Chapter 12
Mangrove and Salt Marsh Migratory and Resident Birds

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12.1 Importance of Mangroves and Salt Marshes to Birds

Mangrove ecosystems are highly productive, representing important nutrient sources for both terrestrial and aquatic food webs and serving as breeding and resting ground for many animals, including birds (Luther and Greenberg 2009). Bird diversity in mangroves is mostly related to habitat heterogeneity, especially due to plant species richness, the density of the understory, and food resource distribution (Nagelkerken et al. 2008; Mohd-Azlan et al. 2015). The aerial roots of mangroves provide substrates on which many species live, including algae, tunicates, sponges, and bivalves. Many infaunal and epifaunal species, together with prawns, crabs, and fish, dwell on the soft substrate and may be predated by birds (Nagelkerken et al. 2008). In Brazil, mangrove-resident bird species such as the scarlet ibis (*Eudocimus ruber*) and the yellow-crowned night heron (*Nyctanassa violacea*) feed mainly on fiddler crabs in mangroves (Olmos and Silva e Silva 2001), while the tricolored egret (*Egretta tricolor*) feeds on small fish (*Poecilia* spp.) (Martinez 2010).

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The mangrove trees and canopy provide important habitats for bird species to rest, roost, and nest. All three abovementioned species and others, such as herons and passerines, nest in mangrove trees (Olmos et al. 2001; Mancini et al. 2018), highlighting the importance of this ecosystem as breeding sites. Some mangrove sites such as the Maranhão State and Santos-Cubatão area, São Paulo State, shelter several thousands of bird nests every year (Martinez and Rodrigues 1999; Silva e Silva 2007) (see Chap. 3, Maps 3 and 14, respectively).

On the Brazilian northern coast, roughly one thousand semipalmated plovers (*Charadrius semipalmatus*) were recorded perched on the red mangrove prop roots during high tide (Rodrigues 2007). Therefore, mangroves also provide high-tide refuge for birds feeding in nearby areas (Rodrigues 2007; Valente et al. 2011). Every year hundreds of thousands of migratory birds such as plovers, sandpipers, terns, and other species fly to Brazilian mangroves after the breeding season. They come mainly from North America, such as the gray plover (*Pluvialis squatarola*) and whimbrel (*Numenius hudsonicus*), both migrating from northern Canada and the Arctic (Sick 1997).

Mangroves are also important as a stopover or wintering grounds because birds need to restore their energy by feeding and resting in these areas to continue their migration. In northern Brazil, the Amazon River and its mangroves harbor about 50% of the North American population of migratory gray plovers, 70% of the population of ruddy turnstones (*Arenaria interpres*), around 50% of the population of willets (*Tringa semipalmata*), and 43% of the population of whimbrels (Morrison and Ross 1989). Also, in the Brazilian state of Sergipe, in the city of Aracaju, about 100,000 individuals of 18 different shorebird species yearly aggregate in mangrove areas (Barbieri 2007) (see Chap. 3, Map 10). Furthermore, there are records of site fidelity of the semipalmated sandpiper (*Calidris pusilla*) in three mangrove wintering areas in the Brazilian Amazon (Rodrigues et al. 2007) and semipalmated plover on the northern coast of São Paulo State (Olmos and Silva e Silva 2001). Thus, mangrove areas have an important role in supporting the maintenance of these species' migratory routes. Strips of mangroves provide habitat for diverse faunal species to rest, find shelter, and feed, especially in regions deprived of inland vegetation (Linneweber and Lacerda 2002).

Wading and aquatic birds often nest and rear their young in large colonies in mangroves, taking advantage of the relative inaccessibility of the forest canopy to terrestrial predators. Mangrove areas are also used by many bird species as roosting sites, especially for heron species such as the snowy egret (*Egretta thula*), little blue heron (*E. caerulea*), black-crowned night heron, and great egret (*Ardea alba*) (Olmos and Silva e Silva 2001; Mestre et al. 2007; Mancini et al. 2018). This means that mangroves are key to aggregations of several bird species for feeding, roosting, as dormitory sites, and breeding purposes.

At the same time, birds are also a key component of this ecosystem, due to their ecological role in the dynamics of mangroves (Acevedo and Aide 2008; Mohd-Azlan et al. 2015). They oxygenate the soil while feeding and fertilize these sites by releasing nutrients into the water column through their feces and food waste, distributing nutrients within the mangrove food chain (Onuf et al. 1977; Navedo

et al. 2015). Moreover, they control prey populations and weed seeds, regulate competition through grazing, and consume invertebrate pests (e.g., golden apple snails or zebra mussels) while facilitating the colonization by less competitive plants and invertebrates (Nagelkerken et al. 2008; Green and Elmberg 2013). They also host exclusive parasites and disperse seeds and invertebrates, linking plants and organisms in remote marshes (Nagelkerken et al. 2008; Green and Elmberg 2013).

Salt marsh ecosystems are particularly important for birds due to their high primary productivity, acting as prime feeding sites and offering roosting and nesting opportunities for a series of resident and migratory species and occasional visitors from adjacent habitats (Hughes 2004; Greenberg et al. 2014). The total number of bird species in southern Brazilian salt marshes is considered relatively high. At the Saco da Mangueira, in the Patos Lagoon estuary, Rio Grande do Sul State, 89 species were recorded in salt marshes, including mud- and sandflats and open water at the edges of marshes (Dias and Maurício 1998) (see Chap. 3, Map 17). At the mouth of the same estuary, three salt marshes harbored 66, 85, and 87 species (Dias et al. 2017).

Variations in species richness between individual salt marshes in that region are largely driven by their distance to the ocean, with the more species-poor sites being found near the mouth of the estuary, which reflects the progressive influence of abiotic stress upon the avifauna (Dias et al. 2017). Within salt marshes, zonation and environmental gradients with adjacent freshwater marshes and grasslands play an important role in shaping avian diversity (Greenberg et al. 2014). In South Brazil, the more densely vegetated and less-flooded high marsh (at or above the mean high-tide line) harbors mostly passerines and rails (and some shorebirds when overgrazed by livestock or recently burned). The low marsh (below the mean high-tide line) and associated mud- and sandflats and open-water habitats are used by ducks, swans, grebes, flamingos, cormorants, egrets, herons, coots, gulls, terns, and shorebirds (Resende and Leeuwenberg 1987; Dias and Maurício 1998; Bencke et al. 2003; Dias et al. 2011, 2017).

Despite the relatively high number of species found in salt marshes, few of them use these wetlands as breeding sites, namely, small passerines, ducks, raptors, shorebirds, and rails (Bencke et al. 2003; Maurício et al. 2013; Greenberg et al. 2014). Likewise, there are no salt marsh-specialist species in South America, despite the high richness in the continent (Greenberg et al. 2014). One of the possible explanations refers to the low contrast between South American salt marshes and the adjacent open-vegetation environments, which minimizes isolation and speciation (Isacch et al. 2014).

The main uses of southern Brazilian salt marshes and associated estuarine habitats by birds are feeding and roosting (Greenberg et al. 2014; Dias et al. 2017). Salt marshes and adjacent waters support large populations of fishes and invertebrates that constitute major food sources for carnivorous birds, such as grebes, cormorants, egrets, herons, shorebirds, gulls, and terns. The seagrass *Ruppia maritima* Linnaeus and other aquatic plants growing in shallow waters along the margins of marshes are consumed by herbivorous ducks, swans, and coots, and the seeds of some salt marsh plants are eaten by a few granivorous species (Isacch et al. 2014; Greenberg et al. 2014; Dias et al. 2017). Salt marshes also constitute a habitat for terrestrial

invertebrates, which in turn are prey for carnivorous passerines. Larger carnivorous birds, such as falcons and harriers, hunt birds and other small animals in the marshes, and scavengers such as caracaras and vultures patrol the vegetation and the water margins searching for dead fish, crabs, and shellfish.

Large concentrations of birds have been recorded in Brazilian salt marshes. For example, at least 800 individuals of buff-breasted sandpipers (*Calidris subruficollis*), 688 white-rumped sandpipers (*Calidris fuscicollis*), and 545 American golden plovers (*Pluvialis dominica*), all Nearctic migrants, were recorded in high densities feeding in overgrazed salt marshes and adjacent grasslands at Ilha da Torotama, in the Patos Lagoon estuary (RS) (Lanctot et al. 2002; Bencke et al. 2006; Dias et al. 2011). In transition areas with freshwater wetlands at the same locality, flocks of approximately 400 individuals of lesser yellowlegs (*Tringa flavipes*), 100 white-rumped sandpipers, and 200 pectoral sandpipers (*Calidris melanotos*) have been registered (Dias et al. 2011). Thousands of black-necked swans (*Cygnus melancoryphus*) gather in shallow bays surrounded by salt marshes at Patos Lagoon estuary during dry summers and autumns, a substantial part of the population inhabiting the country (Bencke et al. 2006). Nearly 500 barn swallows (*Hirundo rustica*) were seen foraging over salt- and neighboring freshwater marshes of the Ilha da Torotama (Dias et al. 2011). Salt marshes at the mouth of the Patos Lagoon estuary also harbor important concentrations of birds, especially gulls and terns, e.g., >5000 common terns (*Sterna hirundo*) (Dias et al. 2011, 2017).

The salt marshes at the Peixe Lagoon (RS) are also important areas for birds. Large numbers of buff-breasted sandpipers and American golden plovers use overgrazed marshes and adjacent grasslands, and thousands of Hudsonian godwits (*Limosa haemastica*), red knots (*Calidris canutus*), sanderlings (*Calidris alba*), and common terns feed and especially roost in mud- and sandflats on the margin of the marshes. Hundreds of black-necked swans and Chilean flamingos (*Phoenicopterus chilensis*) use the lagoon waters to feed (Bencke et al. 2006).

Bird communities inhabiting Brazilian mangroves and salt marshes have never been comprehensively reviewed. Here we present a compilation of published data together with our unpublished field observations to characterize this particular avifauna, its diversity patterns, how they are adapted to live in these ecosystems, the main threats, conservation strategies, and knowledge gaps.

12.2 Bird Adaptations to Live in Mangroves and Salt Marshes

Mangroves and salt marshes are unique and dynamic ecosystems marked by high- and low-tide levels. All exclusive and typical mangrove animal species are subject to dynamic, often extreme, environmental conditions, and birds are the terrestrial group with the most adaptations related to their mobility and feeding habits (Hutchings and Saenger 1987).

Mangrove bird assemblages comprise both terrestrial and aquatic species, which explore resources in diverse ways. Hence, all mangrove microhabitats, i.e., arboreal strata, mudflats, sandflats, and salt flats, are used for foraging by a wide range of bird species with different morphologies and behaviors. For instance, gleaning, bark-foraging, and flycatching insectivores (e.g., Tyrannidae species) are adapted to feed on prey items that piscivorous, carnivorous, or species that probe directly in mudflats are not able to explore (e.g., Scolopacidae species). In countries like Malaysia and Australia, bird assemblages exhibit zonation of prey exploration in mangrove trees. In such cases, different branching patterns and structures of the foliage seem to differ enough so that birds could specialize to different mangrove trees (Noske 1995, 1996; Luther and Greenberg 2009). However, in Brazil, no studies have been conducted on feeding adaptations or vertical zonation patterns in mangroves.

In general, mangrove-exclusive bird species feed primarily on insects (~50%), followed by a smaller proportion that feeds on crabs, nectar, and fish (Lefebvre and Poulin 1997; Luther and Greenberg 2009). Roughly 20% of the bird species restricted to mangroves have larger bills than related subspecies or sister taxa inhabiting inland habitats (Grenier and Greenberg 2005; Luther and Greenberg 2009). There is a consistent pantropical pattern of longer and deeper bills in passerine birds restricted to mangroves and salt marshes (Grenier and Greenberg 2005; Greenberg and Olsen 2010; Luther and Greenberg 2011; Greenberg et al. 2012). Longer and slender bills are correlated with a wider foraging-niche breadth and are advantageous for probing in small cracks and crevices, where many prey items can be found. Long bills are also likely useful for probing in mud and among mangrove roots where other prey may be abundant (Luther and Greenberg 2011). Bill size is also related to temperature, as birds living in habitats with higher temperatures tend to have larger bills than birds living in cooler climates and inland terrestrial habitats (Greenberg et al. 2012; Luther and Greenberg 2014). Bills might play an important thermoregulatory role, as reported for tidal marsh sparrows from hot and exposed dune/salt marsh environments. The bill expels excess body heat in these unbuffered, freshwater-limited environments and potentially may reduce water loss (Greenberg et al. 2012).

