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ABUNDANCE AND SPECIES RICHNESS OF A BIRD ASSEMBLAGE IN AN IMPORTANT BIRD AREA OF SOUTHEASTERN BUENOS AIRES

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ABSTRACT: Coastal sectors of Buenos Aires Province are considered important wintering and refueling sites for a great diversity of shorebirds, seabirds and coastal birds. In this work, we characterized the intra-annual variation in the abundance and richness of the bird assemblage along a sector of the southeastern Buenos Aires coast, the Important Bird Area IBA BA12: Playa Punta Mogotes y Puerto de Mar del Plata. For one year, every two weeks, we recorded the diversity and abundance of birds, together with their main behavioral activities, along three transects (with contrasting environmental characteristics and human activities) on the beaches of the Punta Mogotes resort complex, located on the southern coast of General Pueyrredon District. We recorded a total of 12,820 individuals belonging to at least 33 species. The bird assemblage varied with transect and season. Total bird abundance was lowest in spring. The northern sector of the IBA was identified as holding the greatest number and richness of birds. This site borders the Reserva Natural Puerto Mar del Plata, so it could be proposed for incorporation into the Reserve, which would allow the legal regulation of the human activities carried out in the northern sector of the IBA.

KEYWORDS: *Argentina, bird assemblage, Buenos Aires Province, diversity, important bird area, sandy beaches*

Coastal zones account for about 15% of the global surface and are currently among the most populated areas (Micallef & Williams 2009). These zones have great ecosystem value, mainly because of the variety of environments they include (e.g., dunes, beaches, salt marshes, cliffs; Barbier et al. 2011). Coastal sectors, including sandy beaches, play a key role for numerous vertebrate species, such as some mammals and birds with marine and coastal habits, serving as feeding, settling, breeding, wintering and even stopover sites throughout their annual cycles or migratory routes (Burger 1995, Bastida & Rodríguez 2003, Burger et al. 2007, Schlacher et al. 2014). As land-sea interface sectors, they also provide a base for a wide variety of human activities, from fishing and gathering to recreation and tourism, from which their great economic value derives (Levin et al. 2001, Defeo et al. 2009, Birdir et al. 2013). This has contributed to certain coastal sectors, particularly sandy beaches, being among the most threatened ecosystems globally (Defeo et al. 2009, Dadon 2017).

Regarding birds, during the breeding season many species use sandy beaches as nesting sites (Medeiros et al. 2012, Schlacher et al. 2014), whereas during the non-breeding season these environments can be used as wintering or stopover sites, gathering diverse inter- and intraspecific groups (Hubbard & Dugan 2003, Burger et al. 2007, Lafferty et al. 2013, Barker et al. 2022). The selection and use of sandy beaches by birds is based mainly on food availability (Hubbard & Dugan 2003, Schlacher et al. 2013, Cuttriss et al. 2015, Barker et al. 2022), although other factors such as structural dynamics and environmental/climatic heterogeneity play an important role in the selection of these habitats (i.e., sandy beaches; Neuman et al. 2008, Defeo et al. 2009, Barker et al. 2022). On beaches and in coastal sectors, various

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human activities, mainly recreational, overlap temporally with groups of birds. Human activities with the potential to disturb these birds include the use of motor vehicles and walking with pets (i.e., domestic dogs, *Canis familiaris*), with extreme cases being the destruction of nests, mortality from vehicle collisions or predation by dogs (Burger 1995, Lafferty 2001, Meager et al. 2012, Schlacher et al. 2013). Prolonged anthropogenic disturbance generates energy costs for birds, altering vital behaviors such as feeding, preening and resting (Cornelius et al. 2001, Lafferty 2001, Yasué 2005).

In Argentina, Buenos Aires Province represents the northernmost sector of the country's coast, and although it is characterized by estuarine systems, numerous sandy beaches and intertidal zones (Marcomini & López 2016), it lacks large breeding colonies of seabirds and coastal birds compared with other sites in Patagonia (Yorio et al. 1999, Favero et al. 2016). However, given its strategic location within major bird migratory corridors (Capllonch 2018), the Buenos Aires coast is an important wintering and refueling area for a great diversity of shorebirds, seabirds and coastal birds coming from distant regions such as North America (e.g., Common Tern, *Sterna hirundo*; American Golden Plover, *Pluvialis dominica*; Red Knot, *Calidris canutus*), Patagonia and Antarctica (e.g., *S. hirundinacea*, *Anarhynchus falklandicus*, *Chionis albus*; Silva Rodríguez et al. 2005, Blanco et al. 2006, Favero et al. 2016, Martínez-Curci & Petracci 2016, Hernandez et al. 2021). In fact, the presence of populations of globally threatened and/or range-restricted bird species, as well as gregarious species, has led to the designation of some 25 Important Bird Areas (IBAs, or *AICA* by their Spanish acronym) in Buenos Aires Province, five of which are of special interest for the conservation of shorebirds, seabirds and coastal birds (Fig. 1). This is the case of BA9 (Bahía de Samborombón and Punta Rasa), where seven globally threatened bird species occur and large numbers of Nearctic and Patagonian migrants concentrate, including the Common Tern, the White-rumped Sandpiper (*Calidris fuscicollis*), the Red Knot, the Buff-breasted Sandpiper (*Calidris subruficollis*), the American Golden Plover and the Two-banded Plover (*Anarhynchus falklandicus*), among others (Di Giacomo et al. 2007). Regarding BA11 (Reserva de Biosfera Albufera de Mar Chiquita), BA12 (Playa Punta Mogotes y Puerto de Mar del Plata) and BA15 (Reserva de usos Múltiples de Bahía Blanca, Bahía Falsa y Bahía Verde), the first two are used as wintering sites by species of conservation concern such as Olrog's Gull (*Larus atlanticus*), while BA15 holds approximately 60% of this species' breeding population (Di Giacomo et al. 2007). Although IBAs are identified by different criteria, such as the presence of threatened species or large populations of a particular species (Di Giacomo et al. 2007), few studies update the bird inventories of these sites, and even fewer analyze the occurrence and distribution of these vertebrates within each IBA.

