup>, including its urban center and 41 communities. It has a territorial area of 743.4 km<sup>2</sup>, with a population density of 22.72 inhab./km<sup>2</sup> and a population of 16,891 inhabitants according to IBGE estimates for 2010.

The vegetation found in the region are: restinga vegetation, mangrove vegetation, floodable natural field vegetation and secondary vegetation [39]. Mangrove vegetation is typically composed of tidal plains under the influence of brackish water, or fluvial marine plains, with ideal physiography for the formation of this vegetation, since they constitute marshy or muddy areas, covered by water during flood tides and discovered at ebb tides, also receiving water from river and underground drainage [40].

The data collection period was six months, being carried out from April 2015 to July 2016. For the census, it was considered the counting one by one when the population was small and, in the large one, the method by estimation was used, when a group of 10 is "mentally photographed" and the rest of the birds are counted by group of 10 [22]. The identification of coastal birds was performed at a specific level with the aid of Tasco binoculars (10X25) and specific identification guides [16].

Ten ornithological nets (2.5 x 12 m; mesh 36 mm) were used, which were positioned linearly in the mangrove. The nets were opened from 6:00 a.m. to 11:00 a.m. and from 2:00 p.m. to 6:00 p.m. inspected every 45 minutes) were simultaneously monitored [21,13]. The captured specimens, after identification, were released near the capture sites and the sample effort totaled 1,080 net hours. The classification and taxonomic order to compose the list of registered bird species followed the 12th edition of the Brazilian List of Birds, published by the Brazilian Committee of Ornithological Records [08].

The Frequency of Occurrence (FO) of the species registered per expedition was calculated. The FO was defined as the percentage of the number of individuals of a species in relation to the total individuals counted. The frequency was calculated with the number of visits in which the species was found over the number of visits made, multiplied by 100. The species were categorized as regular: present in more than 50% of the visits, sporadic: between 25 and 50% and occasional: in less than 25% of the species in the visits.

## III. RESULTS AND DISCUSSION

The Neotropical region has a high diversity of birds and it is essential to expand the knowledge about the composition and richness of the bird population of a region to contribute to local ecological studies and migration groups. Birds represent about 38% of the vertebrate fauna associated with mangrove forests around the world, which makes this ecosystem essential for maintaining the diversity of this group. There are a variety of adaptations in birds that allow diverse feeding habits, such as frugivorous,

granivorous, insectivorous, nectarivorous, carnivorous, piscivorous, detritivorous or necrophagous and omnivorous. Birds represent an important group for maintaining the ecological balance of an area, since they act as seed dispersers, pollinating agents, population regulators and are also bioindicators of conservation [10]. The Neotropical region has a high diversity of birds and it is essential to expand the knowledge about the composition and richness of the bird population of a region to contribute to local ecological studies and migration groups.

In the community of São Miguel, 72 bird species were recorded distributed in 27 families and 11 orders. Resident species, seasonal visitors from the northern hemisphere and endemic to Brazil (Table 01). The data corroborates the studies carried out in the Resex Mãe Grande Curuçá where 36 families and 70 bird species were recorded [12] and demonstrates its importance for the conservation of this group, since in Brazil 35 families and 86 bird species are recorded that use the mangrove forest in some way throughout its biological cycle [52]. At Rio de Janeiro, 31 bird species were recorded distributed in 18 families on the Pombeba island [51].

Table.1: List of bird species registered in the mangrove forest on the island of São Miguel, Municipality of São Caetano de Odivelas - Pará, held between April 2015 and July 2016.

Taxon name	Common name	Frequency	Register	Status
<b>Anseriformes</b>				
<b>Linnaeus, 1758</b>				
<b>Anatidae Leach, 1820</b>				
<i>Amazonetta brasiliensis</i> (Gmelin, 1789)	Marrecã	sporadic	O	R
<b>Ciconiiformes</b>				
<b>Bonaparte, 1854</b>				
<b>Ardeidae Leach, 1820</b>				
<i>Nyctanassa violacea</i> (Linnaeus, 1758)	savacu-de-coroa	regular	O	R
<i>Cochlearius cochlearius</i> (Linnaeus, 1766)	Arapapã	regular	O	R

<i>Ardea alba</i> Linnaeus, 1758	garça-branca-grande	regular	O	R
<i>Ptilerodius pileatus</i> (Boddaert, 1783)	garça-real	regular	O	R
<i>Egretta tricolor</i> (Statius Muller, 1776)	garça-tricolor	regular	O	R
<i>Egretta thula</i> (Molina, 1782)	garça-branca-pequena	regular	O	R
<i>Egretta caerulea</i> (Linnaeus, 1758)	garça-azul	regular	O	R
<i>Nyctanassa violacea</i> (Linnaeus, 1758)	savacu-de-coroa	regular	O	R
<i>Butorides striata</i> (Linnaeus, 1758)	socozinho	regular	O	R
<b>Threskiornithidae</b>				
<b>Poche, 1904</b>				
<i>Eudocimus ruber</i> (Linnaeus, 1758)	guará	regular	O	R
<i>Mesembrinibis cayennensis</i> (Gmelin, 1789)	coró-coró	sporadic	O	R
<i>Theristicus caudatus</i> (Boddaert, 1783)	curicaca	sporadic	O	R
<b>Ciconiidae</b>				
<b>Sundevall, 1836</b>				
<i>Ciconia maguari</i> (Gmelin, 1789)	maguari	regular	O	R
<b>Cathartidae</b>				
<b>Lafresnaye, 1839</b>				
<i>Cathartes aura</i> (Linnaeus, 1758)	urubu-de-cabeça-vermelha	regular	O	R
<i>Cathartes burrovianus</i> Cassin, 1845	urubu-de-cabeça-amarela	sporadic	O	R
<i>Coragyps atratus</i> (Bechstein, 1793)	urubu-de-cabeça-preta	regular	O	R