In salt marshes, some morphological characteristics facilitate bird activities (e.g., foraging, evading predators, and intraspecific communication). The most conspicuous is the morphology of the bill and legs of shorebirds using the marsh vegetation or adjacent mud- and sandflats. Rails have long legs and toes and slender bodies to move through the dense herbaceous vegetation, using colorful frontal shields for visual communication in the dark environment (Sick 2001). Some passerines adapted to live in grasslands also occur in the tall, dense vegetation of salt marshes and have strong legs, long and curved claws, and long tails used for balance. Most are carnivorous and use long and thin bills to hunt in the vegetation, some also hop or walk on the mud, and a few are granivorous and use thick bills to crush seeds of salt marsh plants. In coastal salt marshes, North American sparrow populations have comparatively longer and thinner bills than their inland counterparts, which could be an adaptation that increases the consumption of marine invertebrates at the decrease in seed availability (Greenberg et al. 2012). In the bay-capped wren-spinetail

(*Spartonoica maluroides*), a species strongly associated with South American salt marshes, there are differences in bill shape and plumage coloration between coastal and inland marsh populations. These differences may be explained by the selective pressures related to the adaptation of the beak shape to explore prey in salt marshes, whereas the change in plumage pigmentation (melanism) may improve camouflage and assist in predator evasion (Cardoni et al. 2013). Overall, in tidal marshes of North America, birds often show a high degree of local morphological differentiation (Chan et al. 2006; Greenberg et al. 2006), but this topic has not yet been investigated in Brazilian salt marshes.

12.3 Bird Diversity Across Mangroves and Salt Marshes

The species richness of birds in Brazilian mangroves and salt marshes has never been properly investigated and the available information is scattered throughout the literature. The data presented herein were obtained through the compilation of 81 published studies on the matter, encompassing 56 peer-reviewed articles, 16 books, and nine book chapters. Data available in online platforms, e.g., Wikiaves 2021, Xeno-Canto, e-Bird, and Taxeus, was not included for not specifying habitat type in their records. For the same reason, we have not included records of museum specimens, as the habitat type in which birds were collected was frequently omitted, particularly in the older ones. We have also omitted a large part of avian studies conducted in Brazilian mangroves and salt marshes for, again, not mentioning explicitly the habitat type of the records. Hence, in this chapter, we included only studies that clearly stated the presence of a species, or the number of species, in specific areas of mangroves and salt marshes, either in the results section itself or in a species list. Although some of these studies may have considered species from nearby habitats as being of mangroves and salt marshes, a fact that is hard to evaluate, the information presented in this chapter is the most objective compilation of the core avifauna of mangroves and salt marshes in Brazil based on available, published studies (see appendix for the list of the considered references).

The species (Table 12.1) were classified according to their conservation status at global (IUCN 2022) and national levels (MMA 2016, 2022) Nomenclature follows the Brazilian Ornithological Records Committee (Pacheco et al. 2021). Birds were classified into three categories, as follows:

Exclusive species (EXC): Resident species that occur exclusively in mangrove or salt marsh areas

Regular species (Re): Species that use mangrove and salt marsh habitats regularly, either throughout the year or on a seasonal basis (in case they are migratory), but that are also recorded in other habitat types, such as terrestrial forests, grasslands, freshwater wetlands, and marine environments, including beaches

Occasional species (O): Species occasionally recorded in mangrove and salt marsh habitats

Table 12.1 List of resident and migratory bird species recorded in mangroves and salt marshes along the Brazilian coast

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Rheiformes					
Rheidae (1)					
Rhea americana	Greater rhea	Ema		O	
Tinamiformes					
Tinamidae (1)					
Nothura maculosa	Spotted nothura	Codorna-amarela		O	
Anseriformes					
Anhimidae (1)					
Chauna torquata	Southern screamer	Tachã		O	
Anatidae (16)					
Dendrocygna bicolor	Fulvous whistling-duck	Marreca-caneleira	Re	O	
Dendrocygna viduata	White-faced whistling duck	Irerê	Re	O	
Dendrocygna autumnalis	Black-bellied whistling duck	Marreca-cabocla	Re		
Cygnus melancoryphus	Black-necked swan	Cisne-de-pescoço-preto		Re	
Coscoroba coscoroba	Coscoroba swan	Capororoca		Re	
Cairina moschata	Muscovy duck	Pato-do-mato	Re		
Amazonetta brasiliensis	Brazilian teal	Marreca-ananaí	O	Re	
Spatula versicolor	Silver teal	Marreca-cricri	O	Re	
Spatula platalea	Red shoveler	Marreca-colhereira		Re	
Spatula discors	Blue-winged teal	Marreca-de-asa-azul	O		PNW
Anas bahamensis	White-cheeked pintail	Marreca-toicinho	Re		
Anas georgica	Yellow-billed pintail	Marreca-parda	O	Re	
Anas flavirostris	Yellow-billed teal	Marreca-pardinha		Re	
Netta erythrophthalma	Southern pochard	Paturi-preta	O		
Netta peposaca	Rosy-billed pochard	Marrecão	O		
Oxyura vittata	Lake duck	Marreca-rabo-de-espinho	O		SACT
Phoenicopteriformes					
Phoenicopteridae (3)					
Phoenicopterus chilensis	Chilean flamingo	Flamingo-chileno		Re	SACT
Phoenicopterus ruber	American flamingo	Flamingo	O		NNTT
Phoenicoparrus andinus (**VU**[b])	Andean flamingo	Flamingo-dos-andes		Re	SACT
Podicipediformes					
Podicipedidae (4)					

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Rollandia rolland	White-tufted grebe	Mergulhão-de-orelha-branca		Re	
Tachybaptus dominicus	Least grebe	Mergulhão-pequeno	O		
Podilymbus podiceps	Pied-billed grebe	Mergulhão-caçador	O	Re	
Podicephorus major	Great grebe	Mergulhão-grande	O	Re	
Columbiformes					
Columbidae (10)					
Columba livia	Rock pigeon	Pombo-doméstico	O		
Patagioenas picazuro	Picazuro pigeon	Pomba-asa-branca	O		
Patagioenas cayennensis	Pale-vented pigeon	Pomba-galega	O		
Leptotila verreauxi	White-tipped dove	Juriti-pupu	O		
Leptotila rufaxilla	Gray-fronted dove	Juriti-de-testa-branca	O		
Columbina passerina	Common ground-dove	Rolinha-cinzenta	Re		
Columbina minuta	Plain-breasted ground-dove	Rolinha-de-asa-canela	O		
Columbina talpacoti	Ruddy ground-dove	Rolinha-roxa	Re		
Columbina squammata	Scaled dove	Rolinha-fogo-apagou	O		
Columbina picui	Picui ground-dove	Rolinha-picuí	O		
Cuculiformes					
Cuculidae (7)					
Guira guira	Guira cuckoo	Anu-branco	Re		
Crotophaga major	Greater ani	Anu-coroca	O		
Crotophaga ani	Smooth-billed ani	Anu-preto	Re	O	
Tapera naevia	Striped cuckoo	Saci	O		
Piaya cayana	Squirrel cuckoo	Alma-de-gato	O		
Coccyzus melacoryphus	Dark-billed cuckoo	Papa-lagarta-acanelado	O		
Coccyzus minor	Mangrove cuckoo	Papa-lagarta-do-mangue	EXC		
Nyctibiiformes					
Nyctibiidae (1)					
Nyctibius griseus	Common potoo	Urutau	O		
Caprimulgiformes					
Caprimulgidae (6)					
Antrostomus rufus	Rufous nightjar	João-corta-pau	O		
Lurocalis semitorquatus	Short-tailed nighthawk	Tuju	O		
Nyctidromus albicollis	Common pauraque	Bacurau	O		
Hydropsalis torquata	Scissor-tailed nightjar	Bacurau-tesoura	O		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Podager nacunda	Nacunda nighthawk	Corucão	O	Re	
Chordeiles acutipennis	Lesser nighthawk	Bacurau-de-asa-fina	O		
Apodiformes					
Apodidae (5)					
Streptoprocne zonaris	White-collared swift	Taperuçu-de-coleira-branca	O		
Chaetura cinereiventris	Gray-rumped swift	Andorinhão-de-sobre-cinzento	O		
Chaetura meridionalis	Sick's swift	Andorinhão-do-temporal	Re		
Chaetura brachyura	Short-tailed swift	Andorinhão-de-rabo-curto	O		
Tachornis squamata	Fork-tailed palm-swift	Andorinhão-do-buriti	O		
Trochilidae (11)					
Ramphodon naevius	Saw-billed hermit	Beija-flor-rajado	O		
Colibri serrirostris	White-vented violetear	Beija-flor-de-orelha-violeta	O		
Polytmus guainumbi	White-tailed goldenthroat	Beija-flor-de-bico-curvo	O		
Chrysolampis mosquitus	Ruby-topaz hummingbird	Beija-flor-vermelho	O		
Thalurania glaucopis	Violet-capped woodnymph	Beija-flor-de-fronte-violeta	O		
Eupetomena macroura	Swallow-tailed hummingbird	Beija-flor-tesoura	O		
Aphantochroa cirrochloris	Sombre hummingbird	Beija-flor-cinza	O		
Chrysuronia versicolor	Versicolored emerald	Beija-flor-de-banda-branca	O		
Chrysuronia leucogaster	Plain-bellied emerald	Beija-flor-de-barriga-branca	Re		
Leucochloris albicollis	White-throated hummingbird	Beija-flor-de-papo-branco	O		
Chionomesa fimbriata	Glittering-throated emerald	Beija-flor-de-garganta-verde	O		
Opisthocomiformes					
Opisthocomidae (1)					
Opisthocomus hoazin	Hoatzin	Cigana	O		
Gruiformes					
Aramidae (1)					
Aramus guarauna	Limpkin	Carão	Re	Re	
Rallidae (22)					
Rallus longirostris	Mangrove rail	Saracura-matraca	EXC		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Porphyrio martinica	Purple gallinule	Frango-d'água-azul	O		
Rufirallus viridis	Russet-crowned crake	Sanã-castanha	O		
Laterallus flaviventer	Yellow-breasted crake	Sanã-amarela	O		
Laterallus melanophaius	Rufous-sided crake	Sanã-parda	O	Re	
Laterallus exilis	Gray-breasted crake	Sanã-do-capim	O		
Laterallus spilopterus (**EN[a]/VU[b]**)	Dot-winged crake	Sanã-cinza		EXC	
Laterallus leucopyrrhus	Red-and-white crake	Sanã-vermelha	O		
Mustelirallus albicollis	Ash-throated crake	Sanã-carijó	O		
Neocrex erythrops	Paint-billed crake	Turu-turu	O		
Pardirallus maculatus	Spotted rail	Saracura-carijó		Re	
Pardirallus sanguinolentus	Plumbeous rail	Saracura-do-banhado		Re	
Amaurolimnas concolor	Uniform crake	Saracura-lisa	O		
Aramides ypecaha	Giant wood rail	Saracuruçu		Re	
Aramides mangle	Little wood rail	Saracura-do-mangue	Re		
Aramides cajaneus	Gray-necked wood rail	Saracura-três-potes	Re	O	
Aramides saracura	Slaty-breasted wood rail	Saracura-do-mato	O		
Porphyriops melanops	Spot-flanked gallinule	Galinha-d'água-carijó	O	O	
Gallinula galeata	Common gallinule	Galinha-d'água	Re	Re	
Fulica rufifrons	Red-fronted coot	Carqueja-de-escudo-vermelho		O	
Fulica armillata	Red-gartered coot	Carqueja-de-bico-manchado	O	Re	
Fulica leucoptera	White-winged coot	Carqueja-de-bico-amarelo		Re	
Charadriiformes					
Charadriidae (8)					
Pluvialis dominica	American golden-plover	Batuiruçu	O	Re	PNW
Pluvialis squatarola	Black-bellied plover	Batuiruçu-de-axila-preta	Re	Re	PNW
Vanellus chilensis	Southern lapwing	Quero-quero	O	Re	
Charadrius modestus	Rufous-chested dotterel	Batuíra-de-peito-tijolo	Re	Re	SACT
Charadrius semipalmatus	Semipalmated plover	Batuíra-de-bando	Re	Re	PNW

