INCIDENCE OF ANTHROPOGENIC ITEMS IN NESTS OF THE KELP GULL *LARUS DOMINICANUS* PRIOR TO NATIONAL PARK TOURISM DEVELOPMENT, ARGENTINE PATAGONIA

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ABSTRACT

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Birds have long been known to incorporate trash into their nests. Little information exists about this type of pollution in seabird nests in Argentine coastal areas. Here, we report the incidence of anthropogenic debris (trash) in the nests of a generalist and opportunistic predator, the Kelp Gull *Larus dominicanus*, at two islets within Islote Lobos National Park, in northern Argentine Patagonia, before the commencement of tourist visitation. Our sampling also occurred before the construction of a pipeline and oil port facilities 30 km south of the park in response to the hydrocarbon exploitation of Vaca Muerta. Minimal quantities of anthropogenic debris were found in nest materials (n = 463 nests; trash prevalence = ~3%). The study included both open and vegetated nests sampled during three breeding seasons (2022/2023, 2023/2024, and 2024/2025). Plastic dominated the trash items at both nests and adjacent beaches. Long-term studies such as ours, which surveyed both anthropogenic debris incorporated into nests and items found in the vicinity of the two islet nesting grounds we analyzed, should serve as baselines for future studies needed for the development of management plans of this natural protected area.

Key words: anthropogenic nest material, coastal seabird, Kelp Gull, *Larus dominicanus*, natural protected area, Argentine Patagonia

INTRODUCTION

Nests are vital to avian reproduction, being the vessels in which birds lay their eggs or raise offspring (Mainwaring et al., 2014). Still, nests are spatially fixed structures that are not exempt from environmental hazards from both natural (e.g., hurricanes; Wiley & Wunderle, 1993) and artificial (e.g., anthropogenic debris, particularly plastic; Jagiello et al., 2019) sources. The occurrence of anthropogenic (human-made) nest material (ANM)—i.e., trash—has been receiving greater attention by both ornithologists and managers owing to the threats it poses, including ingestion (Henry et al., 2011) or entanglement (Votier et al., 2011). Birds may incorporate ANM (1) to reinforce assembly of the nest, (2) for decorative purposes, (3) to deter parasites, and (4) as a replacement for biological materials where those are scarce (see Jagiello et al., 2019; O'Hanlon et al., 2019; Suárez-Rodríguez & Garcia, 2017).

Recent reviews of the topic have reported ANM use in 125 (Jagiello et al., 2023) and 291 species (Sheard et al., 2024), globally. When considering seabirds as a separate group, ANM has been found in the nests of at least 27 species, chiefly those of coastal habitats (Nelms et al., 2023). Still, the latter investigation shows—at least for the South Atlantic—that the bulk of the studies are focused on seabirds nesting on Brazilian (da Costa et al., 2022; de Souza Petersen et al., 2016; Tavares et al., 2016) or South African grounds (Ryan, 2020; Tavares et al., 2020; Witteveen et al., 2017), with little information available for the southwestern South Atlantic, including Argentina (Nelms et al., 2023). There, the few extant surveys have indicated the issue exists for some seabirds breeding along the coasts of northern (Seco Pon & Pereyra, 2021; Yorio et al., 2022) and southern Argentine Patagonia (Albizzi et al., 2024).

The Kelp Gull *Larus dominicanus*, a generalist coastal seabird, uses a wide variety of nest materials from natural sources, including twigs, grasses, seaweed, shells, feathers, bone fragments, and rocks (de la Peña, 2015). A growing body of evidence indicates also the use of ANM, such as plastic food- and bait-related bags, food wrappers, line tackle, and other items (Seco Pon & Pereyra, 2021; Witteveen et al., 2017; Yorio et al., 2022). Herein, we provide an assessment of ANM use by the species in Islote Lobos National Park, within the San Matías Gulf, northern Argentine Patagonia. Our assessment occurred before the commencement of tourist visitation and before the construction of a pipeline and oil port facilities in Punta Colorada (located 30 km south of the park) associated with the hydrocarbon exploitation of Vaca Muerta. The latter is considered the main unconventional hydrocarbon area of the Argentine territory (Duquelsky & Rocha Varsanyi, 2025). Due

to the small human presence at the time, we expected very low loads of ANM in the surveyed Kelp Gull colonies.