Studies characterizing the assemblage of shorebirds, seabirds and coastal birds using the Buenos Aires shoreline are mainly restricted to the north of the province, in the Bahía Samborombón area, and to other estuarine sectors in southern Buenos Aires (Blanco et al. 2006, Suárez et al. 2014, Martínez-Curci et al. 2015, 2021, Zumpano et al. 2025). Few studies have focused on other coastal areas of Buenos Aires Province, particularly those with substantial urban development, tourist influx and human activities throughout the year (Blanco et al. 2006, García & Gómez Laich 2007, Berón et al. 2023). The objectives of this study were (1) to characterize the bird assemblage using a sector of the southeastern Buenos Aires coast throughout the year, the IBA BA12 'Playa Punta Mogotes y Puerto de Mar del Plata', (2) to identify the main behaviors displayed by birds, and (3) to evaluate bird richness and abundance and the degree of use by birds of sectors with contrasting characteristics (e.g., presence of private beach resorts, proximity to freshwater bodies). We hypothesized that bird richness and abundance are affected by beach sector and the human activities occurring there. We predicted lower bird richness and abundance in sectors with higher levels of disturbance from human activities. Understanding the spatial and seasonal use patterns of the bird species inhabiting this environment will not only update knowledge of the avifauna using a site listed within Argentina's network of Important Bird Areas but also provide information for future conservation policies.

METHODS

Study area

The study was carried out on sandy beaches of the Punta Mogotes resort complex (38°03'S, 57°34'W), located on the southern coast of General Pueyrredon District, in southeastern Buenos Aires. This district holds the most populated coastal city in the country (i.e., Mar del Plata; approx. 670,000 inhabitants, INDEC 2022), whose beaches are used throughout the year by a large number of visitors, with a significant increase in the number of users during the summer months

(Richeri 2011, APM 2026). Given their geomorphological characteristics, these sandy beaches are considered dissipative (i.e., wide with a gentle slope and gently breaking waves; Bertola 2006). The area is listed as an Important Bird Area in Buenos Aires Province (IBA BA12: Playa Punta Mogotes y Puerto de Mar del Plata, Di Giacomo et al. 2007). With a length of approximately 3.5 km, it is bounded to the north and northeast by the industrial complex and the southern breakwater of the Port of Mar del Plata, respectively, to the south by the Punta Cantera headland, and to the east by two clearly distinct sectors: from north to south, it borders the Reserva Natural del Puerto Mar del Plata (RNPMdP) for 0.8 km, and then the Punta Mogotes Resort Complex and the Arenas Blancas resort for 2.4 km (Fig. 1). Taking into account the variations caused by ordinary tides, public beaches range from 120 to 200 m wide, measured from the resorts' building line or the boundary with the RNPMdP, narrowing southward. The installation of fixed wooden beach tents intended to provide shade and delimit outdoor spaces (Boschi 2004) begins in the study area in mid-September, and they are removed in May; once installed, and depending on the sector and ordinary tides, the width of the public beach ranges from 60 to 80 m.

Data collection

The study lasted one year and was carried out between April 2024 and March 2025. Given the length of the study area (~ 3.5 km), we delimited three transects (i.e., Puerto, Medio, Waikiki), 600 m long and 100 m wide, separated from each other by 600 m (Fig. 1). We aimed for transects to be separated by the same distance as the transect length. In addition, this distance (i.e., 600 m) is considered reliable for recording birds in open areas such as coastal sectors (Sutherland 1996). Regarding transect width, and in order to include in the counts bird species using the water body, transects extended 50 m seaward and 50 m landward from the shoreline. The 50-m width on the landward side ensured that transects were not spatially interrupted by the wooden tents mentioned above during the summer months. From north to south, the 'Puerto' transect borders the RNPMdP; this sector has the greatest mean beach width (see Fig. 1), which is not affected during the summer months by the fixed wooden tents set up by the concessionaires of the coastal sector (beach resorts). It also has a stormwater outfall and a stream, originating in the RNPMdP lagoon, which discharge into the sea. The 'Medio' and 'Waikiki' transects border the line of fixed tents set up by the Punta Mogotes Resort Complex during spring and summer, whereas the opposite occurs in winter and autumn, when the tents are removed. Finally, the 'Waikiki' transect also borders a rocky intertidal sector to the south (Fig. 1). Every two weeks, we recorded the diversity and abundance of all birds present within each transect. Because the study area is embedded in an urban matrix, it partly functions as an ecotone and is known to harbor a high diversity of birds (see De Marco et al. 2005), we decided to record all species observed using the area (i.e., aquatic and terrestrial). We recorded individuals to species level or to the lowest possible taxonomic level following the *South American Classification Committee* (AOS 2026). We assigned common names following Monteleone & Pagano (2022). At the same time, for each transect, we used scan sampling (Martin & Bateson 1993) to identify the main behavioral activity of each recorded individual, classified as resting, when the individual was stationary; preening, including feather and/or bill cleaning and bathing; feeding, when the individual was handling and/or ingesting food; flying, including individuals flying over the transect, which may be searching for food (e.g., raptors) or avoiding potential predators or stressors (e.g., dogs, people walking by); and swimming, when the individual was moving in the water. All three authors carried out the observations and data collection using binoculars (8x40) and a digital recorder, and species identifications were confirmed with field guides and photographs. All surveys were carried out in the morning (07:00-09:00 h, GMT -3) at low tide. Considering that some individuals may move between transects during surveys, and to reduce the probability of counting the same individual more than once, we excluded individuals that flew in from the sector surveyed immediately beforehand.