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Charadrius wilsonia (**VU**[a])	Wilson's plover	Batuíra-bicuda	Re		
Charadrius collaris	Collared plover	Batuíra-de-coleira	Re	Re	
Charadrius falklandicus	Two-banded plover	Batuíra-de-coleira-dupla		Re	
Haematopodidae (1)					
Haematopus palliatus	American oystercatcher	Piru-piru	O	Re	
Recurvirostridae (2)					
Himantopus mexicanus	Black-necked stilt	Pernilongo-de-costas-negras	O		
Himantopus melanurus	White-backed stilt	Pernilongo-de-costas-brancas	Re	Re	
Scolopacidae (20)					
Numenius hudsonicus (**VU**[a])	American whimbrel	Maçarico-de-bico-torto	Re	Re	PNW
Limosa haemastica	Hudsonian godwit	Maçarico-de-bico-virado	O	Re	PNW
Limosa fedoa	Marbled godwit	Maçarico-marmóreo	O		OW
Arenaria interpres	Ruddy turnstone	Vira-pedras	Re	Re	PNW
Calidris canutus (**VU**[a])	Red knot	Maçarico-de-papo-vermelho	Re	Re	PNW
Calidris himantopus	Stilt sandpiper	Maçarico-pernilongo	O	Re	PNW
Calidris alba	Sanderling	Maçarico-branco	Re	Re	PNW
Calidris minutilla	Least sandpiper	Maçariquinho	Re		PNW
Calidris fuscicollis	White-rumped sandpiper	Maçarico-de-sobre-branco	Re	Re	PNW
Calidris subruficollis (**VU**[a])	Buff-breasted sandpiper	Maçarico-acanelado	O	Re	PNW
Calidris melanotos	Pectoral sandpiper	Maçarico-de-colete	O	Re	PNW
Calidris pusilla (**EN**[a])	Semipalmated sandpiper	Maçarico-rasteirinho	Re	Re	PNW
Limnodromus griseus (**EN**[a])	Short-billed dowitcher	Maçarico-de-costas-brancas	Re	O	PNW
Gallinago paraguaiae	South American snipe	Narceja	O	Re	
Phalaropus tricolor	Wilson's phalarope	Pisa-n'água	O	Re	PNW
Actitis macularius	Spotted sandpiper	Maçarico-pintado	Re	O	PNW
Tringa solitaria	Solitary sandpiper	Maçarico-solitário	Re	O	PNW
Tringa melanoleuca	Greater yellowlegs	Maçarico-grande-de-perna-amarela	Re	Re	PNW
Tringa semipalmata	Willet	Maçarico-de-asa-branca	Re	Re	PNW
Tringa flavipes	Lesser yellowlegs	Maçarico-de-perna-amarela	Re	Re	PNW

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Jacanidae (1)					
Jacana jacana	Wattled jacana	Jaçanã	Re	O	
Rostratulidae (1)					
Nycticryphes semicollaris	South American painted-snipe	Narceja-de-bico-torto		Re	
Stercorariidae (1)					
Stercorarius parasiticus	Parasitic jaeger	Mandrião-parasítico		Re	
Laridae (17)					
Chroicocephalus maculipennis	Brown-hooded gull	Gaivota-maria-velha	O	Re	
Chroicocephalus cirrocephalus	Gray-hooded gull	Gaivota-de-cabeça-cinza	O	Re	
Leucophaeus atricilla	Laughing gull	Gaivota-alegre	O		PNW
Larus atlanticus	Olrog's gull	Gaivota-de-rabo-preto		Re	SACT
Larus dominicanus	Kelp gull	Gaivotão	Re	Re	
Rynchops niger	Black skimmer	Talha-mar	Re	Re	
Sternula antillarum	Least tern	Trinta-réis-miúdo	O	Re	PNW
Sternula superciliaris	Yellow-billed tern	Trinta-réis-pequeno	O	Re	
Phaetusa simplex	Large-billed tern	Trinta-réis-grande	O	Re	
Gelochelidon nilotica	Gull-billed tern	Trinta-réis-de-bico-preto	O	Re	
Chlidonias niger	Black tern	Trinta-réis-negro		O	PNW
Sterna hirundo	Common tern	Trinta-réis-boreal	Re	Re	PNW
Sterna dougallii (**VU**[a])	Roseate tern	Trinta-réis-róseo	O		PNW
Sterna hirundinacea (**VU**[a])	South American tern	*Trinta-réis-de-bico-vermelho*	Re	Re	
Sterna trudeaui	Snowy-crowned tern	Trinta-réis-de-coroa-branca	O	Re	
Thalasseus acuflavidus (***VU***[a])	Cabot's tern	Trinta-réis-de-bando	Re	Re	
Thalasseus maximus (**VU**[a])	Royal tern	Trinta-réis-real	Re	Re	
Eurypygiformes					
Eurypygidae (1)					
Eurypyga helias	Sunbittern	Pavãozinho-do-pará	O		
Ciconiiformes					
Ciconiidae (3)					
Ciconia maguari	Maguari stork	Maguari	O	Re	
Jabiru mycteria	Jabiru	Tuiuiú	O		
Mycteria americana	Wood stork	Cabeça-seca	O	Re	
Suliformes					
Fregatidae (1)					

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Fregata magnificens	Magnificent frigatebird	Fragata	O	O	
Anhingidae (1)					
Anhinga anhinga	Anhinga	Biguatinga	O		
Phalacrocoracidae (1)					
Nannopterum brasilianum	Neotropic cormorant	Biguá	Re	Re	
Pelecaniformes					
Pelecanidae (1)					
Pelecanus occidentalis	Brown pelican	Pelicano	O		NNTT
Ardeidae (17)					
Tigrisoma lineatum	Rufescent tiger-heron	Socó-boi	Re		
Cochlearius cochlearius	Boat-billed heron	Arapapá	Re		
Botaurus pinnatus	Pinnated bittern	Socó-boi-baio	O	Re	
Ixobrychus exilis	Least bittern	Socoí-vermelho	O		
Ixobrychus involucris	Stripe-backed bittern	Socó-amarelo		O	
Nycticorax nycticorax	Black-crowned night-heron	Socó-dorminhoco	Re	Re	
Nyctanassa violacea	Yellow-crowned night-heron	Savacu-de-coroa	Re	Re	
Butorides striata	Striated heron	Socozinho	Re	Re	
Ardeola ralloides	Squacco heron	Garça-caranguejeira	Re		OW
Bubulcus ibis	Cattle egret	Garça-vaqueira	Re	Re	
Ardea cocoi	Cocoi heron	Garça-moura	Re	Re	
Ardea alba	Great egret	Garça-branca-grande	Re	Re	
Syrigma sibilatrix	Whistling heron	Maria-faceira	O	Re	
Egretta tricolor	Tricolored heron	Garça-tricolor	EXC		
Egretta gularis	Western reef heron	Garça-negra	O		OW
Egretta thula	Snowy egret	Garça-branca-pequena	Re	Re	
Egretta caerulea	Little blue heron	Garça-azul	Re	Re	
Threskiornithidae (7)					
Eudocimus ruber	Scarlet ibis	Guará	EXC		
Plegadis chihi	White-faced ibis	Caraúna	O	Re	
Mesembrinibis cayennensis	Green ibis	Coró-coró	O		
Phimosus infuscatus	Bare-faced ibis	Tapicuru	O	Re	
Theristicus caerulescens	Plumbeous ibis	Curicaca-real		O	
Theristicus caudatus	Buff-necked ibis	Curicaca	O		
Platalea ajaja	Roseate spoonbill	Colhereiro	Re	Re	

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Cathartiformes					
Cathartidae (3)					
Coragyps atratus	Black vulture	Urubu-preto	Re	O	
Cathartes aura	Turkey vulture	Urubu-de-cabeça-vermelha	Re	O	
Cathartes burrovianus	Lesser yellow-headed vulture	Urubu-de-cabeça-amarela	Re	O	
Accipitriformes					
Pandionidae (1)					
Pandion haliaetus	Osprey	Águia-pescadora	Re	Re	PNW
Accipitridae (21)					
Elanus leucurus	White-tailed kite	Gavião-peneira	O		
Chondrohierax uncinatus	Hook-billed kite	Caracoleiro	O		
Leptodon cayanensis	Gray-headed kite	Gavião-gato	O		
Busarellus nigricollis	Black-collared hawk	Gavião-belo	O		
Rostrhamus sociabilis	Snail kite	Gavião-caramujeiro	Re	Re	
Ictinia plumbea	Plumbeous kite	Sovi	O		
Circus cinereus (**VU**[a])	Cinereous harrier	Gavião-cinza		Re	
Circus buffoni	Long-winged harrier	Gavião-do-banhado	O	Re	
Accipiter bicolor	Bicolored hawk	Gavião-bombachinha-grande	O		
Geranospiza caerulescens	Crane hawk	Gavião-pernilongo	O		
Buteogallus schistaceus	Slate-colored hawk	Gavião-azul	O		
Buteogallus aequinoctialis	Rufous crab hawk	Gavião-caranguejeiro	EXC		
Heterospizias meridionalis	Savanna hawk	Gavião-caboclo	O	O	
Amadonastur lacernulatus (**VU**[a,b])	White-necked hawk	Gavião-pombo-pequeno	O		
Urubitinga urubitinga	Great black hawk	Gavião-preto	Re		
Rupornis magnirostris	Roadside hawk	Gavião-carijó	Re		
Parabuteo unicinctus	Harris' hawk	Gavião-asa-de-telha	Re		
Geranoaetus albicaudatus	White-tailed hawk	Gavião-de-rabo-branco	O		
Leucopternis melanops	Black-faced hawk	Gavião-de-cara-preta	O		
Buteo nitidus	Gray-lined hawk	Gavião-pedrês	O		
Buteo brachyurus	Short-tailed hawk	Gavião-de-cauda-curta	O		
Strigiformes					
Tytonidae (1)					
Tyto furcata	American barn owl	Suindara	O		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Strigidae (6)					
Megascops choliba	Tropical screech-owl	Corujinha-do-mato	O		
Glaucidium brasilianum	Ferruginous pygmy owl	Caburé	O		
Athene cunicularia	Burrowing owl	Coruja-buraqueira	O		
Asio clamator	Striped owl	Coruja-orelhuda	O		
Asio stygius	Stygian owl	Mocho-diabo	O		
Asio flammeus	Short-eared owl	Mocho-dos-banhados		O	
Coraciiformes					
Alcedinidae (5)					
Megaceryle torquata	Ringed kingfisher	Martim-pescador-grande	Re	Re	
Chloroceryle amazona	Amazon kingfisher	Martim-pescador-verde	Re	Re	
Chloroceryle aenea	American pygmy kingfisher	Martim-pescador-miúdo	Re		
Chloroceryle americana	Green kingfisher	Martim-pescador-pequeno	Re	Re	
Chloroceryle inda	Green-and-rufous kingfisher	Martim-pescador-da-mata	O		
Galbuliformes					
Galbulidae (1)					
Galbula galbula	Green-tailed jacamar	Ariramba-de-cauda-verde	O		
Bucconidae (5)					
Monasa nigrifrons	Black-fronted nunbird	Chora-chuva-preto	O		
Notharchus tectus	Pied puffbird	Macuru-pintado	O		
Notharchus hyperrhynchus	White-necked puffbird	Macuru-de-testa-branca	O		
Notharchus macrorhynchos	Guianan puffbird	Macuru-de-pescoço-branco	O		
Nystalus maculatus	Spot-backed puffbird	Rapazinho-dos-velhos	O		
Piciformes					
Ramphastidae (2)					
Ramphastos toco	Toco toucan	Tucanuçu	O		
Ramphastos tucanus (**VU**[b])	White-throated toucan	Tucano-de-papo-branco	O		
Picidae (16)					
Picumnus exilis	Bahia piculet	Picapauzinho-de-pintas-amarelas	O		
Picumnus spilogaster (**VU**[b])	White-bellied piculet	Picapauzinho-de-pescoço-branco	O		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Picumnus pygmaeus	Spotted piculet	Picapauzinho-pintado	O		
Picumnus cirratus	White-barred piculet	Picapauzinho-barrado	O		
Picumnus temminckii	Ochre-collared piculet	Picapauzinho-de-coleira	O		
Melanerpes candidus	White woodpecker	Pica-pau-branco	O		
Veniliornis passerinus	Little woodpecker	Pica-pau-pequeno	O		
Veniliornis spilogaster	White-spotted woodpecker	Pica-pau--verde-carijó	O		
Campephilus melanoleucos	Crimson-crested woodpecker	Pica-pau-de-topete-vermelho	O		
Dryocopus lineatus	Lineated woodpecker	Pica-pau-de-banda-branca	O		
Celeus elegans	Chestnut woodpecker	Pica-pau-chocolate	O		
Celeus flavescens	Blond-crested woodpecker	Pica-pau-de-cabeça-amarela	O		
Piculus flavigula	Yellow-throated woodpecker	Pica-pau-bufador	O		
Colaptes punctigula	Spot-breasted woodpecker	Pica-pau-de-peito-pontilhado	O		
Colaptes melanochloros	Green-barred woodpecker	Pica-pau-verde-barrado	O		
Colaptes campestris	Campo flicker	Pica-pau-do-campo	O		
Falconiformes					
Falconidae (9)					
Herpetotheres cachinnans	Laughing falcon	Acauã	O		
Micrastur ruficollis	Barred forest-falcon	Falcão-caburé	O		
Micrastur semitorquatus	Collared forest-falcon	Falcão-relógio	O		
Caracara plancus	Southern caracara	Carcará	Re	Re	
Milvago chimachima	Yellow-headed caracara	Carrapateiro	Re	O	
Milvago chimango	Chimango caracara	Chimango	Re	Re	
Falco sparverius	American kestrel	Quiriquiri	O	O	
Falco femoralis	Aplomado falcon	Falcão-de-coleira	O	O	
Falco peregrinus	Peregrine falcon	Falcão-peregrino	O	Re	PNW
Psittaciformes					
Psittacidae (10)					
Brotogeris tirica	Plain parakeet	Periquito-rico	O		
Pionus maximiliani	Scaly headed parrot	Maitaca-verde	O		
Amazona farinosa	Mealy parrot	Papagaio-moleiro	O		
Amazona brasiliensis	Red-tailed parrot	Papagaio-de-cara-roxa	Re		
Amazona amazonica	Orange-winged parrot	Curica	Re		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Forpus xanthopterygius	Blue-winged parrotlet	Tuim	O		
Pyrrhura frontalis	Maroon-bellied parakeet	Tiriba-de-testa-vermelha	O		
Eupsittula aurea	Peach-fronted parakeet	Periquito-rei	O		
Thectocercus acuticaudatus	Blue-crowned parakeet	Aratinga-de-testa-azul	O		
Psittacara leucophthalmus	White-eyed parakeet	Periquitão	O		
Passeriformes					
Thamnophilidae (4)					
Formicivora grisea	White-fringed antwren	Papa-formiga-pardo	O		
Thamnophilus nigrocinereus	Blackish-gray antshrike	Choca-preta-e-cinza	O		
Thamnophilus caerulescens	Variable antshrike	Choca-da-mata	O		
Sclateria naevia	Silvered antbird	Papa-formiga-do-igarapé	O		
Scleruridae (1)					
Geositta cunicularia	Common miner	Curriqueiro		O	
Dendrocolaptidae (2)					
Xiphorhynchus guttatus	Buff-throated woodcreeper	Arapaçu-de-garganta-amarela	O		
Dendroplex picus	Straight-billed woodcreeper	Arapaçu-de-bico-branco	Re		
Xenopidae (1)					
Xenops minutus	Plain xenops	Bico-virado-miúdo	O		
Furnariidae (13)					
Furnarius figulus	Wing-banded hornero	Casaca-de-couro-da-lama	O		
Furnarius rufus	Rufous hornero	João-de-barro	O	O	
Phleocryptes melanops	Wren-like rushbird	Bate-bico		Re	
Limnornis curvirostris	Curve-billed reedhaunter	João-da-palha		O	
Cinclodes fuscus	Buff-winged cinclodes	Pedreiro-dos-andes		Re	SACT
Phacellodomus striaticollis	Freckle-breasted thornbird	Tio-tio		O	
Phacellodomus ferrugineigula	Orange-breasted thornbird	João-botina-do-brejo	O		
Asthenes hudsoni (**VU**[a])	Hudson's canastero	João-platino		Re	