METHODS

Study Area

The study was conducted at Islote Lobos National Park (hereinafter, *ILNP*), in Rio Negro province, northern Argentine Patagonia (41°26′S, 065°00′W; Fig. 1). This area consists of both terrestrial (35.2 km^2) and marine domains (155.5 km^2). The terrestrial domain spans both governmental and private lands. This protected area is within 1 km of the village of Playas Doradas (442 inhabitants; 1,135 km^2) and also 50 km east of Sierra Grande (8,957 inhabitants; 9,900 km^2) and 30 km north of Punta Colorada Port (four inhabitants; 2.5 km^2), which are both relatively close (Instituto Nacional de Estadística y Censos, 2022). The areas within ILNP are fully managed by the National Parks Administration, with moderate enforcement of policies. The presence of a permanent human population within ILNP—along with artisanal fisheries, livestock, and wildlife tourism—is a stressor impacting the overall management of this area (Administración de Parques Nacionales, 2024).

The Kelp Gull breeds on multiple islets within ILNP, the colonies varying in numbers of breeders from year to year (personal observations by the authors). We chose two (presumed separate) colonies for this study. Each is located within a large seabird cluster: La Pastosa Islet, which had 1,075 breeding pairs, and Los Pájaros Islet, with 1,066 breeding pairs (Lisnizer et al., 2011; Yorio et al., 2005).

Sampling

The sampling effort was part of a long-term study of the trophic ecology and reproductive biology of the Kelp Gull nesting within ILNP. The survey for assessing ANM was conducted during the incubation stage of three consecutive breeding seasons: 2022/2023, 2023/2024, and 2024/2025 (hereinafter, *BS1*, *BS2*, and *BS3*, respectively). Thus, we sampled nests while they were still active, striving not to disturb breeding individuals. Non-active nests were excluded. Pairs do not reuse the same nest during consecutive seasons (personal observations by the authors), and therefore, nests were independent. We classified each nest as open or vegetated based on the surrounding vegetation. An open nest was one built in a scrape on the ground, with virtually no immediate vegetation, while a vegetated nest typically was a scrape formed among vegetation (Yorio et al., 2005). The survey spanned < 3 hr/day, with timing being constrained by tides. At each islet, we took digital photographs of active nests, georeferenced to avoid resampling. The nests photographed were along equally spaced transects across each islet; the start of those transects was randomly selected. Each photograph included the whole nest. The use of a 20-megapixel camera positioned above the nest at ~50 cm and at a right angle to the ground ensured that the entire nest would fit in the photograph (Albizzi et al., 2024; Ryan, 2020). We included a 15-cm-long object with each nest photograph for scale.

During BS1, BS2, and BS3, at Pastosa Islet, we photographed 95, 48, and 101 active nests, respectively, while at Pájaros Islet, we photographed 48, 47, and 124 active nests, respectively. The number of sampled nests for the overall study period was in accord with the recommendations of Tavares et al. (2020), who advocated using similar