<b>Falconiformes</b>						(Molina, 1782)					
<b>Bonaparte, 1831</b>						quero					
<b>Pandionidae</b>						<i>Charadrius collaris</i>					
<b>Bonaparte, 1854</b>						batuíra-de-coleira					
<i>Pandion haliaetus</i>	águia-pescadora	regular	O	SV		Vieillot, 1818	regular	O	R		
<b>Accipitridae</b>						<b>Scolopacidae</b>					
<b>Vigors, 1824</b>						<b>Rafinesque, 1815</b>					
<i>Elanoides forficatus</i>	gavião-tesoura	occasional	O	R		<i>Calidris alba</i>	maçarico branco	sporadic	O	SV	
(Linnaeus, 1758)						(Pallas, 1764)					
<i>Rupornis magnirostris</i>	gavião-carijó	regular	O	R		<i>Actitis macularius</i>	maçarico-pintado	sporadic	O	SV	
(Gmelin, 1788)						(Linnaeus, 1766)					
<i>Buteo swainsoni</i>	gavião-papagaio	occasional	O	R		<i>Numenius phaeopus</i>	maçarico-galego	sporadic	O	SV	
Bonaparte, 1838						(Linnaeus, 1758)					
<b>Falconidae Leach, 1820</b>						<i>Arenaria interpres</i>	vira pedras	regular	O	R	
<i>Milvago chimachima</i>	carrapateiro	regular	O	R		(Linnaeus, 1758)					
(Vieillot, 1816)						<i>Calidris minutilla</i>	maçariquinho	sporadic	O	SV	
<b>Gruiformes</b>						(Vieillot, 1819)					
<b>Bonaparte, 1854</b>						<i>Tringa melanoleuca</i>	maçarico-grande-perna-amarela	sporadic	O	SV	
<b>Rallidae</b>						(Gmelin, 1789)					
<b>Rafinesque, 1815</b>						<i>Tringa semipalmata</i>	maçarico-de-sobre-branco	sporadic	O	SV	
<i>Aramides mangle</i>	saracura-do-mangue	regular	O	R, E		(Gmelin, 1789)					
(Spix, 1825)						<i>Tringa flavipes</i>	maçarico-de-perna-amarela	sporadic	O	SV	
<i>Gallinula chloropus</i>	frango-d'água-comum	regular	O	R		(Gmelin, 1789)					
(Linnaeus, 1758)						<i>Tringa solitaria</i>	maçarico-solitário	sporadic	O	SV	
<b>Eurypyidae Selby, 1840</b>						Wilson, 1813					
<i>Eurypyga helias</i>	pavãozinho-do-pará	regular	O	R		<i>Calidris himantopus</i>	maçarico-pernilongo	sporadic	O	SV	
(Pallas, 1781)						(Bonaparte, 1826)					
<b>Charadriiformes</b>						<i>Calidris minutilla</i>	maçariquinho	occasional	O	SV	
<b>Huxley, 1867</b>						(Vieillot, 1819)					
<b>Charadriidae</b>						<b>Sternidae Vigors, 1825</b>					
<b>Leach, 1820</b>						<i>Sternula antillarum</i>	trinta-réis-	sporadic	O	R	
<i>Vanellus cayanus</i>	batuíra-de-esporão	regular	O	R							
(Latham, 1790)											
<i>Vanellus chilensis</i>	quero	regular	O	R							