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Limnoctites sulphuriferus	Sulfur-throated spinetail	Arredio-de-papo-manchado		Re	
Spartonoica maluroides	Bay-capped wren-spinetail	Boininha		Re	
Certhiaxis cinnamomeus	Yellow-chinned spinetail	Curutié	Re	O	
Synallaxis ruficapilla	Rufous-capped spinetail	Pichororé	O		
Synallaxis spixi	Spix's spinetail	João-teneném	O	O	
Pipridae (2)					
Ilicura militaris	Pin-tailed manakin	Tangarazinho	O		
Chiroxiphia pareola	Blue-backed manakin	Tangará-príncipe	O		
Tityridae (3)					
Tityra inquisitor	Black-crowned tityra	Anambé-branco-de-bochecha-parda	O		
Pachyramphus rufus	Cinereous becard	Caneleiro-cinzento	O		
Pachyramphus polychopterus	White-winged becard	Caneleiro-preto	O		
Tachurisidae (1)					
Tachuris rubrigastra	Many-colored rush tyrant	Papa-piri		Re	
Rhynchocyclidae (7)					
Tolmomyias flaviventris	Yellow-breasted flycatcher	Bico-chato-amarelo	O		
Todirostrum maculatum	Spotted tody-flycatcher	Ferreirinho-estriado	O		
Todirostrum poliocephalum	Gray-headed tody-flycatcher	Teque-teque	O		
Todirostrum cinereum	Common tody-flycatcher	Ferreirinho-relógio	O		
Todirostrum chrysocrotaphum	Yellow-browed tody-flycatcher	Ferreirinho-de-sobrancelha	O		
Hemitriccus striaticollis	Stripe-necked tody-tyrant	Sebinho-rajado-amarelo	O		
Hemitriccus nidipendulus	Hangnest tody-tyrant	Tachuri-campainha	O		
Tyrannidae (37)					
Camptostoma obsoletum	Southern beardless-tyrannulet	Risadinha	Re		
Elaenia flavogaster	Yellow-bellied elaenia	Guaracava-de-barriga-amarela	O		
Elaenia mesoleuca	Olivaceous elaenia	Tuque	O		
Elaenia cristata	Plain-crested elaenia	Guaracava-de-topete-uniforme	O		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Phaeomyias murina	Mouse-colored tyrannulet	Bagageiro	O		
Phyllomyias fasciatus	Planalto tyrannulet	Piolhinho	O		
Pseudocolopteryx sclateri	Crested doradito	Tricolino		Re	
Pseudocolopteryx flaviventris	Warbling doradito	Amarelinho-do-junco		Re	
Serpophaga nigricans	Sooty tyrannulet	João-pobre	O	Re	
Serpophaga subcristata	White-crested tyrannulet	Alegrinho	O		
Attila rufus	Gray-hooded attila	Capitão-de-saíra	O		
Legatus leucophaius	Piratic flycatcher	Bem-te-vi-pirata	O		
Myiarchus swainsoni	Swainson's flycatcher	Irré	O		
Myiarchus ferox	Short-crested flycatcher	Maria-cavaleira	Re		
Myiarchus tyrannulus	Brown-crested flycatcher	Maria-cavaleira-de-rabo-enferrujado	O		
Pitangus sulphuratus	Great kiskadee	Bem-te-vi	Re	Re	
Philohydor lictor	Lesser kiskadee	Bentevizinho-do-brejo	O		
Machetornis rixosa	Cattle tyrant	Suiriri-cavaleiro	O	Re	
Myiodynastes maculatus	Streaked flycatcher	Bem-te-vi-rajado	O		
Megarynchus pitangua	Boat-billed flycatcher	Neinei	O		
Myiozetetes cayanensis	Rusty-margined flycatcher	Bentevizinho-de-asa-ferrugínea	O		
Myiozetetes similis	Social flycatcher	Bentevizinho-de-penacho-vermelho	Re		
Tyrannus melancholicus	Tropical kingbird	Suiriri	O	O	
Tyrannus savana	Fork-tailed flycatcher	Tesourinha	O	Re	
Tyrannus dominicensis	Gray kingbird	Suiriri-cinza	O		NNTT
Sublegatus modestus	Southern scrub-flycatcher	Guaracava-modesta	O		
Arundinicola leucocephala	White-headed marsh tyrant	Freirinha	O	O	
Fluvicola pica	Pied water tyrant	Lavadeira-do-norte	O		
Fluvicola albiventer	Black-backed water tyrant	Lavadeira-de-cara-branca	O		
Fluvicola nengeta	Masked water tyrant	Lavadeira-mascarada	Re		
Pyrocephalus rubinus	Vermilion flycatcher	Príncipe	O		
Heteroxolmis dominicanus (**VU**[a, b])	Black-and-white monjita	Noivinha-de-rabo-preto		O	

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Myiophobus fasciatus	Bran-colored flycatcher	Filipe	O		
Contopus cinereus	Tropical pewee	Papa-moscas-cinzento	O		
Satrapa icterophrys	Yellow-browed tyrant	Suiriri-pequeno	O	Re	
Lessonia rufa	Austral negrito	Colegial	O	Re	SACT
Hymenops perspicillatus	Spectacled tyrant	Viuvinha-de-óculos	O	Re	
Vireonidae (4)					
Cyclarhis gujanensis	Rufous-browed peppershrike	Pitiguari	O		
Hylophilus pectoralis	Ashy-headed greenlet	Vite-vite-de-cabeça-cinza	O		
Vireo chivi	Chivi vireo	Juruviara	O		
Vireo altiloquus	Black-whiskered vireo	Juruviara-barbuda	O		NNTT
Corvidae (3)					
Cyanocorax caeruleus	Azure jay	Gralha-azul	Re		
Cyanocorax cristatellus	Curl-crested jay	Gralha-do-campo	O		
Cyanocorax cyanopogon	White-naped jay	Gralha-cancã	O		
Hirundinidae (10)					
Pygochelidon cyanoleuca	Blue-and-white swallow	Andorinha-pequena-de-casa	Re	Re	
Alopochelidon fucata	Tawny-headed swallow	Andorinha-morena		Re	
Stelgidopteryx ruficollis	Southern rough-winged swallow	Andorinha-serradora	Re		
Progne tapera	Brown-chested martin	Andorinha-do-campo	O	Re	
Progne chalybea	Gray-breasted martin	Andorinha-grande	O	O	
Tachycineta albiventer	White-winged swallow	Andorinha-do-rio	O		
Tachycineta leucorrhoa	White-rumped swallow	Andorinha-de-sobre-branco	O	Re	
Tachycineta leucopyga	Chilean swallow	Andorinha-chilena		Re	SACT
Riparia riparia	Bank swallow	Andorinha-do-barranco		Re	PNW
Hirundo rustica	Barn swallow	Andorinha-de-bando	O	Re	PNW
Troglodytidae (4)					
Troglodytes musculus	Southern house wren	Corruíra	Re	Re	

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Cistothorus platensis	Sedge wren	Corruíra-do-campo		Re	
Cantorchilus leucotis	Buff-breasted wren	Garrinchão-de-barriga-vermelha	O		
Cantorchilus longirostris	Long-billed wren	Garrinchão-de-bico-grande	Re		
Polioptilidae (1)					
Polioptila plumbea	Tropical gnatcatcher	Balança-rabo-de-chapéu-preto	O		
Donacobiidae (1)					
Donacobius atricapilla	Black-capped donacobius	Japacanim	O		
Turdidae (4)					
Turdus flavipes	Yellow-legged thrush	Sabiá-una	O		
Turdus leucomelas	Pale-breasted thrush	Sabiá-barranco	O		
Turdus rufiventris	Rufous-bellied thrush	Sabiá-laranjeira	O		
Turdus amaurochalinus	Creamy-bellied thrush	Sabiá-poca	O		
Mimidae (1)					
Mimus saturninus	Chalk-browed mockingbird	Sabiá-do-campo	O		
Estrildidae (1)					
Estrilda astrild	Common waxbill	Bico-de-lacre	O		
Passeridae (1)					
Passer domesticus	House sparrow	Pardal	O		
Motacillidae (4)					
Anthus lutescens	Yellowish pipit	Caminheiro-zumbidor	O	Re	
Anthus furcatus	Short-billed pipit	Caminheiro-de-unha-curta		O	
Anthus correndera	Correndera pipit	Saminheiro-de-espora		Re	
Anthus hellmayri	Hellmayr's pipit	Caminheiro-de-barriga-acanelada		O	
Fringillidae (4)					
Spinus magellanicus	Hooded siskin	Pintassilgo	O		
Euphonia chlorotica	Purple-throated euphonia	Fim-fim	O		
Euphonia violacea	Violaceous euphonia	Gaturamo-verdadeiro	O		
Euphonia pectoralis	Chestnut-bellied euphonia	Ferro-velho	O		
Passerellidae (2)					
Ammodramus humeralis	Grassland sparrow	Tico-tico-do-campo	O	Re	