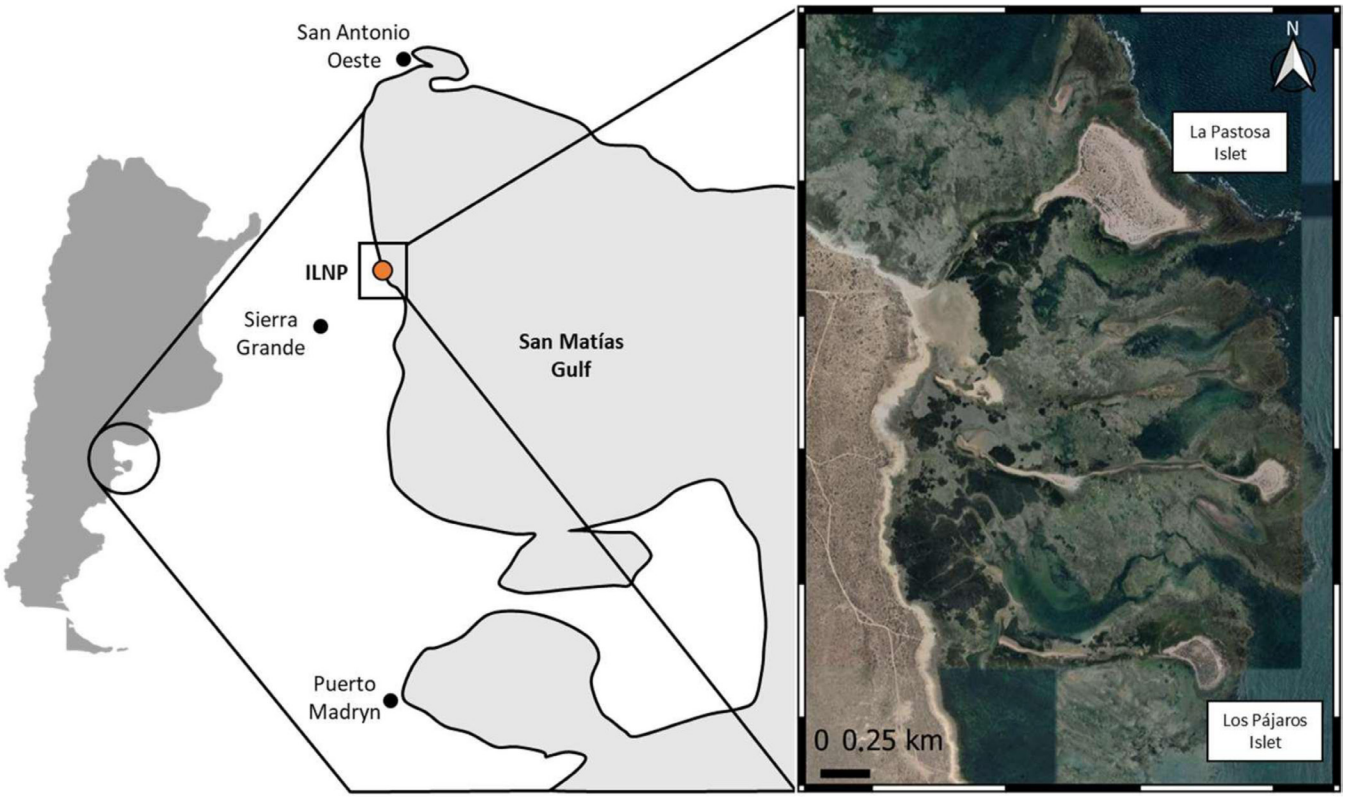

Fig. 1. Study area in relation to the Atlantic coast of the northern sector of Rio Negro province, in Argentina, South America. The location of the natural protected area (Islote Lobos National Park, ILNP) is denoted by a red dot.

proportions of nests for a given bird population under scenarios of (1) more than one sampling site and (2) between 60 and 250 nests.

Image Analysis

The procedure follows previous studies that used digital photographs to record ANM in seabird breeding colonies (Albizzi et al., 2024; Ryan, 2020; Sugasawa et al., 2021). This rapid and effective method minimizes disturbance, as the amount of time spent at each nest is minimal (Ryan, 2020). In this study, we analyzed each photograph using the software ImageJ (version 1.53k). The digital scale was set on pixels/cm, using a 15-cm scale with each photograph as a reference. We measured the surface area (in cm^2) of the nest and each debris item, if present. Total debris coverage and percentage debris coverage (in relation to the overall nest surface) were calculated for each nest.

Various attributes of the debris were noted. We classified items as follows (see Cheshire et al., 2009; Lippiatt et al., 2013): plastic, paper, cloth, rubber, glass, metal, processed wood, and other (or non-classifiable debris). The number representing each category was totalled for each nest. We further classified each debris item as unbroken, fragmented, or broken. The length of the longest axis was measured (in centimeters) for each item. In the case of debris that was bent or twisted (e.g., ropes, plastic bags), length was estimated following the original line of the object's major axis. Identifiable plastics were allocated into three categories: meso-debris (from 5 mm to < 2.5 cm in length), macro-debris (from ≥ 2.5 cm to < 10 cm), and mega-debris (≥ 10 cm) (Thompson et al., 2009). Based on color, we divided debris into white/clear, grey/silver, black, green, orange/brown, blue, and multicolor (> three colors) (Verlis et al., 2014). Items were also sorted into categorical variables such as brightness (presence or absence), consistency (flexible, rigid, or Styrofoam), and label (presence or absence) (Seco Pon et al., 2023). Plastic debris was further classified into multi-use and single-use (e.g., plastic bags, cutlery, straws, cups, non-wrapper food packaging, cartons, jugs, K-Cup coffee pods, and drinking bottles; Schnurr et al., 2018). Finally, we noted presumed sources of marine debris, including items associated with both coastal and leisure activities (Storrier et al., 2007). To reduce potential inter-observer differences when collecting data (see Razzell Hollis et al., 2024), the first author (JPSP) retrieved all overall debris metrics (abundance, surface, length, category, state, size, color, brightness, consistency, source, and single-use purpose in the case of plastic).

Availability of Marine Debris From the Vicinity of the Kelp Gull Nesting Grounds

We assessed the amount of debris from the vicinity of both surveyed islets for each breeding season (BS1, BS2, and BS3) by using two transects, each with a north-south orientation, walked along the boundary of each of the sampled islets at the high-tide mark. These transects encompassed the whole islet boundary. Each transect was ~16,300 m^2 (1,630 m in length, 10 m wide) on Pastosa Islet, and on Pájaros Islet they were each ~7,000 m^2 (700 m in length, 10 m wide). Debris that was partially buried under the substrate was not included. We were not aware of any beach-cleaning campaigns in the vicinity of the study area.