Lesson, 1847	miúdo	c				(Da Silva Maia, 1843)	flor-verde				
<i>Sternula superciliaris</i> (Vieillot, 1819)	trinta-réis-anão	regular	O	R		<i>Amazilia fimbriata</i> (Gmelin, 1788)	beija-flor-de-garganta-verde	regular	C	R	
<i>Phaetusa simplex</i> (Gmelin, 1789)	trinta-réis-grande	regular	O	R		<b>Coraciiformes Forbes, 1844</b>					
<i>Sterna hirundo</i> Linnaeus, 1758	trinta-réis-boreal	occasional	O	R		<b>Alcedinidae Rafinesque, 1815</b>					
<b>Rynchopidae Bonaparte, 1838</b>							martim				
<i>Rynchops niger</i> Linnaeus, 1758	talha-mar	regular	O	R		<i>Megaceryle torquata</i> (Linnaeus, 1766)	- pescador-grande	regular	C	R	
<b>Columbiformes Latham, 1790</b>							martim				
<b>Columbidae Leach, 1820</b>						<i>Chloroceryle americana</i> (Gmelin, 1788)	- pescador-pequeno	regular	C	R	
<i>Columbina passerina</i> (Linnaeus, 1758)	rolinha-cinzent	regular	C	R			martim				
<i>Columbina talpacoti</i> (Temminck, 1811)	rolinha-roxa	sporadic	C	R		<i>Chloroceryle inda</i> (Linnaeus, 1766)	- pescador-da-mata	sporadic	C	R	
<i>Leptotila verreauxi</i> Bonaparte, 1855	juriti-pupu	regular	C	R		<b>Piciformes Meyer &amp; Wolf, 1810</b>					
<i>Leptotila rufaxilla</i> (Richard & Bernard, 1792)	juriti-gemedeira	regular	C	R		<b>Picidae Leach, 1820</b>					
<i>Geotrygon montana</i> (Linnaeus, 1758)	Pariri	regular	C	R		<i>Campephilus melanoleucos</i> (Gmelin, 1788)	pica-pau-de-topete-vermelho	sporadic	O	R	
<b>Psittaciformes Wagler, 1830</b>						<b>Passeriformes Linné, 1758</b>					
<b>Psittacidae Rafinesque, 1815</b>						<b>Dendrocolaptidae Gray, 1840</b>					
<i>Amazona amazonica</i> (Linnaeus, 1766)	curica	regular	O	R		<i>Xiphorhynchus spixii</i> (Lesson, 1830)	arapaçu	sporadic	C	R	
<b>Apodiformes Peters, 1940</b>						<b>Thamnophilidae Swainson, 1824</b>					
<b>Trochilidae vigors, 1825</b>						<i>Thamnophilus aethiops</i> Sclater, 1858	chocalisa	sporadic	C	R	
<i>Thalurania furcata</i> (Gmelin, 1788)	beija-flor-tesoura-verde	regular	O	R		<i>Myrmotherula axillaris</i> (Vieillot,	choquina-de-flanco-	regular	C	R	
<i>Polytmus theresiae</i>	beija-	regular	O	R							



1817)	branco				
<b>Formicariidae Gray, 1840</b>					
<i>Formicarius colma</i> Boddaert, 1783	galinha-do-mato	sporadic	O	R	
<b>Tyrannidae Vigors, 1825</b>					
<i>Pitangus sulphuratus</i> (Linnaeus, 1766)	bem-te-vi	regular	C	R	
<i>Mionectes oleagineus</i> (Lichtenstein, 1823)	abre-asas	regular	C	R	
<i>Tyrannus melancholicus</i> (Vieillot, 1819)	suiriri	regular	C	R	
<b>Turdidae Rafinesque, 1815</b>					
<i>Turdus rufiventris</i> (Vieillot, 1818)	sabiá-laranjeira	regular	C	R	
<b>Thraupidae Cabanis, 1847</b>					
<i>Tachyphonus rufus</i> (Boddaert, 1783)	pipira-preta	regular	C	R	
<i>Ramphocelus carbo</i> (Pallas, 1764)	pipira-vermelha	regular	C	R	
<i>Conirostrum bicolor</i> (Vieillot, 1809)	figuirinha-do-mangue	regular	C	R	
<b>Pipridae Rafinesque, 1815</b>					
<i>Chiroxiphia pareola</i> (Linnaeus, 1766)	tangará-falso	occasional	C	R	
<i>Manacus manacus</i> (Linnaeus, 1766)	rendeirã	occasional	C	R	
<b>Thraupidae Cabanis, 1847</b>					
<i>Thraupis episcopus</i> (Linnaeus, 1766)	sanhaçu-da-Amazônia	regular	C	R	
<i>Thraupis palmarum</i> (Wied, 1823)	sanhaçu-do-coqueir	regular	C	R	

<i>Sporophila angolensis</i> (Linnaeus, 1766)	o	Curió	regular	C	R
Type of register: C = capture; O = visual observation; Status R = resident, SV = seasonal visitor from the northern hemisphere, and E = endemic species of Brazil					

The Scolopacidae family had the highest richness with 15% of the species (n: 11), followed by Ardeidae with 13% (n:09), Columbidae 7% (n:05), Sternidae with 6% (n:04) Threskiornithidae, Cathartidae, Charadriidae, Alcedinidae, Accipitridae, Trochilidae, Tyrannidae and Thraupidae each one with 4% (n:03) Rallidae, Thamnophilidae, and Pipridae with 3% each (n:02) and Anatidae, Ciconiidae, Falconidae, Rynchopidae Pandionidae, Psittacidae, Eurypygidae, Picidae, Dendrocolaptidae, Formicariidae, and Turdidae with 1.5% each (n:01). The Scolopacidae family obtained the highest number of species (10) of seasonal visitor from the northern hemisphere. Migrations are seasonal movements at various geographical scales (local, regional, intercontinental, etc.), whose routes include a breeding area. Each year, thousands of birds that breed in the northern hemisphere move to various locations in the south, fleeing the boreal winter. The birds identified as migrants correspond to representatives of the Charadriidae and Scolopacidae families. The species of these families are basically related to the beach, but can be observed in flooded environments, such as swamps and mangroves (Graphic 1).