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Zonotrichia capensis	Rufous-collared sparrow	Tico-tico	O	Re	
Icteridae (12)					
Leistes superciliaris	White-browed meadowlark	Polícia-inglesa-do-sul	O	Re	
Cacicus solitarius	Solitary black cacique	Iraúna-de-bico-branco	O		
Cacicus chrysopterus	Golden-winged cacique	Tecelão	O		
Cacicus cela	Yellow-rumped cacique	Xexéu	O		
Cacicus haemorrhous	Red-rumped cacique	Guaxe	O		
Icterus pyrrhopterus	Variable oriole	Encontro	O		
Molothrus bonariensis	Shiny cowbird	Chupim	O	Re	
Agelasticus thilius	Yellow-winged blackbird	Sargento	O	Re	
Agelasticus cyanopus	Unicolored blackbird	Carretão-do-oeste	O		
Chrysomus ruficapillus	Chestnut-capped blackbird	Garibaldi	O	Re	
Pseudoleistes guirahuro	Yellow-rumped marshbird	Chopim-do-brejo	O		
Pseudoleistes virescens	Brown-and-yellow marshbird	Dragão		Re	
Parulidae (5)					
Geothlypis aequinoctialis	Masked yellowthroat	Pia-cobra	Re	Re	
Setophaga pitiayumi	Tropical parula	Mariquita	O		
Setophaga petechia	Yellow warbler	Mariquita-amarela	O		NNTT
Myiothlypis rivularis	Neotropical river warbler	Pula-pula-ribeirinho	O		
Basileuterus culicivorus	Golden-crowned warbler	Pula-pula	O		
Thraupidae (33)					
Embernagra platensis	Great pampa-finch	Sabiá-do-banhado		Re	
Hemithraupis ruficapilla	Rufous-headed tanager	Saíra-ferrugem	O		
Tersina viridis	Swallow tanager	Saí-andorinha	O		
Dacnis cayana	Blue dacnis	Saí-azul	O		
Saltator maximus	Buff-throated saltator	Tempera-viola	O		
Coereba flaveola	Bananaquit	Cambacica	Re		
Volatinia jacarina	Blue-black grassquit	Tiziu	O		
Loriotus cristatus	Flame-crested tanager	Tiê-galo	O		

(continued)

Table 12.1 (continued)

Taxon	Common name (EN)	Common name (PT)	M	S	Mi
Tachyphonus rufus	White-lined tanager	Pipira-preta	O		
Tachyphonus coronatus	Ruby-crowned tanager	Tiê-preto	O		
Ramphocelus bresilia	Brazilian tanager	Tiê-sangue	Re		
Ramphocelus carbo	Silver-beaked tanager	Pipira-vermelha	O		
Sporophila frontalis (**VU**[a, b])	Buffy-fronted seedeater	Pixoxó	O		
Sporophila collaris	Rusty-collared seedeater	Coleiro-do-brejo	O	O	
Sporophila caerulescens	Double-collared seedeater	Coleirinho	O		
Sporophila albogularis	White-throated seedeater	Golinho	O		
Sporophila leucoptera	White-bellied seedeater	Chorão	O		
Sporophila angolensis	Chestnut-bellied seed-finch	Curió	O		
Thlypopsis sordida	Orange-headed tanager	Saí-canário	O		
Donacospiza albifrons	Long-tailed reed finch	Tico-tico-do-banhado	O	O	
Conirostrum bicolor	Bicolored conebill	Figuinha-do-mangue	EXC		
Sicalis flaveola	Saffron finch	Canário-da-terra	O		
Sicalis luteola	Grassland yellow-finch	Tipio	O	Re	
Haplospiza unicolor	Uniform finch	Cigarra-bambu	O		
Paroaria dominicana	Red-cowled cardinal	Cardeal-do-nordeste	O		
Paroaria gularis	Red-capped cardinal	Cardeal-da-amazônia	O		
Thraupis episcopus	Blue-gray tanager	Sanhaço-da-amazônia	O		
Thraupis sayaca	Sayaca tanager	Sanhaço-cinzento	Re		
Thraupis cyanoptera	Azure-shouldered tanager	Sanhaço-de-encontro-azul	O		
Thraupis palmarum	Palm tanager	Sanhaço-do-coqueiro	O		
Stilpnia peruviana (**VU**[b])	Black-backed tanager	Saíra-sapucaia	O		
Stilpnia cayana	Burnished-buff tanager	Saíra-amarela	O		
Tangara cyanocephala	Red-necked tanager	Saíra-militar	O		

Number in brackets refer to the number of species in each taxonomic family
M mangrove, *SM* salt marsh, *Mi* migratory, *EXC* exclusive, *Re* regular, *O* occasional, *PNW* Pan New World migrants, *SACT* South American cool, temperate migrants, *NNTT* Nearctic-Neotropical temperate-tropical, *OW* Old World migrants, *VU* vulnerable, *EN* endangered, *CR* critically endangered
[a]According to MMA (2016, 2022)
According to IUCN (2022)

Since mangroves and salt marshes are important areas for migratory birds, we highlighted migratory species using these ecosystems in Brazil. We defined migratory species following Somveille et al. (2018): "(...) those whose breeding and non-breeding distributions do not completely overlap." Migratory species were identified using references listed in the appendix and Somenzari et al. (2018). Only fully migratory species along the entire Brazilian coast were included, i.e., species breeding in south Brazil and that winter in the northern part of the country were not included in the list. Migratory birds were then attributed into the migration systems defined by Joseph (1997):

Pan New World migrants (PNW): Species that winter and summer between the geographical extremes of the South and North American continents

Nearctic-Neotropical temperate-tropical migrants (NNTT): Species breeding in temperate North America and migrating to the warm humid tropics

South American cool, temperate migrants (SACT): Species breeding in southernmost South America and that migrate towards the midlatitudes of the continent

Species breeding in the Old World (Africa and Eurasia) were indicated separately.

12.3.1 Mangrove Birds

In Brazilian mangroves there are 368 bird species distributed in 24 orders and 62 families, representing 19% of the species occurring in the country. The most representative families are Tyrannidae (34 out of 144 species in Brazil), Thraupidae (32/156), Rallidae (16/35), Accipitridae (20/47), Scolopacidae (20/36), Ardeidae (16/24), Picidae (16/57), Anatidae (12/26), Icteridae (11/42), Trochilidae (11/89), Psittacidae (10/87), and Falconidae (9/20). From this list, there are 117 species in common with birds recorded in salt marshes. Also, 87 species (23%) are regularly recorded in mangroves, in addition to the five exclusive species, representing 5% of the birds in Brazil. The most representative families of the regularly recorded species were Scolopacidae (13), Ardeidae (11), Anatidae (5), Accipitridae (4), Alcedinidae (4), Rallidae (4), and Charadriidae (4) (see Table 12.1).

12.3.1.1 Exclusive Species

Five species are included in this category: tricolored heron, scarlet ibis, rufous crab hawk (*Buteogallus aequinoctialis*), mangrove rail (*Rallus longirostris*), and mangrove cuckoo (*Coccyzus minor*). Another species, bicolored conebill (*Conirostrum bicolor*), is exclusive to mangroves in most of its range but also inhabits the *várzea* forests of the Amazon basin (Cohn-Haft et al. 2007). In mangroves, this species is frequently recorded and more common than the other exclusive ones. The tricolored egret and mangrove cuckoo show restricted geographical ranges in relation to the

Fig. 12.1 Mangrove-exclusive or nearly exclusive birds: tricolored heron (*Egretta tricolor*) (**a**), scarlet ibis (*Eudocimus ruber*) (**b**), rufous crab hawk (*Buteogallus aequinoctialis*) (**c**), bicolored conebill (*Conirostrum bicolor*) (**d**), mangrove rail (*Rallus longirostris*) (**e**), and mangrove cuckoo (*Coccyzus minor*) (**f**). Salt marsh-exclusive bird: dot-winged crake (*Laterallus spilopterus*) (**g**). The black-crowned night heron (*Nyctanassa violacea*) (**h**) and little wood-rail (*Aramides mangle*) (**i**) occur in both ecosystems in Brazil (Photos **a**, Robson Czaban; **b**, Daniel Mello; **c**, Guto Balieiro; **d**, Daniel Mello; **e**, Daniel Mello; **f**, Alexander Lees; **g**, Rafael Antunes Dias; **h**, Patricia Luciano Mancini; **i**, Robson Czaban)

distribution of mangroves along the Brazilian littoral, occurring only in the north and northeast regions, whereas the remaining species present broader distributions. The scarlet ibis has large populations in the north and northeastern regions, with a population in the southeast region currently expanding both northwards and southwards from Cubatão, São Paulo State. Rufous crab hawk presents local occurrence, with reduced populations; mangrove rail is frequent in the south and southeastern regions of the country, rarer in the northeast, and absent in the north (Vieira 2015) (Fig. 12.1).

12.3.1.2 Regular Species

As many as 87 species are included in this category. The yellow-crowned night heron and the little wood-rail (*Aramides mangle*) are largely restricted to mangroves. The former species is not considered exclusive to mangroves because there is a population in a salt marsh area in south Brazil (Gianuca et al. 2011). The little wood-rail is a typical mangrove species, although the populations from Northeast Brazil

perform partial landward migrations during the rainy season, a movement still poorly known (Marcondes et al. 2014). A large part of the regular species is associated with aquatic habitats (families Anatidae, Ardeidae, Alcedinidae, among others), and only five passerines are associated with those environments, namely, the yellow-chinned spinetail (*Certhiaxis cinnamomeus*), short-crested flycatcher (*Myiarchus ferox*), masked water-tyrant (*Fluvicola nengeta*), southern rough-winged swallow (*Stelgidopteryx ruficollis*), and masked yellowthroat (*Geothlypis aequinoctialis*). Other species such as the black vulture (*Coragyps atratus*), ruddy ground-dove (*Columbina talpacoti*), and great kiskadee (*Pitangus sulphuratus*) are associated with a broad range of habitats, including open environments and urban areas. The azure jay (*Cyanocorax caeruleus*), long-billed wren (*Cantorchilus longirostris*), and Brazilian tanager (*Ramphocelus bresilia*) are frequently recorded in mangroves due to the direct connection between the latter and the coastal lowland forests and *restinga* forests where they dwell. Among sandy beach species, the migratory common tern and the resident collared plover (*Charadrius collaris*) are frequently recorded in mangroves, using sedimentary banks (muddy or preferably sandy) for resting. Some seabird species such as the South American tern (*Sterna hirundinacea*), Cabot's tern (*Thalasseus acuflavidus*), and royal tern (*Thalasseus maximus*) display local occurrences in mangroves, mainly in regions where there are sandbanks between or within mangroves.

12.3.1.3 Occasional Species

There are 275 species included in this category, represented by a wide range of families. The high species richness in this category may be explained by the broad latitudinal extension of mangroves along the Brazilian coast, enabling the occurrence of species from a broad range of adjacent habitat types, even sporadically. In northern Brazil, the least tern (*Sternula antillarum*), yellow-billed tern (*Sternula superciliaris*), large-billed tern (*Phaetusa simplex*), gull-billed tern (*Gelochelidon nilotica*), and roseate tern (*Sterna dougallii*) show local occurrences in mangroves, mainly in regions where there are sandbanks between or within mangrove areas. The toco toucan (*Ramphastos toco*) and curl-crested jay (*Cyanocorax cristatellus*) have expanded their ranges eastwards in the last decades, especially in São Paulo State, and have been locally recorded in mangrove areas (Silva e Silva and Olmos 2007; Mancini et al. 2018). Brown pelican (*Pelecanus occidentalis*) and western reef-heron (*Egretta gularis*) are vagrant (Somenzari et al. 2018). The remaining species present local and sporadic occurrences.