Data Analysis

We computed the frequency of debris occurrence (%) per category based on the number of items, taking into account all samples collected. We determined the total amount of debris for each breeding season by totalling the number of items for each debris category per sampled nest. The overall prevalence of ANM (i.e., the number of nests containing debris divided by the total number of nests sampled) was assessed for each breeding season separately.

We used one-way analysis of variance (ANOVA) to test for differences among surveyed colonies in total coverage of overall debris. The same approach was used to assess differences in percentage of average debris coverage. Likewise, we also explored differences in overall nest surface between breeding seasons using one-way ANOVA. However, the small ANM debris sample sizes obtained in our study (see Results) prevented us from analyzing the nest data in all the ways originally planned, such as for total and percentage debris coverage. Moreover, we could not compare the debris collected from open and vegetated nests due to the small debris sample sizes, especially so for vegetated nests (see Results).

To assess the spatial (i.e., sampled islets) and temporal (i.e., three consecutive breeding seasons) effects on ANM abundance, we used a generalized linear model (GLM) applying a Poisson distribution and a log link function (Zuur et al., 2009). In the modelling, ANM abundance (presence/absence) was included as a categorical variable; the same treatment was given to the number of sampled islets (Pastosa and Pájaros) and the surveyed breeding seasons. We checked the fitness of the model through diagnostic plots using the "DHARMa" package in R (Hartig, 2022).

We performed all analyses using R version 4.3.3 (R Core Team, 2024) and set the significance level in all tests to $p < .05$. All values are reported as mean ± two standard deviations (SD).

RESULTS

Total and Percentage ANM Coverage

At Pastosa Islet, combining the three seasons, seven debris items were present in 244 photographed nests (e.g., Fig. 2). The items were in different nests, leading to the overall prevalence being 2.86% of nests. Overall, each of the 95 nests sampled in BS1 contained an average of 0.08 ± 0.28 items, while each of the 48 nests surveyed in BS2 and each of the 101 nests sampled in BS3 averaged 0.02 ± 0.14 items (Appendix 1, available on the website). The mean total coverage of overall debris per nest for BS1 at this site was 66.43 ± 61.20 cm^2 (range = 0.21–147.52 cm^2) and for BS3 was 17.85 ± 9.89 cm^2 (range = 10.86–24.85 cm^2). The sole piece of debris photographed at a sampled nest during BS2 covered 36.75 cm^2. The average debris percentage coverage per nest calculated for BS1 at this site was 0.81% (range = 7.80%–18.8%) and for BS3 was 0.05% (range = 1.38%–3.81%). For reference, overall nest surface at Pastosa Islet (regardless of the type of nest) averaged 712.19 ± 84.43 cm^2 (range = 506.65–882.92 cm^2), 650.97 ± 102.75 cm^2 (range = 513.74–838.33 cm^2), and 709.09 ± 93.92 cm^2 (range = 449.65–907.9 cm^2) during BS1, BS2, and BS3, respectively. This variable did not vary significantly among sampled seasons (ANOVA: $F_{2,244} = 2.534$, $p = .662$).

At Pájaros Islet, and irrespective of surveyed breeding season, we tallied a total of seven debris items over 219 photographed nests (Fig. 2). These seven debris items were all found in different nests; at this site, prevalence was estimated to be slightly over three percent of the total nests (3.19%). Each of the 48 nests surveyed in BS1