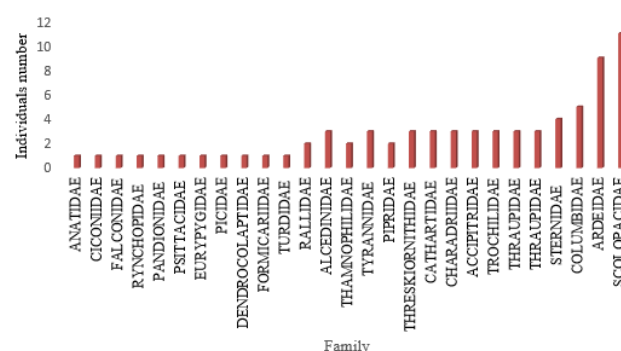


Fig.1: Number of species present in the families of birds registered on the island of São Miguel in the municipality of São Caetano de Odivelas - Pará, held between April 2015 and July 2016.

The Charadriidae family is distributed along the coast of Brazil, in the intertidal zone of beaches and mangroves, with displacement between these landscapes by the continuous movement in search of food both migratory

species and residents [05]. The birds feed on the invertebrates of the entomofauna of these habitats, the abundance of the organisms that constitute the food of these birds obeys seasonal cycles, and the peaks of this abundance occur in fixed periods, which makes it possible to synchronize the timing of the arrival of the birds in their "conditioning areas" adjusted to coincide with these peaks of food.

The exchanges between different areas within the landscape have the same ecological function as the more restricted movements between the spots that concentrate food in the same area [27,34]. Another factor can be the variation in scale and time of the density of invertebrates [29,22], and foraging by cohesiveness can quickly decrease the number of local invertebrates. When the abundance of local prey decreases, beach birds move to areas where the food density is higher, such as mangroves.

The protection of migratory birds is linked to the preservation of their breeding, feeding and resting sites. The loss or alteration of wintering and resting sites of these birds may result in the reduction and even the local extinction of some species or the decrease of the population. In this context, the conservation of the mangrove swamp on the island of São Miguel represents a fundamental area for species especially of the Scolopacidae family, with record *Actitis macularius* (April/August 2015 and February/March 2016), *Tringa solitaria* (April/December 2015), *Tringa melanoleuca* and *Calidris minutilla* (February/March 2016) and *Numenius phaeopus* (October 2015), it is necessary to highlight the importance of the quality of the habitats used as resting and feeding points for migratory birds, especially those that cross great geographical barriers during their movements [32].

The family Threskiornithidae (Ciconiiformes Order) includes 13 genera and 32 species of birds widely distributed around the globe, except in Antarctica, highlighting the ibis and spoonbills. They have long and curved beaks, long legs and neck, characteristics that contributed to the occupation of flooded environments and a diet based on aquatic species such as small crustaceans, larvae, mollusks, fishes, and crabs [48]. The Ciconiiformes of the northern coast of Brazil occupy both the continental wetlands, such as the Baixada Maranhense, and the mangroves where about 10 species occur, almost all of which are colonial, which can be monospecific or mixed. Coloniality has provided the development of scientific studies on development, reproductive strategy, and puppy diet due to high detectability. Several species of Ciconiiformes have their reproductive strategy strongly influenced by the specific conditions of the mangrove swamp, either by their spatial configuration in the form of

micro-habitat along a saline gradient or by seasonal variations in the abundance of resources [12].

The Ardeidae family consists of herons and punches and has as remarkable characteristics the long neck and legs; the straight and long beak, higher than wide, almost always pointed and in most cases with the presence of serrations for the capture of fish. The species *Ardea alba* (white-great-egret) presents greater daytime activity, of solitary habit, as in groups or flocks. It presents a diet composed of fish, invertebrates, reptiles, and amphibians, being predominant the consumption of fish. In foraging for food capture, it moves slowly walking in the water, near the margin to the location of the prey [30]. *Ardea alba* can form numerous nests, lay two to three blue-grey colored eggs and the incubation period is 25 to 26 days [19,25].



Fig.2: A. *Ardea alba* (garca-branca). B. *Nyctanassa violacea* (savacu-de-coroa).

*Eudocimus ruber*, the guará is a representative of the Threskiornithidae family and is closely related to mangrove environments on the Brazilian coast [47,50]. In Brazil it is distributed in two disjointed populations, one in the North, in the State of Pará and the State of Maranhão [47,15] and another in the South, particularly in the State of São Paulo [48]. The carciphagous species, such as *Eudocimus ruber*, are more dependent on marine resources and present a smaller laying size, about two eggs, which indicates an optimizing strategy for resources and the production of offspring [12].

On the island of São Miguel about 1500 reproductively active individuals of *Eudocimus ruber* were registered in the period from April to June 2015. The first study on the guará colonies was carried out between the mouth of the Orinoco and the Amazon, on the Amapá coast [50]. Later research in Viseu-PA [43] and on Cajual-Maranhão island [41] recorded the presence of nests of this species. In the State of Santa Catarina, after decades of absence, there were reports of the presence of reproductive activity in late 2012 [14].

The guarás were mostly observed sharing foraging and dormitory sites with other species. The sharing of feeding areas is known for several species of estuarine birds, and there is a general pattern of distribution for each one at the

foraging site. The guardians remain relatively more aggregated, while the *Egretta thula*, *Ardea alba* and *Nyctanassa violacea* are more isolated.



Fig.3: *Eudocimus ruber* (guará).