Data analysis

Behavioral activity frequencies used to analyze activity profiles are expressed as absolute (i.e., all individuals) and relative (i.e., per transect) percentages. To compare the bird assemblage between transects and seasons (i.e., autumn, winter, spring, summer), we performed multivariate analyses using a PERMANOVA based on the Bray-Curtis dissimilarity index with 9999 permutations. All variables included in the analysis met the assumption of homogeneity of variances (betadisper: pseudo-$F_{transect}$ = 2.34, p = 0.11; pseudo-F_{season} = 1.81, p = 0.16). Subsequently, to visualize bird assemblage composition, we performed a non-metric multidimensional scaling (nMDS) on three axes, based on the Bray-Curtis dissimilarity index, with a minimum of 20 and a maximum of 200

random starts (Palacio et al. 2020).

To identify which bird species were indicators of each transect and season, we used the indicator value method (IndVal; Dufrene & Legendre 1997), calculated with the R package *indicspecies* (De Cáceres & Legendre 2009). This method evaluates the association of species with a given site (specificity) and their frequency of occurrence (fidelity) at that site. A high indicator value (specificity × fidelity; 0 to 100%) shows that a species is characteristic of a site (Dufrene & Legendre 1997). Species with significant IndVal values (> 60%) were considered characteristic of the transect and season (adapted from Mbiba et al. 2021). The significance of the indicator value was assessed with a permutation test (De Cáceres & Legendre 2009). For each transect and season, we calculated species richness, defined as the total number of species recorded. To compare this value between transects and seasons, we built rarefaction curves for each category of the variables analyzed, using as a reference the abundance of the smallest sample in each comparison (García & Gómez Laich 2007). We estimated the quantile intervals of the rarefaction curves using 200

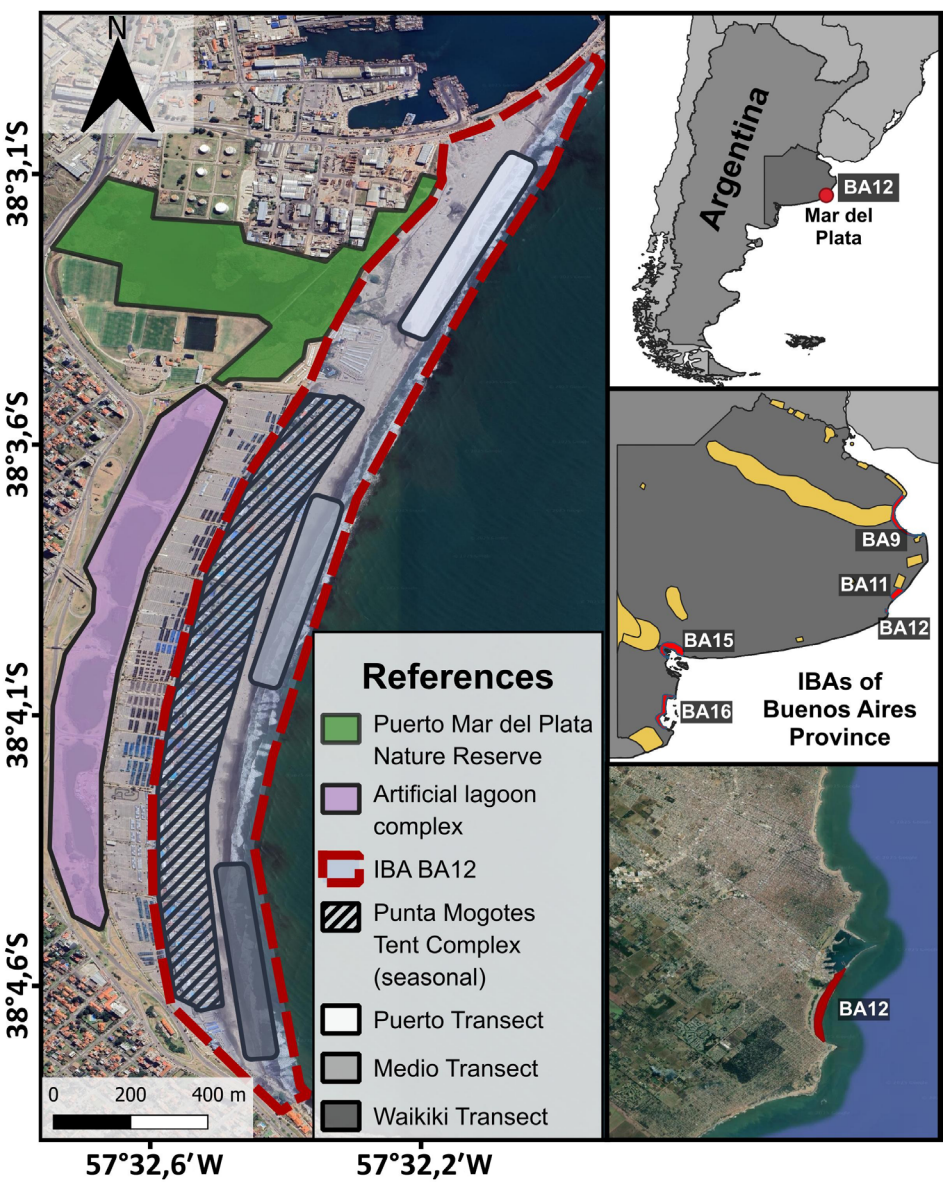


Figure 1. Study area. The study area is shown in relation to the coast of General Pueyrredon District, in southeastern Buenos Aires Province, Argentina. IBAs: Important Bird Areas. Yellow polygons represent the IBAs within Buenos Aires Province; the IBAs most relevant to the conservation of seabirds and coastal birds are labeled BA (number) (see Di Giacomo et al. 2007 for details).

bootstrap resamples (Chao et al. 2014). We performed the PERMANOVA with the R package *vegan* (Oksanen et al. 2022) and built the rarefaction curves with the *iNEXT* package (Hsieh et al. 2016).