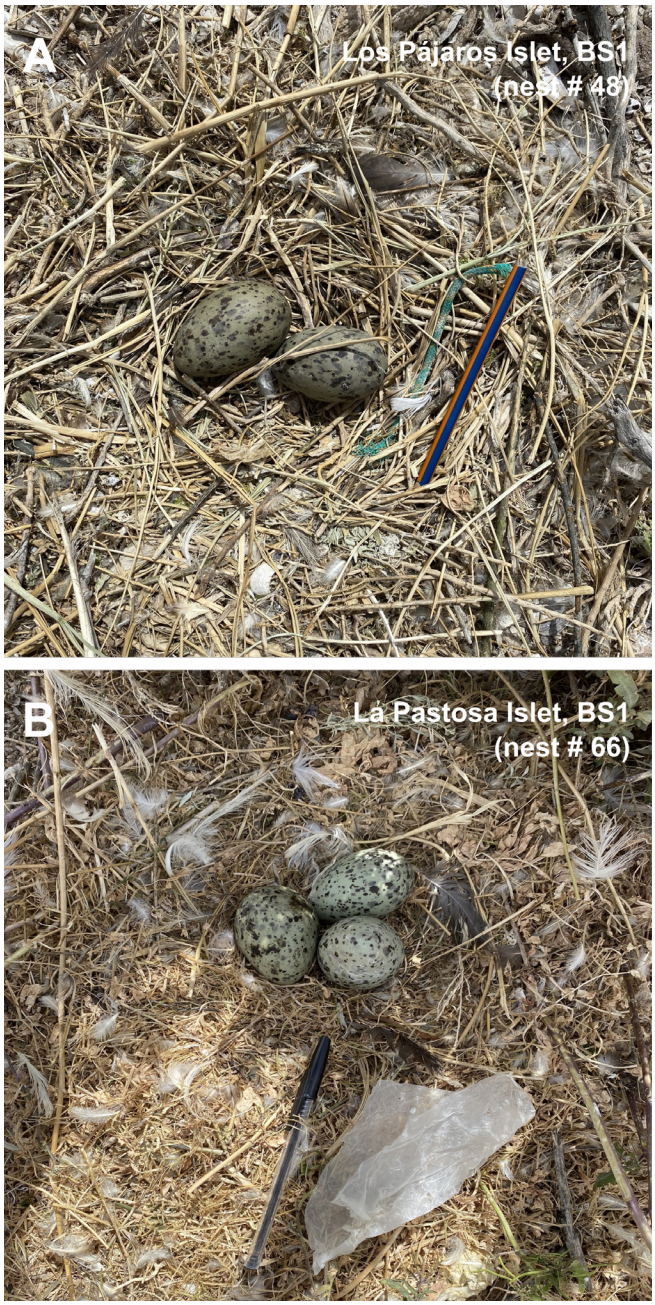

Fig. 2. Anthropogenic debris used as nest materials by Kelp Gulls *Larus dominicanus* within Islote Lobos National Park, San Matías Gulf, Argentina, in 2022/2023 (BS1 in the picture labels). The nests include (A) a worn green (flexible) plastic fishing rope fragment (nest #48) and (B) a clear (flexible) plastic fragment (nest #66). The pen and/or pencil (15 cm in length) in the images is included for scale purposes. Photo credits: Alexia Trinidad Aguilar, 28 October 2022 (A); Alexia Trinidad Aguilar, 29 October 2022 (B)

contained a mean of 0.08 ± 0.28 items, while each of the 47 nests surveyed in BS2 contained a mean of 0.02 ± 0.14 items, and each of the 124 nests surveyed in BS3 contained a mean of 0.01 ± 0.12 items (Appendix 1). At this site, the mean total coverage of debris per nest for BS1 was 7.77 ± 3.76 cm^2 (range = 6.43–12.53 cm^2) and for BS3 was 17.32 ± 10.33 cm^2 (range = 10.02–24.63 cm^2). The sole piece of debris photographed at a sampled nest during BS2 covered 0.28 cm^2. The average debris percentage coverage per nest calculated for BS1 at this site was 0.08% (range = 0.50%–1.70%) and for BS3 was 0.04% (range = 1.76%–3.31%). For reference, overall nest surface at Pájaros Islet averaged 668.36 ± 92.64 cm^2 (range = 503.60–812.57 cm^2), 660.72 ± 98.85 cm^2 (range = 504.10–829.32 cm^2), and 651.07 ± 101.39 cm^2 (range = 499.40–865.78 cm^2) during BS1, BS2, and BS3, respectively. This variable did not vary significantly among sampled seasons (ANOVA: $F_{2,219} = 1.524$, $p = .466$).

Type, Size, Color, and Presumed Sources of ANM

Regardless of category or breeding season, fragmented debris prevailed (100% of items) in nests at Pastosa Islet. There, plastic debris (six items, 85.7%), followed only by paper debris (one item, 14.3%), dominated the fraction of ANM over the three seasons sampled. Considering only plastic debris, all items were categorized as being flexible. This debris was mostly classified as mega-debris (mean debris length = 16.19 ± 5.96 cm, $n = 4$), followed by a lesser proportion of macro-debris (mean debris length = 6.15 ± 4.24 cm, $n = 2$). The main source of ANM at Pastosa Islet was packaging (five items), followed by fisheries and recreational activities (one item in each category). Packaging debris included mainly plastic bags, whereas the fisheries item was from artisanal fishing (fishing rope; Fig. 2A) and the item categorized as recreational was toilet paper. At this site, white/clear items (three items, 50%) made up the bulk of plastic ANM observed, followed by multicolor, green, and blue (16.6% in each color category).