The genus *Cathartes* covers the necrophagous birds of the New World Vulture family (Cathartidae). There are three species classified in this genus. All species have featherless heads with bright colored skin (yellow or orange on the yellow-headed vulture, and bright red on the red-headed vulture). *Cathartes aura* has been frequently recorded in mangrove swamps, this species also occurs in forests, open lands, farms and on roadsides, captures small vertebrates on shallow flights and steals eggs from herons in nests. It sleeps in large flocks on dry trees and feeds on carcasses and, thanks to its keen sense of smell, is usually the first of vultures to find them. It also feeds on locusts and small fish; it appreciates fruits such as avocado and palm coconuts and stirs up fresh cattle manure for food.

The Alcedinidae family has a wide geographic distribution, occurring in tropical and subtropical zones, near aquatic environments [47]. Kingfishers are characterized as birds with colorful and bright plumage, robust body, relatively large head, short neck, short tongue, long beak, robust and pointed. The species *Megaceryle torquata*, also known as martim-pescador-grande or ariramba is the largest representative of this family, measures approximately 42 centimeters and weighs from 305 to 341 grams. This species was recorded more frequently in the rainy season, in this period there is an increase in soil humidity, which facilitates the construction of the nests, in addition to the increase in food supply. Another species recorded was *Chloroceryle inda*, martim-pescador-da-mata, this species feeds on fish, batrachios and crabs that it catches by diving from low perches in the mangrove vegetation near the water.



Fig.4: A. *Chloroceryle inda* (martim-pescador-da-mata).  
B. *Megaceryle torquata* (martim-pescador-grande).

Passeriforme birds are often cited in lists of bird species associated with mangroves [35,36,24,46,03]. In a study carried out in mangroves in the eastern State of Pará, the authors registered nine species of Passeriforme birds, which represented 50% of the inventoried species [35], while in another study 12 species were registered in mangrove areas in the island of Canela, Bragança, Pará [46]. In the island of São Miguel in the Municipality of São Caetano de Odivelas, the number of species belonging to the order of Passeriforme birds, was represented by 21 % of the species (n:15), demonstrating that this taxonomic group has an effective association with the mangrove ecosystem and, consequently, should exert some direct influence on the available resources and the dynamics of this ecosystem.

The arapaçus belong to the family Dendrocolaptidae formed by 14 genera, where 43 known species are classified in Brazil. The group is typical of the Neotropical regions of the New World, with distribution from southern Mexico to central Argentina. They are insectivorous birds that feed on insects preferentially crickets, cockroaches, ants, termites and beetles. Occasionally they also consume small amphibians or reptiles and only in conditions of extreme scarcity do they feed on fruits or seeds. The *Xiphorhynchus spixii* was registered in the study area and its distribution covers the Brazilian Amazon to the south of the Amazon River, extending south to Mato Grosso and east to Maranhão. It is also found in Colombia, Ecuador, Peru and Bolivia. It lives alone or in pairs, often accompanying mixed flocks of birds, and only eventually run ants.

Tyrannidae constitute the largest family of birds in the western hemisphere, where they occur exclusively, distributed from north to south of the American continent, with greater concentration in the Tropical region. This group gathers a wide diversity, totaling 413 species and constituting about 18% of the Passeriforme species in South America. In Brazil they occupy all types of landscape, most of which are arboreal and woodland, feeding essentially on insects and arthropods, but some species are frugivorous, granivorous and carnivorous [48].



The species *Mionectes oleagineus* of the Tyrannidae family was the most representative having an omnivorous diet composed of insects, mainly of the orders Hymenoptera, Coleoptera and Hemiptera, being complemented by fruits, mainly by the species: *Myconia ciliata* (Melastomataceae), *Virola surinamensis* (Myristicaceae), *Spermacoce verticillata* (Rubiaceae), *Phthirusa micrantha* (Loranthaceae), *Symphonia globulifera* (Clusiaceae), *Solanum crinitum* (Solanaceae), *Myrcia fallax* (Myrtaceae).

The pyrids are fruit-eating species of understory, present in general wide geographic distributions and high population densities, being found in the Amazon region the greatest richness of species per biome or ecoregion of the neotropics [01]. This family stands out for presenting a mating system in flocks, in which males are grouped in places or traditional flocks to execute cooperative exhibitions. The female of *Manacus manacus* (lace maker) was registered, a relatively small bird (15 - 18 g) with a diet composed predominantly of fruits. They play an important role in seed dispersal, removing them from areas of high population density, near the mother-plant and places of intense predation by insects and mammals receiving in return nutritional content, play an important role as vectors in seed dispersal in the Neotropical region [48].



Fig.5: A. *Mionectes oleagineus* (abre-asas). B. *Manacus manacus* (rendeira).

Representatives of the Thamnophilidae family are distributed in the Neotropical region and reach their greatest diversity in the Amazon basin. *Thamnophilus aethiops* (flat brook) is also known as xorró, measuring about 16 cm long and weighing 23 g. The male has a general dark grey coloration with the top of the head black and the female is brown with the lower part lighter. His diet is composed of insects and arthropods, including Aranea, Scorpiones, Chilopoda and Isopoda.