To analyze whether total bird abundance varied with transect and season, we fitted a Generalized Linear Model (GLM; Crawley 2012) with a Negative Binomial error structure and 'log' link function, including the following explanatory variables: transect (categorical variable: Puerto, Medio or Waikiki) and season (categorical variable: autumn, winter, spring or summer). We assessed model fit through the percentage of deviance explained, used as a measure analogous to the coefficient of determination (R^2; Zuur et al. 2009). Given that the aim of the work was specifically to evaluate whether bird abundance varied between transects and seasons, we decided to fit a 'global' model (i.e., a model including both variables) and to make inferences from its parameters. We built the model with the *MASS* package (Venables & Ripley 2025). We evaluated model assumptions using DHARMa diagnostic plots and the corresponding tests (Kolmogorov-Smirnov test, dispersion test and quantile test) of the DHARMa package (Hartig 2022), all of which yielded $p > 0.05$.

The significance level for all tests was $p \leq 0.05$. Data handling and statistical analyses were performed in R, version 4.4.1 (R Development Core Team 2024).

RESULTS

Throughout the study period, we recorded a total of 12,820 individuals belonging to 12 orders, 18 families and at least 33 species (Table 1). The order Charadriiformes accounted for 82% of the individuals recorded, followed to a lesser extent by the order Passeriformes with 7% and by the orders Falconiformes and Columbiformes with 4% and 3%, respectively. Within the order Charadriiformes, gulls and terns accounted for 74% and 24% of the records, respectively. In terms of relative abundance (i.e., percentage of all individuals recorded), the Kelp Gull (*Larus dominicanus*), the Brown-hooded Gull (*Chroicocephalus maculipennis*) and the Snowy-crowned Tern (*Sterna trudeaui*) together accounted for approximately 73% (Table 1). On the other hand, the Chimango Caracara (*Daptrius chimango*) was the species with the highest frequency of occurrence (88%), followed by the Kelp Gull (70%), the Rock Dove (*Columba livia*; 58%), the Brown-hooded Gull (56%) and the Southern Lapwing (*Vanellus chilensis*; 54%; Table 1).

In terms of conservation, only two of the species recorded are listed under some degree of threat: Olrog's Gull (*Larus atlanticus*), listed as Near Threatened by the IUCN and as Vulnerable nationally, and the Southern Giant Petrel (*Macronectes giganteus*), listed as Vulnerable nationally. All other species recorded in the counts are listed as Least Concern/Not Threatened both globally and nationally (Table 1).

Regarding the behavioral activities observed, and in general terms (i.e., all individuals), the birds recorded were mostly resting (~ 67%), to a lesser extent flying (~ 29%) and engaged in feeding-related activities (~ 3%); individuals observed swimming accounted for less than 1% of the records (Supplementary Materials Table S1). Regarding the behavioral activities in each transect, flight-related activities dominated in the Medio and Waikiki transects, followed by resting and feeding, while the opposite was observed in the Puerto transect, where resting dominated, followed by flying (Supplementary Materials Table S2).

Assemblage characterization

The bird assemblage varied significantly with the transect sampled and the season (PERMANOVA; transect: pseudo-$F = 5.760$, $p < 0.001$, $R^2 = 0.130$; season: pseudo-$F = 2.840$, $p < 0.001$, $R^2 = 0.100$; Supplementary Materials Table S3). The assemblages observed in the Puerto transect were markedly different from those recorded in the Medio and Waikiki transects (Puerto-Medio: pseudo-$F = 7.270$, $p < 0.001$; Puerto-Waikiki: pseudo-$F = 8.040$, $p < 0.001$), with no significant differences between the latter two (Medio-Waikiki: pseudo-$F = 1.080$, $p = 0.340$; Figs. 2A-C). As for seasons, we found significant differences between all seasons sampled ($1.980 <$ pseudo-$F < 4.010$, all $p < 0.050$), except between the assemblages observed in autumn and winter (winter-autumn: pseudo-$F = 0.800$, $p = 0.560$; Figs. 2D-F).

The indicator species (i.e., those with a significant indicator value > 60%) for the Puerto transect were the Kelp Gull, the Brown-hooded Gull, the Snowy-crowned Tern, the Common Tern (*Sterna hirundo*), the Chimango Caracara, the Rock Dove and the Southern Lapwing (Table 2). There were no indicator species for the Medio and Waikiki transects. As for seasons, the Snowy-crowned Tern and the Rock Dove were indicator species of autumn, the Neotropic Cormorant (*Nannopterum brasilianum*) and the Common Tern of spring, and the Brown-hooded Gull of summer (Table 2). There were no indicator species for winter.

Table 1. List of the bird species recorded on the sandy beaches of the Punta Mogotes Complex (IBA BA12), Buenos Aires Province, Argentina (April 2024 - March 2025). Abu: abundance, SD: standard deviation, Max: maximum number of individuals recorded in a single survey, RA: relative abundance (%), FO: frequency of occurrence (%). Conservation status in Argentina (Arg.) according to MAyDS y AA (2017) and globally according to IUCN (2026). MP: migratory pattern according to Monteleone & Pagano (2022). EB: endemic breeder; NM: Nearctic migrant; AM: austral migrant; PM: partial migrant; I: introduced species; '-': not reported (see Monteleone & Pagano (2022) for details on these classifications).