For nests surveyed at Pájaros Islet (regardless of category or season), fragmented debris also prevailed (100% of items). Plastic (four items, 57.1%) dominated, followed by paper (two items, 28.6%) and cloth (14.3%). Among the plastic debris, all items were categorized as being flexible (100%) and were considered to be macro-debris (mean debris length = 5.86 ± 3.44 cm, $n = 4$). The sources of anthropogenic debris for nests sampled at this site were packaging (three items), followed by recreational and fisheries (each source accounted for two items). Overall, the ANM was similar to that found at Pastosa Islet (Fig. 2B). At Pájaros Islet, among the plastic items, white/clear items were prevalent (two items, 50.0%), followed by green and blue (each color, 25.0%).

Nesting Ground and Breeding Season Effects on ANM

A global GLM model was used to determine the effects of spatial (i.e., nesting ground) and temporal (i.e., breeding season) scales on the overall ANM abundance. The model showed a good fit, with residuals following a normal distribution and non-significant dispersion ($p = .82$). Modelling showed a significant effect of the temporal scale alone on ANM abundance; this metric was significantly lower during BS3 when compared with BS1 (GLM: $z_{1;416} = -2.533$, $p = .01$), though no variation was encountered during BS1 when compared with BS2 (GLM: $z_{1;416} = -1.767$, $p = .07$) nor during BS2 when compared with BS3 (GLM: $z_{1;416} = -0.179$, $p = .858$). The spatial scale had no significant effect on ANM abundance (GLM: $z_{1;416} = 0.132$, $p = .895$).

Amount and Size of Anthropogenic Debris Surrounding Kelp Gull Nesting Grounds

Across both colonies and all breeding seasons, we collected a total of 765 debris items on the beaches surrounding the Kelp Gull nesting grounds. Looking at each breeding season, across all

transects (regardless of the islet), this metric ranged between 101 and 299 items for BS1, 85 and 187 items for BS2, and 43 and 106 items for BS3.

We tallied a total of 230 debris items at Pastosa Islet: 102 items during BS1, 85 items during BS2, and 43 items during BS3. At this site, and irrespective of the sampled breeding season, plastic dominated the ANM (181 items, 78.7%), chiefly comprising fragmented, flexible, dull, non-branded items (Appendix 2, available on the website). A large proportion (134 items, 74.0%) was classified as single-use plastic. Mega-debris (flexible plastic items: mean debris length = 50.32 ± 62.24 cm, n = 96; hard plastic items: mean debris length = 28.31 ± 13.37 cm, n = 17) dominated the plastic debris size category, followed by macro-debris (flexible plastic items: mean debris length = 6.78 ± 1.76 cm, n = 29; hard plastic items: mean debris length = 4.33 ± 1.95 cm, n = 28) and in a lesser proportion by meso-debris (flexible plastic items: mean debris length = 0.91 ± 0.74 cm, n = 7; hard plastic items: mean debris length = 2.17 ± 0.47 cm, n = 4). In terms of their abundance, packaging (108 items, 43.9%) was the foremost source of anthropogenic debris, followed by fisheries (61 items, 26.5%) and to a lesser extent by recreational activities (22 items, 9.5%). White/clear (85 pieces, 36.9%), blue (31 pieces, 13.5%), multicolor (20 pieces, 8.7%), black (20 pieces, 8.7%), and brown (17 pieces, 7.4%) debris dominated the color categories, followed by lesser proportions (< 5% each) of the remaining colors. A very small proportion of debris (5.6%) was found showing a label and language. Irrespective of category, Spanish was the only language that appeared (plastic = 73.9%, glass = 17.4%, and rubber = 8.7%).