For a long time, scientists focused mainly on the conservation of terrestrial ecosystems, because among other reasons their impacts were directly observed. In a silent and less perceptible way, coastal zones, seas and oceans around the world also gradually suffered the effects of the expansion of occupation and anthropic uses. Among

the main causes for the loss of coastal biodiversity were loss of habitat, contamination of continental waters by agrochemicals and fertilizers used in agriculture, toxic industrial waste [20] and human waste without treatment or partially treated, capture of fishing resources (fish, mollusks, crustaceans and algae) in quantities greater than their capacity for reproduction and climate change.

The coastal and marine ecosystem is home to a significant variety of living beings, and provides essential services for human survival, such as food, climate maintenance, water purification, flood control and coastal protection. The mangroves, in turn, present high structural and functional diversity, acting, together with the estuaries, as exporters of biomass to the adjacent systems, this system works as a place of refuge, rest, feeding and reproduction of several taxa of marine and terrestrial life, including birds.

#### IV. CONCLUSION

The Neotropical region of mangrove on the island of São Miguel, found along the coast of São Caetano de Odivelas - Pará, presents a high diversity of endemic, resident, migratory birds, and other seasonal visitors. Thus, it is necessary to expand the knowledge about the composition and richness of the bird species, in order to contribute to local ecological studies and migratory groups. According to the methodology used, it could be concluded that there were several bird species registered in the region, being those belonging to the Brazilian or migratory bird species, such as those of the Scolopacidae family. Thus, the maintenance of the mangrove swamp on the island of São Miguel is fundamental as a way to conserve these species, since it serves as habitat, resting point, and feeding point for birds, especially those that cross great geographical barriers during their displacement.

#### ACKNOWLEDGEMENTS

To the Coastal Studies Program (PEC) of the Museu Paraense Emilio Goeldi (MPEG), to the Amazônia Paraense Foundation for Research Support (FAPESPA), for the financial contribution to the project: "Economic valuation of direct and indirect uses of the mangrove ecosystem in São Caetano de Odivelas-Pará", under the coordination of Prof. Dr. Maria de Nazaré do Carmo Bastos, which enabled the development of this research.