12.3.1.4 Migrant Species

In mangroves, 40 migrant species were recorded (including 27 in common with salt marshes), mainly of the families Scolopacidae (19), Charadriidae (4), and Laridae (4). There are 29 Pan New World migrants, 17 of which are frequently recorded in mangrove areas and 12 that use this habitat occasionally. Among the most frequent

species are the shorebirds *Tringa* spp. and *Calidris* spp. and the osprey *Pandion haliaetus*. Six species are Nearctic-Neotropical temperate-tropical migrants such as the American flamingo (*Phoenicopterus ruber*), brown pelican, and great blue heron. The lake duck (*Oxyura vittata*), rufous-chested dotterel (*Charadrius modestus*), and austral negrito (*Lessonia rufa*) are South American cool, temperate migrants. Lastly, the squacco heron (*Ardeola ralloides)*, western reef-heron, and marbled godwit (*Limosa fedoa*) are migrants from the Old World (Table 12.1).

12.3.1.5 Knowledge Gaps in Species Composition

The knowledge about mangrove birds in Brazil presents some important gaps regarding species composition. There are at least three species that occur in mangroves in adjacent French Guiana, namely, rufous-necked wood rail (*Aramides axillaris*), arrowhead piculet (*Picumnus minutissimus*), and northern scrub-flycatcher (*Sublegatus arenarum*) that may potentially occur in Brazil (Restall et al. 2006; Sigrist 2006; Robbins 2018; Taylor 2018; Winkler et al. 2018). Furthermore, there are species known to use mangroves in neighboring countries but that never have been reported for these environments in Brazil, e.g., red-legged honeycreeper (*Cyanerpes cyaneus*), carib grackle (*Quiscalus lugubris*), and Amazonian tyrannulet (*Inezia subflava*) (Ridgely and Tudor 1994; Restall et al. 2006). New taxonomic proposals, which often elevate some populations to the species level, may contribute to increasing avian species richness in Brazilian mangroves as well. In addition, some species have more than one subspecies with known or potential occurrence on the Brazilian coast and that may attain specific status after future studies, e.g., Wilson's plover (*Charadrius wilsonia*) and mangrove rail, the former even presenting two subspecies in North and Northeast Brazil (Grantsau and Lima 2008; Vieira 2015).

12.3.1.6 Conservation

Among the 368 species recorded in mangroves, 15 (4.1%) are currently considered endangered to some extent. Seven are globally threatened (IUCN 2022), nine are included in the Brazilian list of threatened taxa (MMA 2016, 2022) and two, Dot-winged Crake (*Laterallus spilopterus*) and buffy-fronted seedeater (*Sporophila frontalis*), are in both lists. Regarding the 87 species classified as regular mangrove users, seven are included in the Brazilian Red List: Wilson's plover, red knot, South American tern and Cabot tern are vulnerable; royal tern and semipalmated sandpiper and short-billed dowitcher (*Limnodromus griseus*) are endangered (MMA 2016, 2022).

Habitat loss is the main cause for all population declines (Morrison and Ross 1989; Mohr et al. 2008; Campos 2010; Sipinski et al. 2014; Schunck and Rodrigues 2018). The red-tailed parrot (*Amazona brasiliensis*) has a stable population in its main area of occurrence in the state of Paraná, but its restricted range (from the

southern coast of São Paulo State to the northern coast of Santa Catarina State) makes it especially vulnerable to habitat loss (Sipinski et al. 2014). The same occurs with royal tern, whose breeding areas in Brazil are all located in São Paulo State (Mohr et al. 2008; Campos 2010). For the Pan New World migrant red knot, there was a population decline of 55% in Northeast Brazil in the last three decades (Morrison and Ross 1989; Schunck and Rodrigues 2018). This decline happened because of the fall in food availability at Delaware Bay, in the United States of America, together with habitat loss along migration routes (Baker et al. 2004; Morrison et al. 2004). Similarly, short-billed dowitcher has presented a population decline of roughly 86% in the last decades in North Brazil (Morrison and Ross 1989; Schunck and Almeida *in prep.*), due to habitat loss both in the wintering grounds and along the migration routes (Rodrigues and Carvalho 2011; Valente et al. 2011). The population of semipalmated sandpiper declined 79% in northern Brazil since the 1980s (Valente et al. 2011; Morrison et al. 2012; Schunck et al. in prep.). Wilsons's plover presents a resident subspecies in Brazil; nevertheless, some other populations migrate to Brazil, such as *Charadrius w. cinnamominus* (Wiersma et al. 2018), and in northern and northeastern Brazilian coast, these populations have been declining in the last decades (Rodrigues 2007; Oliveira in prep.), probably due to disturbance in their breeding grounds.

12.3.2 Salt Marsh Birds

In Brazilian salt marshes 163 bird species (18 orders and 39 families) were reported in the literature, representing 8% of the country's species list. The most representative families are Scolopacidae (18 out of 28 species in Brazil), Laridae (15/29), Tyrannidae (12/144), Rallidae (11/35), Ardeidae (11/24), Furnariidae (10/106), Anatidae (9/26), and Charadriidae (7/11) (see Table 12.1). From this list, 117 species also occur in mangroves. A total of 123 species occurs regularly in salt marshes, representing 75% of Brazilian salt marsh birds and 6% of the Brazilian avifauna. The most representative families of the regularly recorded species were Scolopacidae (18), Ardeidae (10), Sternidae (9), Rallidae (8), Anatidae (7), and Charadriidae (7).

12.3.2.1 Exclusive Species

The dot-winged crake (*Laterallus spilopterus*) is the only species exclusively recorded in salt marshes in Brazil (Bencke et al. 2003). This small, globally threatened bird inhabits mainly salt marshes covered by dense stands of denseflower cordgrass (*Spartina densiflora* Brongn). The Peixe and Patos lagoons (RS) are the only localities where this bird has been recorded in the country (Bencke et al. 2003). The species is found almost exclusively in halophytic vegetation throughout its range in southern South America, both in coastal and inland wetlands, and is one of the few birds strongly associated with salt marshes in the continent (Greenberg et al. 2014) (Fig. 12.1).

12.3.2.2 Regular Species

A total of 123 bird species are included in this category, 43 in common with regular mangrove species such as yellow-crowned night heron, roseate spoonbill (*Platalea ajaja*), and lesser yellowlegs. Nearly 65% of the regular species in this category belong to typical waterbird families (e.g., Scolopacidae, Anatidae, Ardeidae, among others). Among the remaining regular species, some are exclusive of wetland habitats, despite being members of families of predominantly terrestrial species, such as the furnariids wren-like rushbird (*Phleocryptes melanops*) and sulfur-throated spinetail (*Limnoctites sulphuriferus*), the tyrannids of the genus *Pseudocolopteryx*, and the icterids yellow-winged blackbird (*Agelasticus thilius*) and chestnut-capped blackbird (*Chrysomus ruficapillus*). Several grassland birds, aerial-feeding species, and habitat generalists complete the list. Most waterbirds of regular occurrence in salt marshes also use freshwater wetlands or beaches and lagoons in southern Brazil (Belton 1994). However, some of them are more abundant or frequent in salt marshes and associated habitats and probably rely more on this kind of wetland than other wetland types, namely, the Chilean flamingo, Andean flamingo (*Phoenicoparrus andinus*), yellow-crowned night-heron, little blue heron, semipalmated plover, Hudsonian godwit, willet, semipalmated sandpiper, Olrog's gull (*Larus atlanticus*), and bay-capped wren-spinetail (Barbieri 2008). The latter is also strongly associated with salt marsh habitats in Argentina and Uruguay and may be considered a salt marsh specialist after additional investigations (Greenberg et al. 2014). Despite being recorded in a broad range of grassland habitats, sometimes in expressive numbers, the buff-breasted sandpiper and grass wren (*Cistothorus platensis*) are particularly abundant in Brazilian salt marshes, where both attain high densities (Bencke et al. 2003).

12.3.2.3 Occasional Species

This category includes 39 species represented by a range of families. Included in this list are birds common in adjacent freshwater wetlands and grasslands and that occasionally venture into estuarine habitats, such as the white-faced whistling-duck (*Dendrocygna viduata*), spot-flanked gallinule (*Porphyriops melanops*), spotted nothura (*Nothura maculosa*), and Hellmayr's pipit (*Anthus hellmayri*), as well as species reliant on shrubs and trees to fulfill part of or their entire life cycles, e.g., rufous hornero (*Furnarius rufus*), Spix's spinetail (*Synallaxis spixi*), and tropical kingbird (*Tyrannus melancholicus*). These species are only found in salt marshes with the presence of woody vegetation, which is naturally rare. Species that are uncommon in south Brazil are also included among the occasional users of salt marshes, such as the magnificent frigatebird (*Fregata magnificens*), short-billed dowitcher, and black tern (*Chlidonias niger*) (Belton 1994).

12.3.2.4 Migrant Species

A total of 34 migrant species are reported in Brazilian salt marshes, mainly Scolopacidae (16) and Laridae (4), all of which also occur in mangroves. There are 27 Pan New World migrant species, of which 85% are regularly recorded in salt marshes. Among the most frequent species are the shorebirds *Tringa* spp. and *Calidris* spp. Seven species are South American cool, temperate migrants, all making frequent use of salt marshes (Table 12.1).

12.3.2.5 Conservation

Among the 163 species recorded in salt marshes, 13 are of conservation concern. One is globally threatened (IUCN 2022), ten are included in the Brazilian list of threatened taxa (MMA 2016, 2022), and two species, the dot-winged crake and the black-and-white monjita (*Heteroxolmis dominicanus*), are in both lists (MMA 2016, 2022; IUCN 2022). Of the three globally threatened species, only the Andean flamingo and dot-winged crake are salt marsh regulars. The former is mostly an Andean breeder found in Brazil in shallow waters and mudbanks adjacent to and, more rarely, within salt marshes in a few localities of Santa Catarina State and at Peixe Lagoon (Bencke et al. 2006; Ghizoni-Jr and Piacentini 2010). The species occurs in small and varying numbers throughout the year in Brazil, being more numerous in the winter, and may largely be composed of immature and nonbreeding individuals (Bencke et al. 2006; Ghizoni-Jr and Piacentini 2010). Disturbance by humans, coastal development, and hunting are the main threats to this flamingo in Brazil (Ghizoni-Jr and Piacentini 2010). Individuals at Peixe Lagoon are protected within the Lagoa do Peixe National Park, but since this protected area is not fully implemented, they are often disturbed by shrimp harvesters and tourists.

In Brazil, the dot-winged crake occurs only in salt marshes of the Peixe Lagoon, which are located entirely within the national park, plus a handful of individual salt marshes at the estuary of Patos Lagoon (Bencke et al. 2003; Dias et al. 2017). This resident species inhabits dense vegetation and is largely threatened by overgrazing and burning of salt marshes and, to a lesser extent, by coastal development (Bencke et al. 2003). Despite occurring in two protected areas (Parque Nacional da Lagoa do Peixe and Área de Proteção Ambiental da Lagoa Verde) (see Chap. 3, Map 17), overgrazing and burning are still major threats due to the low regulation enforcement in both areas (Bencke et al. 2003, 2006; Dias et al. 2017). Two of the regionally threatened species considered regular salt marsh users, semipalmated sandpiper and red knot, are found in large numbers in Brazilian salt marshes only at the mouth of the Peixe Lagoon. In this locality, semipalmated sandpiper occurs throughout the austral warm season, whereas red knot peaks in the late austral summer and early austral autumn (Resende and Leeuwenberg 1987; Bencke et al. 2006). Both species may be impacted by disturbance by shrimp harvesters, fishermen, and tourists, which are frequent at the mouth of the lagoon (Bencke et al. 2006).