Species	Abu	Mean ± SD	Max	RA	FO	IUCN	Arg.	MP
Order Charadriiformes								
Family Laridae								
Kelp Gull (*Larus dominicanus*)	4700	65.28 ± 113.40	512	36.66	69.44	LC	NA	-
Olrog's Gull (*Larus atlanticus*)	21	0.29 ± 1.33	9	0.16	6.94	NT	VU	Ec PM
Brown-hooded Gull (*Chroicocephalus maculipennis*)	3123	43.38 ± 148.64	861	24.36	55.56	LC	NA	PM
Grey-headed Gull (*Chroicocephalus cirrocephalus*)	10	0.14 ± 0.51	3	0.08	8.33	LC	NA	PM
Unidentified tern (*Sterna* sp.)	26	0.36 ± 2.38	20	0.20	6.94	-	-	-
South American Tern (*Sterna hirundinacea*)	110	1.53 ± 6.40	46	0.86	16.67	LC	NA	PM
Common Tern (*Sterna hirundo*)	865	12.01 ± 90.84	771	6.75	15.28	LC	NA	NM
Snowy-crowned Tern (*Sterna trudeaui*)	1477	20.51 ± 109.83	895	11.52	30.56	LC	NA	-
Sandwich Tern (*Thalasseus sandvicensis*)	13	0.18 ± 1.10	8	0.10	2.78	LC		PM
Royal Tern (*Thalasseus maximus*)	28	0.39 ± 1.52	8	0.22	8.33	LC	NA	PM
Family Rynchopidae								
Black Skimmer (*Rynchops niger*)	4	0.06 ± 0.33	2	0.03	2.78	LC	NA	NM PM
Family Charadriidae								
Two-banded Plover (*Anarhynchus falklandicus*)	25	0.35 ± 1.99	16	0.20	5.56	LC	NA	PM
Southern Lapwing (*Vanellus chilensis*)	120	1.67 ± 2.19	9	0.94	54.17	LC	NA	-
Family Recurvirostridae								
Black-necked Stilt (*Himantopus mexicanus*)	46	0.64 ± 1.56	7	0.36	18.06	LC	NA	-
Order Podicipediformes								
Family Podicipedidae								
Great Grebe (*Podiceps major*)	1	0.01 ± 0.12	1	0.01	1.39	LC	NA	PM
Order Procellariiformes								
Family Procellariidae								
Southern Giant Petrel (*Macronectes giganteus*)	2	0.03 ± 0.17	1	0.02	2.78	LC	VU	-
Order Suliformes								
Family Phalacrocoracidae								
Neotropic Cormorant (*Nannopterum brasilianum*)	238	3.31 ± 10.19	46	1.86	30.56	LC	NA	-
Order Pelecaniformes								
Family Threskiornithidae								

Species	Abu	Mean ± SD	Max	RA	FO	IUCN	Arg.	MP
White-faced Ibis (*Plegadis chihi*)	178	2.47 ± 20.98	178	1.39	1.39	LC	NA	-
Order Anseriformes								
Family Anatidae								
Unidentified duck (*Anas* sp.)	2	0.03 ± 0.24	2	0.02	1.39	-	-	-
Yellow-billed Teal (*Anas flavirostris*)	1	0.01 ± 0.12	1	0.01	1.39	LC	NA	-
Yellow-billed Pintail (*Anas georgica*)	1	0.01 ± 0.12	1	0.01	1.39	LC	NA	-
Order Falconiformes								
Family Falconidae								
Chimango Caracara (*Daptrius chimango*)	475	6.60 ± 5.96	25	3.71	88.89	LC	NA	-
Crested Caracara (*Caracara plancus*)	20	0.28 ± 1.33	9	0.16	5.56	LC	NA	-
Order Accipitriformes								
Family Accipitridae								
Snail Kite (*Rostrhamus sociabilis*)	1	0.01 ± 0.12	1	0.01	1.39	LC	NA	PM
Order Columbiformes								
Family Columbidae								
Rock Dove (*Columba livia*)	310	4.31 ± 7.68	32	2.42	58.33	LC	IN	I
Picazuro Pigeon (*Patagioenas picazuro*)	59	0.82 ± 2.00	11	0.60	23.61	LC	NA	-
Spot-winged Pigeon (*Patagioenas maculosa*)	14	0.19 ± 1.02	7	0.11	5.56	LC	NA	-
Eared Dove (*Zenaida auriculata*)	5	0.07 ± 0.48	4	0.04	2.78	LC	NA	-
Order Psittaciformes								
Family Psittacidae								
Monk Parakeet (*Myiopsitta monachus*)	62	0.86 ± 4.79	36	0.48	4.17	LC	NA	-
Order Passeriformes								
Family Hirundinidae								
Barn Swallow (*Hirundo rustica*)	856	11.89 ± 72.07	600	6.68	26.39	LC	NA	Ma NM
White-rumped Swallow (*Tachycineta leucorrhoa*)	4	0.06 ± 0.23	1	0.03	5.56	LC	NA	PM
Family Passeridae								
House Sparrow (*Passer domesticus*)	13	0.18 ± 1.53	13	0.10	1.39	LC	IN	I
Family Tyrannidae								
Great Kiskadee (*Pitangus sulphuratus*)	8	0.11 ± 0.46	3	0.06	6.94	LC	NA	-
Family Furnariidae								
Rufous Hornero (*Furnarius rufus*)	1	0.01 ± 0.12	1	0.01	1.39	LC	NA	-
Order Trochiliformes								
Family Trochilidae								
Unidentified hummingbird (*Trochilidae* sp.)	1	0.01 ± 0.12	1	0.01	1.39	-	-	-