## REFERENCES

- [1] Anciães, M. & Peterson, A.T. (2006). Climate change effects on Neotropical manakin diversity based on ecological niche modeling. *Condor*, 108, 778-791.
- [2] Antas, P.T.Z. (1984). Migration of nearctic shorebirds (Charadriidae and Scolopacidae) in Brasil – flyways and their different seasonal use. *Wader Studie Group Bulletin*, Tring, 39, 52-56.
- [3] Araújo, H.F.P., Rordrigues, R.C.E Nishida, A.K., (2006). Composição da avifauna em complexos estuarinos a Paraíba, Brasil. *Ararajuba*, 14(3), 249 -259.
- [4] Azevedo-Júnior, S.M. DE & Larrazabal, M.E.L. (2000). Aves: Biologia, Ecologia e Movimentação. In: Barros, H.M., Eskinazi-Leça, E., Macedo, S.L., Barbieri E. & Sato, T. Information analysis foraging behavior sequences of colored plover (*Charadrius collaris*). *Revista Ciência e Cultura*, 52(3), 176-606.
- [5] Barbieri, E., J. T. Mendonça e S. C. Xavier. (2000) Distribuição da batufira-de-bando (*Charadrius semipalmatus*) ao longo do ano de 1999 na Ilha Comprida. *Notas Técnicas Facimar* 4:69-76
- [6] Clemente, C.J., Schaeffer-Novelli, Y. (2000). Considerações Teóricas e Práticas sobre o Impacto da Carcinocultura nos Ecossistemas Costeiros Brasileiros.. *Mangrove200 Sustainable use of estuaries and mangrove: challenges and prospects*. Recife, CD-ROM.
- [7] Coelho Jr, C.; Novelli, Y.S. Considerações teóricas e práticas sobre o impacto da carcinocultura nos ecossistemas costeiros brasileiros, com ênfase no ecossistema manguezal. In: *Mangrove (2000) Sustentabilidade de estuários e manguezais : desafios e perspectivas*. Recife: Universidade Federal Rural de Pernambuco.
- [8] Comitê Brasileiro de Registros Ornitológicos (2014). Lista das aves do Brasil. Disponível em: <<http://www.cbro.org.br/CBRO/listabr.htm>> Acesso em: 04 de agosto de 2020.
- [9] Ellenberg, H. (1981).. Was its ein Bioindikator? *Okologie, Vogel*, 3, 83-99.
- [10] Fernandes, M.E.B.(Org.), 2003. Os Manguezais da Costa Norte Brasileira. Fundação Rio Bacanga: Maranhão.
- [11] Francisco, M.R. & Galetti M. (2002). Aves como potenciais dispersoras de sementes de *Ocotea pulchella* Mart. (Lauraceae) numa área de vegetação de cerrado do sudeste brasileiro. *Revista Brasileira de Botânica* 25, 11-17.
- [12] Frederick, P., Towles, T., Sawicki, R. & Bancroft, T. (1996). Comparison of aerial and ground techniques for discovery and census of wading bird (Ciconiiformes) nesting colonies. *The Condor*, 98, 837~841.
- [13] Furtado, L.G., Silveira, I.M., Santana, G. (2012) Reserva Extrativista Marinha Mãe Grande - Curuçá, Pará, Brasil: estudo etnoecológico e sociocultural. Belém: Museu Paraense Emílio Goeldi, 2012.
- [14] Gosler, A. (2004). Birds in the hand. In: Sutherland, W.J., Newton, I. & Green, R.E. *Birds ecology and conservation: a handbook of techniques*. New York: Oxford University Press.
- [15] Grose, A.V., Cremer, M.J.& Moreira, N. (2013) Reprodução do Guará *Eudocimus ruber* no estuário da Baía da Babitonga, Litoral. Resumos do XX Congresso Brasileiro de Ornitologia, Passo Fundo, RS.
- [16] Hass, A., Matos, R.H.R. & Marcondes-Machado, O.(1999) Ecologia reprodutiva e distribuição espacial da colônia de *Eudocimus ruber* (Ciconiiformes: Threskiornithidae) na Ilha do Cajual, Maranhão. *Revista Brasileira de Ornitologia* 7, 41–44.
- [17] Hayman, P., Marchant, J. & Prater, T. (1986). *Shorebirds: An Identification Guide*. Boston : A and C Black.
- [18] Herz, R. (1991). *Manguezais do Brasil*. São Paulo: Universidade de São Paulo.
- [19] Hilty, S L. (2003). *Birds of Venezuela*. (2nd ed). Princeton: Princeton University Press.
- [20] Hófling, E., Camargo, H.F.A.(1996). *Aves no campus*. (2nd.ed) São Paulo: EDUSP.
- [21] Hypolito, R., Ferrer, L.M.& Nascimento, S. C. (2005). Comportamento de espécies de mercúrio no sistema sedimento-água do mangue no município de Cubatão, São Paulo. *Revista Águas Subterrâneas*, 19(1), 15-24.
- [22] Karr, J.R. (1981). Surveying birds with mist nets. In: Ralph, C. J. & Scott, J. M. (Eds). *Estimating numbers of terrestrial birds*. *Studies in Avian Biology* 6. Los Angeles : Cooper Ornithological Society.
- [23] Kasprzyk, M.J. & Harington, B.A. (1989). Manual de Campo para maçaricos e batufiras. In: *Seminário Internacional sobre manejo e conservação de maçaricos e ambientes aquáticos nas Américas*. Recife: IBAMA.
- [24] Larrazábal, M.E., S. M. DE Azevedo-Junior & Pena, O. (2002). Monitoramento de aves limícolas na Salina Diamante Branco, Galinhos, Rio Grande do Norte, Brasil. *Revista Brasileira de Zoologia*, 19(4), 1081-1089.
- [25] Lefebvre, G., Poulin, B.E.& Mcneil, R. (1994). Temporal dynamics of mangrove bird communities in Venezuela with special reference to migrant warblers. *The Auk*, 111(2), 405.
- [26] Lins, A.L.F.A.; Marceliano, M.L.V.; Mendes, A.C. & Gorayeb, I.S. (Org.) (2014). *Amazônia, zona costeira: termos técnicos e populares*. Belém: Museu Paraense Emílio Goeldi.
- [27] Lyra-Neves, R.M. DE, A.M.I. DE Farias; W.R. Telino-Júnior, M. Arzua, M.C.N. Botelho & M. DA C. Abreu E Lima (2000). Ectoparasitismo em aves silvestres (Passeriformes – Emberizidae) de Mata Atlântica, Igarassu, Pernambuco. *Melospittacus* 3(2), 64-71.
- [28] Macarthur, R.H.. Recher, M.C. (1996)..On the relation between habitat election and species diversity. *The American naturalist*, 100, 319-332.
- [29] Magris, R.A., &Barreto, R., 2010. Mapping and assessment of protection of mangrove habitats in Brazil. *Pan-American Journal of Aquatic Sciences* 5(4), 546–556
- [30] Masero, J.A, Pérez-Gonzales, M., Basadre, M., Otero-Saavedra, M. (1999). Food supply for waders (Aves: Charadrii) in an estuarine area in the Bay of Cádiz (SW Iberian Peninsula). *Acta oecologica* 20, 429-434.