Royal tern also occurs in large numbers in salt marshes at the mouths of the Patos and Peixe lagoons, especially in winter, where they use sandbanks for roosting and may also suffer disturbance from fishermen and tourists. The two most important areas used by the buff-breasted sandpiper in Brazil, Lagoa do Peixe National Park and Torotama Island, are used throughout the austral spring and summer (Resende and Leeuwenberg 1987; Bencke et al. 2003, 2006). This sandpiper is restricted to areas of stunted vegetation where overgrazing by domestic livestock maintains the grass low. Suitable habitat on Torotama Island is relatively stable, but with the full implementation of Lagoa do Peixe National Park and the removal of livestock from the protected area, this species is expected to lose a substantial area of habitat unless specific habitat management practices are put in place (Bencke et al. 2003, 2006).

Cinereus harrier (*Circus cinereus*) is regionally threatened by the loss of nesting habitat in freshwater wetlands (Bencke et al. 2003). This bird hunts over a variety of natural and man-made open vegetation habitats, especially grasslands and freshwater wetlands, and is comparatively rarer in salt marshes (Bencke et al. 2003). Likewise, populations of Hudson's canastero (*Asthenes hudsoni*) inhabiting salt marshes are comparatively less threatened than those using adjacent sandy grasslands, which are prone to exotic pine tree invasion and urban and wind energy development (Serafini 2013).

12.4 Threats to Birds in Mangroves and Salt Marshes

Brazilian mangroves have steadily decreased in the area (Magris and Barreto 2010; Schaeffer Novelli et al. 2016), which represents a major threat to its avifauna. On the other hand, salt marsh destruction has been less severe, remaining almost unchanged since 1947 in south Brazil (Marangoni and Costa 2009a, b). Although the role of habitat loss and fragmentation upon avian diversity in Brazilian mangroves has not been properly explored, studies in other countries have demonstrated that area reduction can lead to population declines and local extinctions, predominantly of insectivorous species (Alongi 2009; Buelow and Sheaves 2015; Lawson et al. 2017).

Studies evaluating the effects of mangrove fragmentation on birds have shown contradictory results, either emphasizing (Alongi 2009) or deemphasizing (Chacin et al. 2015) the role of isolation in reducing diversity. In salt marshes, bird diversity is positively associated with patch size and proximity to other patches, with large wetlands possibly serving as population sources for some species, while small, isolated marshes act as population sinks (Shriver et al. 2004; Powell 2006). The landscape context in which mangrove and salt marsh fragments are inserted may also influence species richness and composition since adjacent patches of unsuitable habitat usually correlate with less diversity (Lefebvre and Poulin 1997; Shriver et al. 2004).

Mangrove and salt marsh remnants in Brazil are subject to habitat modification from a series of anthropogenic activities. Avian diversity in mangroves is positively associated with habitat heterogeneity, especially of vegetation features and foraging

habitats (Mohd-Azlan et al. 2015; Mancini et al. 2018). Although there are no studies evaluating how habitat modification influences mangrove birds in the country, it is likely that human-induced habitat homogenization, especially through logging, garbage disposal, and canalization (Olmos and Silva e Silva 2003; Valente et al. 2011; Schaeffer Novelli et al. 2016), is negatively affecting bird diversity.

Fishing and harvesting of aquatic resources are widespread along the Brazilian coastline. Direct effects include the damage to mangrove roots and propagules, plastic and oil pollution, and erosion from the wake of boats, while indirect effects are linked to the removal of keystone species known to influence forest structure and nutrient cycling (Schories et al. 2003; Nascimento et al. 2017). Harvesting may impact fish-, shrimp- and crab-eating birds or even the entire bird community indirectly via habitat modification (Nagelkerken et al. 2008; Mohd-Azlan et al. 2015). Trophic cascade effects are also known to affect salt marsh ecosystems. In North America, overfishing of predator species increased herbivory by crabs and led to marsh die-offs (Altieri et al. 2012). Crabs are also important primary consumers in Brazilian salt marshes (Alberti et al. 2007) and may indirectly influence the diversity of bird communities by altering vegetation structure, as observed in nearby Argentina (Cardoni et al. 2007). Nevertheless, how the harvesting of aquatic resources influences avian diversity in Brazilian estuaries remains to be properly evaluated.

The increasing use of estuarine habitats for leisure may also impact birds due to direct disturbance promoted by people and their pets. People walking or running, accompanied by unleashed dogs, driving all-terrain vehicles and boats disrupt avian behavior, especially feeding, resting, and breeding (Smit and Visser 1993; Borgmann 2011; Scarton 2018). This may cause alterations on how birds use key estuarine habitats, affecting food intake, resting/non-resting budgets, and breeding performance – all of which are expected to have negative consequences at the population level due to energetic and reproductive costs (Smit and Visser 1993; Borgmann 2011; Scarton 2018). In Brazil, such forms of disturbance are more likely to affect plovers, sandpipers, and terns (most of which are migratory) roosting in sandbars and mudflats, especially near cities, ports, and touristic destinations (Olmos and Silva e Silva 2003; Valente et al. 2011; Dias et al. 2013).

Invasive alien species, such as water buffalos in mangroves (Valente et al. 2011) and feral pigs and wild boars in salt marshes (Quintela et al. 2010) may additionally impact bird communities. Browsing by livestock alters the morphological structure of mangroves (Hoppe-Speer and Adams 2015) and may lead to habitat simplification and associated loss of avian diversity. Pigs uproot salt marsh vegetation, eliminating habitat for rails and salt marsh passerines reliant on dense, tall vegetation. Pigs may also prey on bird eggs and younglings, directly affecting the population of breeding birds such as rails and ducks.

Southern Brazilian salt marshes are also affected by poorly managed extensive livestock ranching, which impacts wetlands by decreasing aboveground plant material, altering biodiversity, and modifying ecosystem functioning (FNMA et al. 2009; Marangoni and Costa 2009a). Similar effects have been recorded in salt marshes subject to fire, which are frequently used to manage pastures in livestock ranching areas (Marangoni and Costa 2009a). In Argentinean salt marshes, overgrazing and

burning impact birds by reducing the abundance of tall-vegetation specialists, including species of conservation concern as dot-winged crake and bay-capped wren-spinetail, while favoring a few short-vegetation species but without major influence on abundance and species richness (Isacch et al. 2004; Isacch and Cardoni 2011). However, tallgrass birds can maintain populations under low-intensity grazing and burning, which demonstrates that livestock ranching and avian conservation are compatible under proper management (Cardoni et al. 2012).

Pollution from various sources (e.g., sewage and urban wastewater, industrial and agricultural effluents, garbage and solid waste, airborne pollutants) is also a common threat to Brazilian estuarine ecosystems, particularly to mangroves and salt marshes inserted within or near urban and industrial areas (Olmos and Silva e Silva 2003; Marangoni and Costa 2009a; Magris and Barreto 2010; Valente et al. 2011; Schaeffer Novelli et al. 2016). Birds are vulnerable to a range of pollutants that can result in mortality or sublethal behavioral, reproductive, and physiological effects depending on the intrinsic toxicity of the pollutant and exposure (Burger and Gochfeld 2001). The effects of pollutants depend on whether the exposure is acute or chronic, and in aquatic birds, this usually occurs through the ingestion of food and water (Burger and Gochfeld 2001, 2004). Oil spills recorded in Brazilian mangroves (Olmos and Silva e Silva 2003; Valente et al. 2011) may have impacted birds by disrupting their thermal balance and via toxicological effects following ingestion (Jenssen 1994; Burger and Gochfeld 2001). Plastic pollution is widespread (Olmos and Silva e Silva 2003; Valente et al. 2011) and tends to increase in coastal environments, threatening birds through entanglement and ingestion of plastic litter (Derraik 2002). Chemicals from sewage and urban wastewater, as well as industrial and agricultural effluents, usually affect individuals and populations through chronic effects linked to neurotoxicity and endocrine disruption (Burger and Gochfeld 2001, 2004; Köhler and Triebskorn 2013). Bioaccumulation of pollutants is a major concern, especially because many birds in mangroves and salt marshes occupy high trophic levels (Burger and Gochfeld 2001, 2004). On top of that, chemical pollution from sewage discharges may also modify the physiognomy of salt marsh vegetation, indirectly altering the composition and abundance of bird assemblages (Cardoni et al. 2011).

The greatest potential threat to mangroves and salt marshes is climate change, which will impact estuarine habitats via alterations in temperature and rainfall regimes, increasing extreme weather events, storms, and high tides, higher oceanic carbon dioxide concentration, and sea-level rise (Schaeffer Novelli et al. 2016). The survival of bird populations under climate change will depend on how they adapt to climate change and track their preferred climate via dispersal (Sekercioglu et al. 2012). Migratory species are expected to be particularly susceptible because higher temperatures may influence the timing of migration, as well as the availability of food resources in breeding and nonbreeding areas (Wrona et al. 2006; Sekercioglu et al. 2012). Since many mangroves and salt marsh areas in Brazil are key staging or wintering sites for migratory sea- and shorebirds (Valente et al. 2011; Dias et al. 2013), the fate of these areas under climate change will have important implications for avian conservation on a global scale.

If higher temperatures indeed promote an increase in mangrove cover along the Brazilian coast, such habitat expansion could benefit mangrove birds. However, the predicted increase is expected to be accompanied by changes in vegetation physiognomy and diversity (Schaeffer Novelli et al. 2016), potentially altering the diversity of avian communities. Loss of mangrove area among other effects of climate change, on the other hand, would reduce avian diversity overall, implying important population declines (or even extinction) of typical mangrove species (e.g., rufous crab hawk, little wood-rail), as well as forest birds that use these habitats as a refuge because of the loss of other upland adjacent forest types (Nagelkerken et al. 2008; Luther and Greenberg 2009).

The extensive salt marshes in south Brazil are expected to shrink in area due to erosion by rising sea level and invasion by southward expanding mangroves (Schaeffer Novelli et al. 2016). This may lead to the regional extinction of exclusive species (e.g., dot-winged crake), as well as important population losses of birds that are particularly abundant in these marshes (e.g., bay-capped wren-spinetail, grass wren) (Bencke et al. 2003). Changes in bird community structure may already be taking place in southern Brazilian salt marshes, even though mangrove trees have not yet colonized these formations. For example, the recent expansion and breeding of mangrove birds (e.g., yellow-crowned night heron and little blue heron) in salt marshes of south Brazil have been linked to the local increase in air temperature (Gianuca et al. 2011, 2012). Such expansion suggests that mangrove bird species may move ahead of the vegetation shift by using other forest types to breed and roost.

12.5 Conservation Challenges and Initiatives

Mangroves represent a rare forest type found in intertidal coastal zones largely restricted to tropical and subtropical regions (Sandilyan and Katherisan 2012). This complex ecosystem has been facing increasing threats due to human activities in the last decades, and it is estimated that roughly 35% of the global cover of mangroves was lost between 1980 and 2000 (Valiela et al. 2001; ICMBio 2015). Such reduction may be responsible for increasing the risk of extinction of at least 40% of the animal species that are restricted to mangroves (Polidoro et al. 2010), and ca. 14 bird species that are threatened to some extent. Nevertheless, detailed studies regarding the effects of mangrove destruction on the avifauna are still insufficient, especially in the Neotropics.

Brazil is the second country in mangrove extension, encompassing nearly 10% of this ecosystem in the world (Hamilton and Casey 2016). Roughly 80% of the Brazilian mangroves are in legally protected areas in the three levels of governance (national, state, and municipal) (Ferreira and Lacerda 2016). Taking national protected areas into consideration, ca. 79% are designed to promote sustainable use, most under the categories of environmental protected areas (APA) and extractive reserves (RESEX) (Magris and Barreto 2010). However, continuous threats are

known to impact Brazilian mangroves, such as the deterioration of water quality in freshwater effluents and coastal habitats, deforestation, use of salt flats for salt extraction, and shrimp farming, among others. Of all threats, aquaculture represents the highest one (Alongi 2002; Magris and Barreto 2010). Recent estimates indicate that roughly 500 km^2 of Brazilian mangroves were destroyed in the last 30 years (FAO 2007; Romanach et al. 2018), even though the Brazilian Forest Code defines these ecosystems as Areas of Permanent Preservation (APP) and imposes restrictions to their use and occupation. Thus, it is extremely important not only to create protected areas and elaborate management plans but also to strengthen law enforcement (for more information, see Chap. 16).