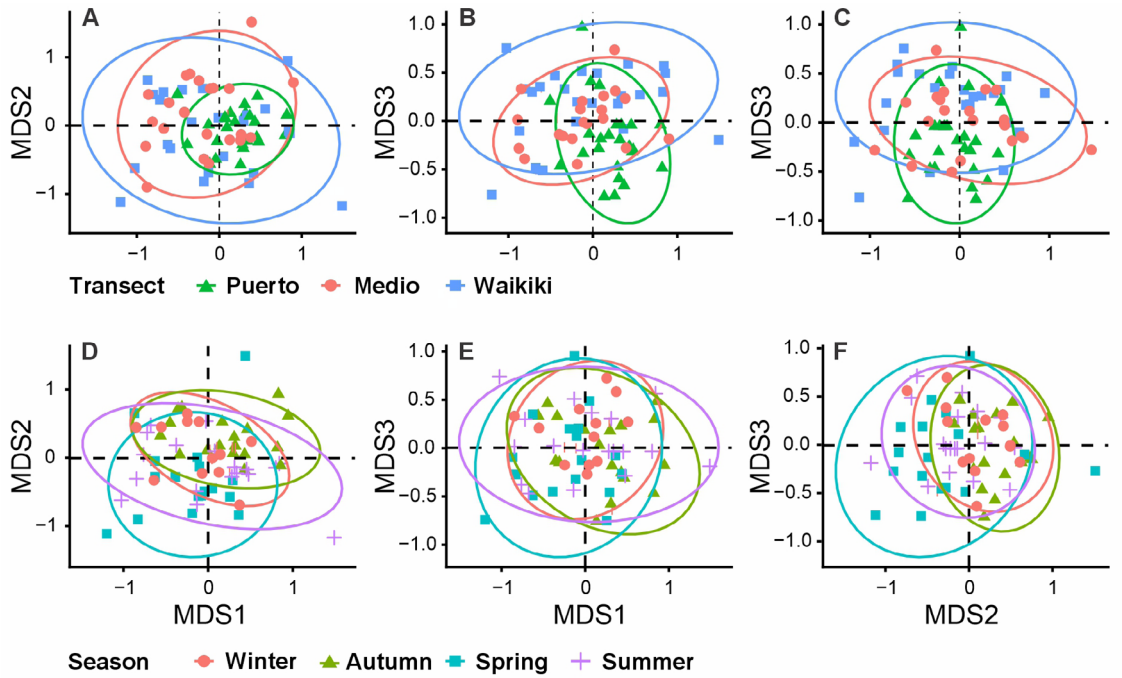


Figure 2. Non-metric multidimensional scaling (nMDS; stress = 0.15) of the bird assemblages, showing the combinations of axes (MDS1, MDS2, MDS3) by sampling site (A, B and C) and season (D, E and F). Each point represents the count of the number of individuals per species.

Table 2. Specificity, fidelity and indicator value (i.e., specificity × fidelity) of the species recorded at the Punta Mogotes resort, Buenos Aires Province, by transect and season. Only species with a significant indicator value greater than 60% ($p < 0.05$) are shown. No indicator species were found for the Medio and Waikiki transects or for winter.

	Species	Specificity	Fidelity	Indicator value
Transect				
Puerto	Kelp Gull	0.80	0.95	0.88
	Brown-hooded Gull	0.92	0.83	0.88
	Chimango Caracara	0.61	1.00	0.78
	Snowy-crowned Tern	0.86	0.70	0.78
	Rock Dove	0.63	0.83	0.73
	Southern Lapwing	0.52	0.79	0.65
	Common Tern	0.99	0.41	0.64
Season				
Autumn	Snowy-crowned Tern	0.94	0.44	0.65
	Rock Dove	0.46	0.77	0.60
Spring	Neotropic Cormorant	0.74	0.64	0.69
	Common Tern	0.98	0.41	0.64
Summer	Brown-hooded Gull	0.89	0.72	0.80

When analyzing species richness by transect, it ranged between 17 and 29 species (Table 3). However, richness estimates from rarefaction curves showed no significant differences between transects, given the wide overlap of the confidence intervals (Fig. 3A; Table 3). Regarding seasonality, observed richness ranged between 16 and 24 species (Table 3). Estimated richness was highest in spring, exceeding winter and summer, whose confidence intervals did not overlap with those of this season. In contrast, autumn showed a slight overlap with spring, indicating less marked differences between these two seasons (Fig. 3B; Table 3).

Total bird abundance ranged from a minimum of two to a maximum of 1679 (mean: 180 ± 323 birds). The fitted model explained 56% of the deviance (deviance $R^2 = 0.56$). Bird abundance differed with transect ($F = 93.400$, $p < 0.001$) and season ($F = 9.400$, $p < 0.050$). Abundance was higher in the Puerto transect than in the Medio and Waikiki transects ($t_{\text{medio-puerto}} = -8.100$, $p < 0.001$; $t_{\text{puerto-waikiki}} = 8.700$, $p < 0.001$), with no differences in abundance between the latter two ($t_{\text{medio-waikiki}} = 0.500$, $p = 0.870$; Fig. 3C). As for seasons, we recorded the lowest bird abundance in spring ($t_{\text{winter-spring}} = 2.740$, $p < 0.050$; $t_{\text{autumn-spring}} = 2.950$, $p < 0.050$; $t_{\text{spring-summer}} = -2.570$, $p < 0.050$), while there were no significant differences among the other seasons ($t_{\text{winter-autumn}} = -0.200$, $p = 0.990$; $t_{\text{winter-summer}} = 0.180$, $p = 0.990$; $t_{\text{autumn-summer}} = 0.380$, $p = 0.980$; Fig. 3D).