At Pájaros Islet, we tallied a total of 592 debris items: 299 items during BS1, 187 items during BS2, and 106 items during BS3. At this site also, regardless of the sampled breeding season, plastic dominated the anthropogenic debris (508 items, 86%; Appendix 2). Similar to what we found on Pastosa Islet, plastic items at Pájaros Islet chiefly comprised fragmented, flexible, dull, and non-branded items (Table 2). The bulk of plastic debris (397 items, 78%) were identified as single-use items. The main size of plastic debris found there was mega-debris (flexible plastic items: mean debris length = 29.36 ± 29.21 cm, n = 309; hard plastic items: mean debris length = 31.41 ± 10.72 cm, n = 24), followed by macro-debris (flexible plastic pieces: mean debris length = 5.57 ± 2.83 cm, n = 98; hard plastic pieces: mean debris length = 3.71 ± 1.80 cm, n = 57) and, to a lesser extent, by meso-debris (flexible plastic items: mean debris length = 1.08 ± 0.65 cm, n = 7; hard plastic items: mean debris length = 1.28 ± 1.04 cm, n = 5). Packaging (388 items, 66.2%) was the main source of anthropogenic debris, according to its abundance, followed to a lesser extent by recreational activities (47 items, 8.1%) and fisheries (32 items, 5.4%). According to its abundance, white/clear (351 items, 59.9%), multicolor (65 items, 11.1%), green (35 items, 5.9%), and blue (33 items, 5.6%) debris prevailed, followed by lesser proportions (< 5% each) of the remaining colors. A moderate proportion of debris (16.7%) contained a written label. Spanish was the sole language appearing on all items with labels, regardless of their category (plastic = 88.7%; glass = 5.1%; rubber = 3.1%; and metal, cloth, and paper = 1.0% each).

DISCUSSION

Classical methods used to document ANM, such as visual surveys of the colony or mechanical debris retrieval from individual nests, may be time consuming, might cause annoyance to the breeding birds, or might not be appropriate for birds that reuse their nests in the following breeding season (Grant et al., 2021; Thompson et al., 2020). Thus, the use of photographs is advantageous in various ways: it is (1) non-invasive, (2) less time consuming, and (3) both repeatable and comparable among species (e.g., Albizzi et al., 2024; Grant et al., 2021; O'Hanlon et al., 2019; Sugasawa et al., 2021; Thompson et al., 2020). Still, this technique might fail to quantify the total amount of ANM if photographs do not show the entire nest (O'Hanlon et al., 2019). With this caveat, we present here the first records of ANM incidence in Kelp Gull nests within Islote Lobos National Park. The incidence was low—3% of nests—and mostly comprised plastic items. Nevertheless, other coastal populations of the Kelp Gull, like the one inhabiting ILNP, are likely also exposed to plastic debris, at least at their breeding sites (see Seco Pon & Pereyra, 2021; Witteveen et al., 2017; Yorio et al., 2022). Incidence elsewhere could be higher.

The prevalence of ANM in our study (~3%) is in line with studies on other populations of the species inhabiting other protected areas of the region, including Punta Loma and Punta Tombo (overall prevalence of ANM = 7.2%) and unprotected coastal areas within the Bahía Blanca Estuary, e.g., Banco Nordeste (prevalence of ANM = 3.3%) (Yorio et al., 2022). Comparably, our results are in line with studies of other *Larus* gulls dwelling in protected areas (Table 1).

Besides showing marginal loads of ANM in Kelp Gull nests within ILNP, our study shows only low percentage coverage of debris in relation to nest surface (overall range = 0.50%–18.8%). This is in line with previous photograph-based studies conducted in southern Argentina, i.e., for Imperial Shag *Leucocarbo atriceps* (3.9%–5.9%, n = 89–91 nests; Albizzi et al., 2024) and Silver Gull *Chroicocephalus novaehollandiae* (1%–24%; n = 126 nests) in southwest Scotland (Thompson et al., 2020). Apart from these studies, few other investigations report surface area of the ANM relative to total surface area of the nest (but see Albizzi et al., 2024; Thompson et al., 2020). We encourage researchers and managers to collect this type of data so as to better understand the potential impacts on the functional performance of polluted bird's nests, in terms of, for example, thermal properties, integrity, drainage, and camouflage (Deeming & Mainwaring, 2015; Thompson et al., 2020).

When combining information from both Kelp Gull nests and the nearby beach (on the two islets), plastic items dominated the trash. The predominance of plastic was not unexpected given that plastic items dominate both terrestrial- and marine-based debris locally (e.g., on beaches of northern Argentine Patagonia; Becherucci et al., 2017; Hines et al., 2023), regionally (Díaz-Mendoza et al., 2023), and globally (Jambeck et al., 2015). The very sparse ANM in our study comprised fragmented and flexible plastic items, chiefly from food-related bags, in accord with previous studies conducted elsewhere in northern Argentine Patagonia (Seco Pon & Pereyra, 2021; Yorio et al., 2022). Such findings, coupled with evidence indicating the ingestion of debris by Kelp Gulls elsewhere in Argentina and South Africa (Witteveen et al., 2017; Yorio et al., 2020), highlights the importance of investigating the degree to which ANM is derived from the diet. Preliminary results indicate that this type of interaction with ANM, i.e., ingestion, is plausible among the Kelp Gulls of ILNP (authors, unpublished data).