Globally, salt marsh areas have declined between 25% and 50% in cover (Duarte et al. 2008; Crooks et al. 2011). In Brazil, a large portion of salt marshes is considered either Areas of Permanent Preservation (APP) or of restricted use according to the Brazilian Forest Code (Dias et al. 2017). Although a few individual marshes in southern Brazil have been partially or entirely lost to urban and industrial development and shrimp farms up to the 1990s, law enforcement has maintained salt marsh area stable up to the present (Marangoni and Costa 2009a, b). Two protected areas conserve salt marshes in Brazil: the Lagoa Verde Environmental Protection Area (510 ha under municipal responsibility) and the Lagoa do Peixe National Park (34,000 ha under national responsibility) (FNMA et al. 1999; Bencke et al. 2006; Dias et al. 2017). The former has been poorly implemented and allows "sustainable development," meaning that it is managed not only for biodiversity conservation but also for human sustainable activities (Dias et al. 2017). Although included in a more restrictive category, the Lagoa do Peixe National Park is also not fully implemented and still has many private areas used for livestock ranching within its boundaries (Bencke et al. 2006). Particularly troublesome is the dilemma of the removal of livestock from the park since it provides habitat for some bird species reliant on shortgrass habitats while eliminating tallgrass salt marshes on which other birds depend (Bencke et al. 2006). Shrimp harvesters and fishermen still carry on with their activities in the park, and unregulated tourism is common (Bencke et al. 2006). Fully implementing these protected areas and including formal measures to ensure adequate habitat management and the protection of threatened species in management plans would benefit salt marsh birds (Bencke et al. 2006; Dias et al. 2017).

Large, virtually pristine salt marshes exist at Pequena Lagoon and Torotama Island and the establishment of protected areas could ensure their conservation (Dias et al. 2017). Law enforcement and environmental education campaigns would also benefit avian conservation, especially if the restrictions imposed by the Forest Code were reinforced (Dias et al. 2017). Moreover, awareness towards conservation should be stimulated through environment-friendly activities (e.g., birdwatching, organic farming, properly managed extensive livestock ranching), all of which have the potential to generate income for local communities if properly implemented (Dias et al. 2017).

Recently, the Chico Mendes Institute for Biodiversity Conservation (ICMBio), a branch of the Brazilian Ministry of the Environment, has promoted working groups to elaborate conservation plans for specific bird groups, such as mangrove birds and

Table 12.2 Summary of knowledge gaps in ecological and anthropogenic impact studies in Brazilian mangrove and salt marsh birds

Ecological studies
1. Lack of bird inventories and studies on avian habitat use
2. Lack of reviews on the information available in museum specimens and citizen science online platforms for a better understanding of the occurrence status and species conservation
3. Lack of studies on the ecology and natural history of exclusive and regular species for which the reduction in habitat quality or extent may be an important pressure
4. Limited knowledge on habitat and niche differentiation within these ecosystems
5. Lack of studies on avian morphological differentiation in Brazilian mangroves and salt marshes
6. Lack of studies on avian feeding adaptations or zonation patterns
7. Publication of relevant unpublished data carried out in mangroves and salt marshes (reducing the use of grey literature)
Anthropogenic impact studies
1. Long-term quantitative bird population studies, especially of sensitive taxa (e.g., threatened, exclusive, or migrant species)
2. Long-term monitoring and assessment of the effects of landscape changes on avian diversity
3. Evaluation of the impacts of water pollutants on birds
4. Evaluation of the impacts of aquatic resource harvesting on birds
5. Evaluation of the impacts of habitat modification (logging, garbage disposal, canalization, etc.) on birds
6. Evaluation of the impacts of mangrove and salt marsh destruction on birds
7. Evaluation of the impacts of climate change on birds and their habitats
8. Establishment of local conservation education programs and citizen science initiatives

migrant shorebirds. The National Plan for the Conservation of Migrant Shorebirds (ICMBio 2013) and the National Plan for Threatened Mangrove Species of Socio-economic Importance (ICMBio 2015) have as their main goals the proposal of effective conservation policies and the establishment of mechanisms that ensure the protection of the species under their scope and minimize the loss of their habitat.

12.6 Knowledge Gaps

Knowledge gaps are summarized in Table 12.2. Among the 69 consulted pieces of literature on Brazilian mangrove birds, 74% were scientific papers, 17% books, and 9% book chapters. A substantial part of these studies does not present detailed information on species specifically recorded in mangroves. Field studies represent the largest amount of information in the literature (93%), while the other 7% are large compilations (books), which are also based on field studies, museum specimens, and authors' observations (Ridgely and Tudor 1989, 1994; Stotz et al. 1996; Sick 1997; Willis and Oniki 2003; Sigrist 2006; Grantsau 2010). There is also important information on mangrove birds in dissertations and congress abstracts (gray literature). Virtually nothing is known about birds using salt marshes in Brazil other than what features in studies carried out in the Peixe and Patos lagoons (RS). The avifauna of salt marsh fringes in mangrove areas, for example, is unknown.

12.6.1 Field Studies

The published information on mangrove birds was collected in 16 Brazilian states that contain these habitats, with the number of studies varying according to the extension of habitat in each state. One of the most well-studied mangrove areas in Brazil is Mangue Seco in Bahia State, northeast Brazil, but the published studies do not mention the precise habitat where the bird species were recorded.

The largest part of the available studies presents qualitative data over quantitative or natural history data. Among the quantitative data, most studies focus on Nearctic migrants of the families Charadriidae, Laridae, Scolopacidae, and Sternidae, as well as Accipitridae, Anatidae, Ardeidae, Falconidae, Psittacidae, and Threskiornithidae (e.g., Olmos and Silva e Silva 2003; Galetti et al. 2006; Almeida and Rodrigues 2015; Souza and Rodrigues 2015). Natural history accounts are available only for a few species, such as the scarlet ibis, yellow-crowned night heron, Wilson's plover, orange-winged parrot (*Amazona amazonica*), and red-tailed parrot (e.g., Cunha et al. 2000; Gianuca 2007; Grose et al. 2013). The more incipient studies are those aimed at investigating the effects of human activities, e.g., water pollution, illegal mangrove occupation, and oil spills on coastal birds, including mangrove species (e.g., Olmos and Silva e Silva 2003; Rodrigues 2007; Valente et al. 2011), albeit not quantitatively evaluating those impacts (e.g., Barbieri 2001; Hvenegaard and Barbieri 2010).

Long-term bird population studies are still lacking in Brazilian mangroves and salt marshes. Such studies are crucial for a better understanding of population trends on both local and national scales. Quantitative studies that detect annual rates of changes in the average number of individuals in different areas, especially of sensitive taxa (e.g., threatened, exclusive, or migrant species), may reveal population declines that would go unnoticed with purely qualitative, presence/absence-based studies (see Lloyd and Doyle 2011). Likewise, natural history studies focused on elucidating avian ecology may also help to understand the proximal causes of eventual declines. This may be especially important for habitat-specialist species, for which the diminishing quality or extent of habitat surely is an important pressure.

Virtually nothing is known about the potential impacts of pollutants in urban and industrial wastewater on Brazilian mangrove and salt marsh bird communities. Long-term, wide-range monitoring initiatives as well as short-term, local studies targeting the effects of water quality on mangrove and salt marsh bird species are highly recommended. Likewise, environmental impact assessments (EIA), a national requirement ensuring that decision-makers understand the environmental impacts of their projects and plans, must be conducted more rigorously and taking into account their effects on mangrove and salt marsh birds. Unfortunately, human interference and its consequences to coastal ecosystems are still underestimated, and thorough population studies in mangroves and salt marshes, correlated with physical and other biological parameters, are critical to determine avian population trends and whether eventual declines are in course.

12.7 Final Remarks

Besides the significant advances in the knowledge of mangrove and salt marsh birds and the gaps mentioned above, additional procedures may improve our understanding of this ecological system. Ornithological studies conducted in mangrove and salt marsh areas (e.g., inventories, monitoring programs, specimen collection) must explicitly include a reference of the habitat where each species was recorded. This is valid for photographic, sound, or video records deposited in databases as well. In the case of published works, this information must be included either in the results section, in species accounts, or as details in species lists (see, e.g., Olmos and Silva e Silva 2003; Lees et al. 2014). Relevant information present in the grey literature should be formally published to better understand the occurrence and status of poorly known species in mangroves, such as red-and-white spinetail (*Certhiaxis mustelinus*), pileated finch (*Coryphospingus pileatus*), crested oropendola (*Psarocolius decumanus*), comb duck (*Sarkidiornis sylvicola*), and yellow-bellied seedeater (*Sporophila nigricollis*), among others.

Field studies in Brazilian mangroves are urgent along the whole coast, including quantitative data, which are crucial for short- and long-term populational monitoring initiatives. Detailed studies of the human impacts on mangrove birds are also fundamental from a conservation perspective. In addition to that, reviews of the information available in museum specimens and citizen science online platforms (e.g., Wikiaves, e-Bird, Xeno-Canto, Táxeus) are also important for a better understanding of the occurrence and conservation status of mangrove and salt marsh birds.

In some mangrove regions, bird assemblages exhibit zonation, with species even specializing on different mangrove tree species (Noske 1995, 1996; Luther and Greenberg 2009). Since habitat loss may have a differential effect upon distinct mangrove zones, some bird species may be more threatened than others by human activities within or nearby these ecosystems (Magris and Barreto 2010; Polidoro et al. 2010). Therefore, future studies should focus on detecting and documenting fine-scale habitat requirements of exclusive and regular species to better understand niche partitioning and the possible existence of avian zonation in Brazilian mangroves. This could shed light on how different species respond to different human activities and their potential negative effects. Another goal is the implementation of local conservation education programs and citizen science initiatives, with public engagement and the involvement of local communities, which are fundamental to set best practices for the conservation of mangrove and salt marsh birds.

Finally, the creation of new protected areas encompassing mangroves (ICMBio 2018) and salt marshes would be important to conserve birds and other organisms in Brazil. However, even the categorization of mangrove habitats as Areas of Permanent Protection (APP) has been constantly threatened by the current government. In 2020, the National Environment Council (CONAMA) approved the removal of these regulations, which would allow developers to clear large areas of natural habitats for tourism or real state enterprises. Fortunately, the Federal Supreme Court revoked the removal of these regulations following protests from researchers and environmentalists. Mangrove restoration projects are limited to less than

25 isolated attempts, rarely exceeding half a hectare and with high plant mortality rates (Menghini et al. 2018). Furthermore, data on restoration and monitoring remain unpublished or reduced to planting techniques (Rovai et al. 2012). Salt marsh restoration projects are also incipient and limited to small areas (Costa 2011).

Appendix

Mangrove Bird References Ridgely and Tudor (1989), Azevedo-Júnior (1992), Pacheco (1994), Ridgely and Tudor (1994), Martuscelli (1995), Rodrigues (1995), Stotz et al. (1996), Alves et al. (1997), Sick (1997), Silva et al. (1997), Azevedo-Júnior (1998), Hass et al. (1999), Cunha et al. (2000), Olmos (2000), Olmos and Silva-e-Silva (2001), Silva e Silva and Olmos (2002), Naka et al. (2002), Azevedo et al. (2003), Olmos and Silva e Silva (2003), Willis and Oniki (2003), Develey (2004), Araújo et al. (2006), Galetti et al. (2006), Lima (2006 apud Somenzari et al. 2018), Roda and Pereira (2006), Sigrist (2006), Silva e Silva (2007), Amorim and Piacentini (2007), Araújo and Nishida (2007), Dantas et al. (2007), Efe et al. (2007), Mestre et al. (2007), Rodrigues (2007), Rodrigues et al. (2007), Ruschi and Simon (2007), Silva e Silva and Olmos (2007), Almeida and Barbieri (2008), Pereira et al. (2008), Periquito et al. (2008), Rupp et al. (2008), Silva e Silva (2008), Souza et al. (2008), Fedrizzi and Carlos (2009), Maciel (2009), Piacentini et al. (2009), Aguiar et al. (2010), Grantsau (2010), Lima et al. (2010), Nunes et al. (2010), Almeida and Ferrari (2011), Girão and Albano (2011), Carvalho and Rodrigues (2011), Santos (2011), Xavier and Boss (2011), Lees et al. (2012), Pereira et al. (2012), Ghizoni-Jr et al. (2013), Gomes et al. (2013), Grose et al. (2013), Olmos et al. (2013), Bisinela et al. (2014), Lees et al. (2014), Melo et al. (2014), Pereira et al. (2014), Grose and Cremer (2015), Vieira (2015), Favoretti and Batalla (2017), and Mancini et al. (2018)

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