DISCUSSION

In this study, we provide novel information on the bird community, including migrants and residents, that uses a sandy-beach habitat in southeastern Buenos Aires listed as an Important Bird Area throughout the year (BA12: Playa Punta Mogotes y Puerto de Mar del Plata; Di Giacomo et al. 2007). The BA12 area is used by large heterogeneous groups, made up mainly of gulls and terns; these groups tend to form mixed assemblages at other wintering sites in Buenos Aires Province (Petracci et al. 2005, Silva Rodríguez et al. 2005, García & Gómez Laich 2007, Berón et al. 2023, Zumpano et al. 2025). In line with our predictions, we identified an effect of the different sectors surveyed within the study area on species richness and abundance. The northern sector (i.e., Puerto) held the greatest number of individuals. The spring months had the highest species diversity, although with the lowest abundance of individuals.

Sandy beaches can be used throughout the year by various groups of migratory birds (e.g., Nearctic, austral), which leads to seasonal changes in the abundance and diversity of the bird assemblages using them (Vooren & Chiaradia 1990, Hubbard & Dugan 2003, Alfaro & Clara 2007, Lafferty et al. 2013, Graells et al. 2022). The fact that the study area is used throughout the year by species with different

Table 3. Total abundance, observed richness and estimated richness, with their respective 95% quantile intervals obtained from rarefaction curves, for each transect and season. LQL: lower quantile limit; UQL: upper quantile limit.

	Total abundance	Observed richness	Estimated richness (LQL-UQL)
Transect			
Puerto	10,716	29	20.35 (19.62 – 21.09)
Medio	1037	19	19.00 (16.83 – 21.16)
Waikiki	1067	17	16.86 (14.12 – 19.60)
Season			
Autumn	3868	21	18.38 (16.47 – 20.18)
Winter	1872	16	15.77 (14.09 – 17.46)
Spring	1757	24	24.00 (19.91 – 28.08)
Summer	5323	21	17.48 (15.94 – 19.02)

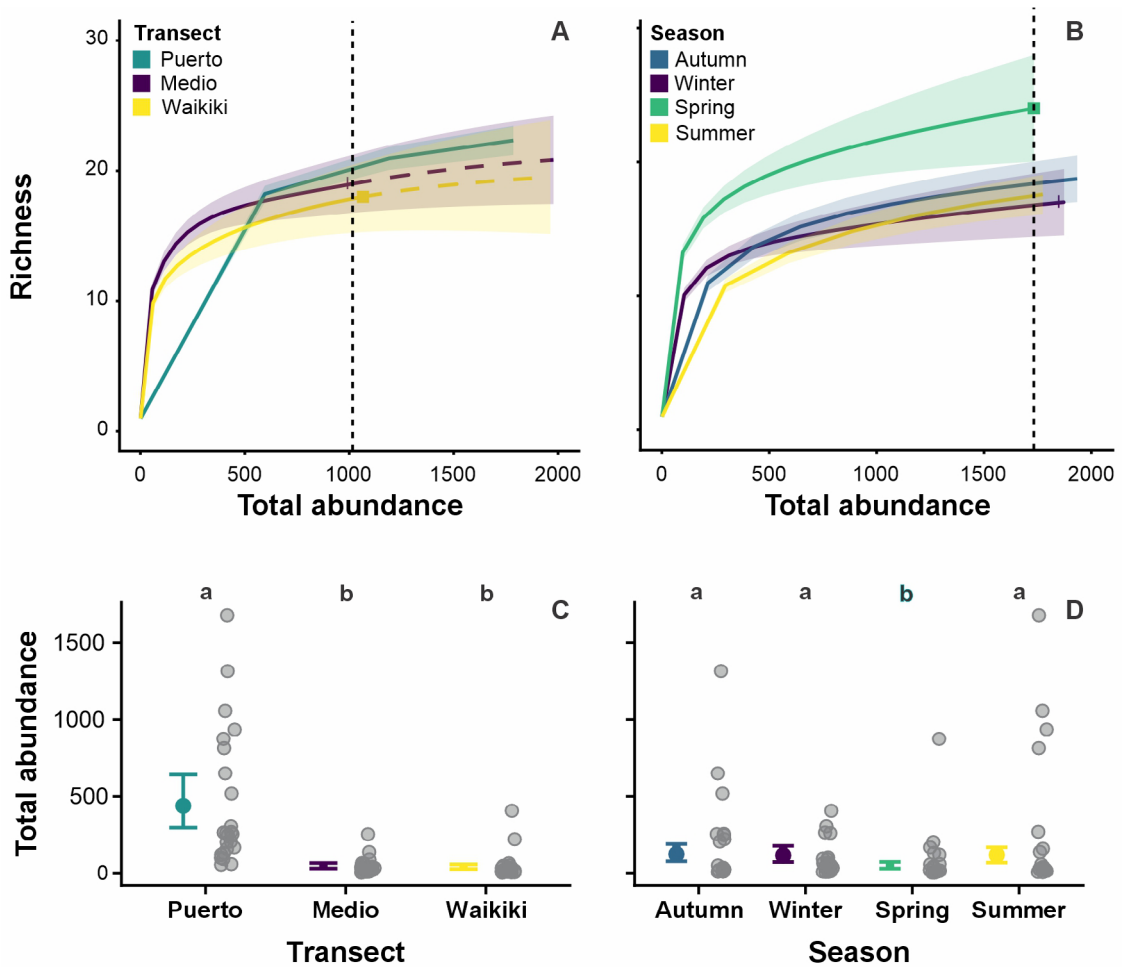


Figure 3. Rarefaction curves of species richness as a function of total abundance for each transect (A) and season (B), and total bird abundance by transect (C) and season (D). Dotted lines represent extrapolated values, shading indicates the 95% quantile confidence intervals and the vertical dotted line marks the abundance of the smallest sample used to estimate richness (see Table 3). Grey points represent observed values, while colored points and bars correspond to model-estimated means and their 95% confidence intervals. Different lowercase letters indicate significant differences between categories ($p < 0.05$).