- [31] Matarazzo-Neuberger, W.M.(1994). Guildas, organização e estrutura da comunidade: análise da avifauna da represa Billings, São Paulo. Tese (Doutorado). Universidade de São Paulo, São Paulo.
- [32] Ministério do Meio Ambiente (2018). Atlas dos manguezais do Brasil. Brasília: Instituto Chico Mendes de Conservação.
- [33] Moore, F.R. & Simons, T.R.(1992). Habitat suitability and stopover ecology of Neotropical landbird migrants. In: Hagarm, J.M. & Kohnston, D.W.(Eds) Ecology and conservation of neotropical migrant landbirds. Washington, Smithsonian Institution Press.
- [34] Nascimento, J. L. X. 1999. Registros de ninhas de garças (Ciconiiformes, Ardeidae) na Paraíba, Brasil. Airo Lisboa 10 (1), 39-42.
- [35] Neves, L R.M., Azevedo-Júnior, S.M. & Telino Júnior, W.R. (2004). Monitoramento do maçarico-branco, *Calidris alba* (Pallas) (Aves, Scolopacidae), através de recuperações de anilhas coloridas, na Coroa do Avião, Igarassu, Pernambuco, Brasil. Revista Brasileira de Zoologia, 21(2), 319-324.
- [36] Novaes, F.C. & Lima, M.F. (1992). Aves das campinas, capoeiras e manguezais do leste do Pará. Boletim do Museu Paraense Emílio Goeldi. Série Zoologia,. 8(2), 271-303.
- [37] Novaes, F.C., & Lima, M F C.(1998). Aves da grande Belém: municípios de Belém e Ananindeua, Pará. Belém, Pará: Parpa: Museu Paraense Emílio Goeldi.
- [38] Oliveira, A.C., Barbora, A.E.A., Sousa, A.E.B.A., Palludo, D., Lima, D.M.Nascimento, J.L.X., Souza, MA.,Arantes, M.S., Serafini, P.P., Amaral, P.P., Rossato, R.M. & Medeiros, R.C.S. (2014). Relatório anual de rotas e áreas de concentração de aves migratórias no Brasil.Paráiba: Instituto Chico mendes de conservação.
- [39] Olmos, F. (2000). Dieta e biologia reprodutiva de *Eudocimus ruber* e *Egretta caerulea* (Aves: Ciconiiformes) nos manguezais de Santos-Cubatão. Tese (Doutorado em Zoologia) – Instituto de Biociências, Universidade Estadual Paulista, São Paulo.
- [40] Picanço, M.S.M. (2012). A formação vegetal do Município de São Caetano de Odivelas (PA) por meio de produtos de sensoriamento remoto. Revista geonorte 1(4),113 – 124..
- [41] Prost, M.T., Mendes, A.C., Faure, J F., Berredo, J.F., Sales, M.E.C., Furtado, L.G., Silva, M.G.S., Silva, C. A., Nascimento, I., Gorayeb, I., Secco, M.F.V., Luz, L.M. (2001). Manguezais e estuários da costa paraense: exemplo de estudo multidisciplinar integrado (Marapanim e São Caetano de Odivelas). In: M.T. Prost & A.C. Mendes: Ecossistemas Costeiros: Impactos e Gestão Ambiental. Belém: Museu Paraense Emílio Goeldi.
- [42] Rodrigues, A.A.F. (1995). Ocorrência da reprodução de *Eudocinus ruber* na Ilha do Cajual, Maranhão, Brasil (Ciconiiformes: Threskiornithidae). Ararajuba.3, 67-68.
- [43] Rodrigues, A.A.F. (2000). Seasonal abundance of Neartic shorebirds in the Gulf of Maranhão, Brazil. Journal of Field Ornithology. Lawrence, 71(4), 665-675.
- [44] Rodrigues, A.A.F., Fernandes, M. (1994). Nota sobre um ninhal de guara, *Eudocinus ruber*, (Ciconiiformes) no litoral do Para, Brasil. Boletim do Museu Paraense Emílio Goeldi Serie. Zoologia.10,.289-292..
- [45] Rossi-Wongtschowski, C L.D.B.; Valentin, J.L., Jablonski, S., Amaral, A.C.Z.; Hazin, F.H.V.; El-Robrini, M.(2006). Relatório Executivo: avaliação do potencial sustentável de recursos vivos na Zona Econômica Exclusiva do Brasil. Brasília: MMA.
- [46] Schaeffer- Novelli, Y.(Ed.) (1995). Manguezal: Ecossistema entre a Terra e o Mar. São Paulo: Caribbean Ecological Research.
- [47] Schories, D. (2001). A biodiversidade e a comunidade de pescadores na Ilha Canela, Bragança, Pará, Brasil., Belém: MCT/ Museu Paraense Emílio Goeldi.
- [48] Sick, H. (1997). Ornitologia Brasileira. Rio de Janeiro. Editora Nova Fronteira
- [49] Sick, H.(2001) Ornitologia Brasileira. Rio de Janeiro: Editora Nova Fronteira.
- [50] Silva, R.C.A., Saiki, M., Oliveira, P. T.M.S.(2011). Selenium levels in liver of Great Egret (*Ardea alba*) from São Paulo metropolitan region, Brazil. INAC International Nuclear Atlantic Conference.
- [51] Spaans, A. L.(1990). The Scarlet Ibis (*Eudocimus ruber*): status, conservation and recent research. Caracas: International Waterfowl and Wetlands Research Bureau Special Publication 11.
- [52] Souza ,V.A., Silveira, V.V., Kvassay, G.E.C., Silva, R.F., Gobbi, C.N.(2012). Levantamento e monitoramento da avifauna na Ilha da Pombeba, Baía de Guanabara, Rio de Janeiro, Brasil. Atualidades Ornitológicas On-line 170.
- [53] Vannucci, M. 2003. Os manguezais e nós: uma síntese de percepções. São Paulo: Editora da Universidade de São Paulo.
- [54] Viellard, Jacques et al. Levantamento quantitativo por pontos de escuta e o Índice Pontual de Abundância (IPA). In: VON MATTER, Sandro et al. Ornitologia e conservação: ciência aplicada, técnicas de pesquisa e levantamento. Rio de Janeiro: Technical Books, 2010, p. 45-60.
- [55] Wilson, M.F.(1974). Avian community organization and habitat structure. Ecology, Brooklyn, v.55, n.5, p.1017-1029.