In our study, the length of plastic debris, averaging 6.85 ± 2.62 cm, was similar to what has been reported for other Kelp Gull populations in northern Argentine Patagonia (Seco Pon & Pereyra, 2021) and for the Yellow-legged gull *Larus michahellis* on the Portuguese coast

TABLE 1
National and global comparison of anthropogenic debris found at nests of the Kelp Gull *Larus dominicanus* and other gull species[a]

Species	*N*	PMAD	AIPN	Sample location, country	Reference
Kelp Gull *Larus dominicanus*	259	37.0	2.80	Novaro Island, Argentina	Seco Pon and Pereyra (2021)
	60	15.5	1.20	Bahía San Blas, Argentina	Yorio et al. (2022)
	40	7.5	1.30	Punta Loma, Argentina	Yorio et al. (2022)
	72	37.5	1.50	Punta León, Argentina	Yorio et al. (2022)
	58	6.9	1.30	Punta Tombo, Argentina	Yorio et al. (2022)
	115	12.2	1.00	Isla Blanca Mayor, Argentina	Yorio et al. (2022)
	60	26.7	1.00	Islas Vernaci, Argentina	Yorio et al. (2022)
	463	3.0	0.04	Islote Lobos National Park, Argentina	This study
	630	36.0	1.20	Several sites, South Africa	Witteveen et al. (2017)
Hartlaub's Gull *Chroicocephalus hartlaubii*	265	0.7	n.r.[b]	Meeuw Island, South Africa	Tavares et al. (2020)
Yellow-legged Gull *L. michahellis*	69	2.9	0.04	Deserta Island, southern Portugal	Lopes et al. (2020)
Silver Gull *Chroicocephalus novaehollandiae*	126	9.0	1.50	Pitt Water-Orielton Lagoon, Australia	Henderson et al. (2022)

[a] *N* = total nests sampled, PMAD = prevalence of marine anthropogenic debris (%), AIPN = average items per nest. Plastic was the main type of debris found on nests.
[b] n.r. = not reported.

(Lopes et al., 2020). However, it has been reported to be an order of magnitude longer for Yellow-legged Gulls in the Canary Islands, Spain (Domínguez-Hernández et al., 2024). Macro- (≥ 2.5 cm to < 10 cm) and mega-length plastics (> 10 cm) prevailed at the gulls' nests and the adjacent beaches, respectively. One potential factor that could explain our results is the relatively large tidal range within the entire San Matías Gulf (our study area), which is 6–9 m in amplitude. Higher tides theoretically may confine more debris on shorelines (Eriksson et al., 2013). In addition, Thompson et al. (2020) speculated that larger plastic debris could be harder to incorporate into a nest. Despite the impracticality of comparing both databases (i.e., debris found in nests and on adjacent beaches), mainly due to the small amount of ANM, and therefore of being able to perform statistical analyses, our results indicate a greater abundance of debris on the beaches adjacent to the colonies. We also saw a greater abundance of packaging debris items categorized as white/clear, which outnumbered both the amounts in other color categories and other sources of debris at nests and adjacent beaches. Considering results of other studies (Seco Pon & Pereyra, 2021; Yorio et al., 2022), this may indicate that the Kelp Gull incorporates into its nests a high prevalence of white/clear debris derived from packaging-related activities (as well as fisheries related items). In fact, this seems to be a generalized pattern among other gull species breeding in lower latitudes at a regional scale, including in Brazil (Brentano et al., 2020; de Souza Petersen et al., 2016) and elsewhere around the globe (see, e.g., Lopes et al., 2020; Thompson et al., 2020).

Finally, given the geographical location of our samplings and the socioeconomic context in which they took place (i.e., little human visitation in the study area and occurring before the construction of a pipeline and oil port facilities relatively nearby), we encourage further samplings when such conditions have changed. We propose that the Kelp Gull is a suitable species to monitor plastic pollution, at least in coastal South America, given the evidence of ANM in the species in northern Argentine Patagonia. We further propose such monitoring of ANM has logistical and conservation-related advantages: namely, that it is less time consuming, simpler, inexpensive, and causes less disturbance to birds when compared to diet sampling (Bond et al., 2012; Ryan, 2020). Comparisons among samplings would be possible as long as standardized methodologies are used (Hamilton et al., 2023; Lavers et al., 2014).

AUTHOR CONTRIBUTIONS

Conceptualization: JPSP. Formal analysis: JPSP, VMP, PJP. Funding acquisition: JPSP. Investigation: JPSP, ATA, VMP, LLDA, PJP. Methodology: JPSP, ATA, VMP, LLDA, LJ, ET, PJP. Project administration: JPSP. Writing—original draft: JPSP. Writing—review & editing: all coauthors.

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