breeding chronologies means that, at certain times of the year, mainly spring and autumn, species may overlap (e.g., Nearctic and austral). These transition periods are reflected in the overlap between species, with the consequent increase in species number and changes in assemblage composition and abundance. During spring, for example, bird assemblages were dominated by the Common Tern, a Nearctic migrant whose main wintering area in Buenos Aires is Punta Rasa, where it arrives in mid-September and October (Sapoznikow et al. 2002, Nisbet et al. 2011). The Neotropic Cormorant was also recorded using the area mainly during spring, coinciding with the species' breeding season in other regions of the country (Quintana et al. 2002). Since breeding records of the species in Buenos Aires Province are restricted to inland sectors in the north and southwest of the province (Morici 2025), we consider that the individuals observed in this study during spring, as well as in other coastal sectors of southern Buenos Aires Province (García & Gómez Laich 2007, Petracci et al. 2009), may be juveniles or non-breeding individuals. On the other hand, bird assemblages during summer were dominated by the Brown-hooded Gull, which showed abundance peaks in February and March, made up entirely of individuals in non-breeding plumage (personal observation). This species breeds between October and February, mainly in inland water bodies of southeastern Buenos Aires (Josens et al. 2009); however, breeding records are scarce and the numbers of breeding individuals are low along the marine coast of Buenos Aires Province (Suárez et al. 2014, Berón & Seco Pon 2024). Recently, Berón & Seco Pon (2024) identified breeding colonies of the Brown-hooded Gull and the Grey-headed Gull (*Chroicocephalus cirrocephalus*) in the complex of artificial urban lagoons adjacent to the study area. This may explain why individuals of both species in breeding plumage were observed using the study area during the breeding season (pers. obs.). Changes in the assemblages were observed not only in the species composing them but also in their abundances. During spring, a decrease in the abundance of individuals, mainly breeding adults that settle at their breeding sites in other regions, is expected (Haedo Rossi & Esteban 2022), as is an increase in the abundance of Nearctic migrants, as was the case of the Common Tern. In our study, the spring months had the lowest abundances, which we attribute to the abrupt decrease in the abundance of the Kelp Gull, which strongly dominated abundance in the assemblages of the other seasons. The Kelp Gull is widely distributed along the Argentine marine coast (Yorio et al. 2016), and its breeding cycle, although with latitudinal variation, takes place between September and January (Yorio et al. 2005, Kasinsky et al. 2021). The dispersal of breeding individuals to their colonies may explain the abrupt decrease observed in the number of Kelp Gulls in September and the low abundance, mainly of adults, in spring and summer (personal observation), similar to what has been observed for this species and period in other regions throughout its range (Vooren & Chiaradia 1990). Another frequently observed species, whose abundance remained stable throughout the year, was the Chimango Caracara; although it is not considered a coastal bird, it has been expanding its range to include both natural and urban coastal areas (Vooren & Chiaradia 1990, Carrete et al. 2009, Biondi et al. 2020, Zumpano et al. 2025).

The availability of other habitats near the beach can influence the bird community present there (Meager et al. 2012, Lafferty et al. 2013). In the present work, the Puerto sector was identified as holding the greatest number of individuals and bird species. This sector has contrasting characteristics that set it apart from the others analyzed (i.e., Medio, Waikiki), since it borders not only the RNPMdP but also the southern breakwater of the Port of Mar del Plata. The aggregation of birds in areas near seaports, and their interaction with human activities, mainly those related to fish processing, has been identified both locally and regionally (Yorio & Caille 2004, Berón et al. 2023). Disturbance from human activities is another important factor to consider. In general, birds on sandy beaches prefer less disturbed sectors (Cornelius et al. 2001, Lafferty 2001). The Puerto sector has no beach resorts or wooden tents throughout the year, which considerably increases the beach width compared with the Medio and Waikiki sectors. The environmental heterogeneity of the Puerto sector, given by its proximity to the RNPMdP, the Port of Mar del Plata and freshwater bodies, together with its greater spatial extent and lower human disturbance, may also explain the differences found not only in the richness and composition of the bird assemblages but also in the main behaviors displayed by these species. Lower levels of disturbance allow birds to use their time more efficiently for vital activities such as feeding and/or resting (Cornelius et al. 2001, Lafferty 2001). In the Puerto sector, resting was the most frequently recorded activity for all species, showing the importance of this sector as a refuge and resting site.

With a length of approximately 3.5 km, the Punta Mogotes sandy beach was designated as an Important Bird Area about two decades ago (IBA BA12: Playa

Punta Mogotes y Puerto de Mar del Plata, Di Giacomo et al. 2007). The present work identified the northern sector of the IBA, called Puerto, as the one holding the greatest number and diversity of birds. Notably, this sector is used by Olrog's Gulls, a species listed as Near Threatened by the IUCN (BirdLife International 2018) and as Vulnerable in Argentina (MAyDS y AA 2017). Although there are currently no public policies regulating the multiple human activities that could affect the local avifauna, the Puerto sector has the advantage of having no private beach resorts, although in summer it is intensively used by beachgoers as a public area. Because it borders the Reserva Natural Puerto Mar del Plata, the northern sector of the IBA BA12: Playa Punta Mogotes y Puerto de Mar del Plata could be proposed as an extension of the reserve's boundaries. This would give reserve status to the sector of the IBA most used by birds, which entails the legal regulation of the human activities that may take place there.

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SUPPLEMENTARY MATERIAL

You can access the supplementary material for this article by visiting the link https://doi.org/10.56178/eh.v41i2.1551.

USE OF ARTIFICIAL INTELLIGENCE

We did not use artificial intelligence in the research or in the preparation of the manuscript.

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